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(54) **SOLAR COLLECTOR FOR EVAPORATION OF AQUEOUS SOLUTIONS**

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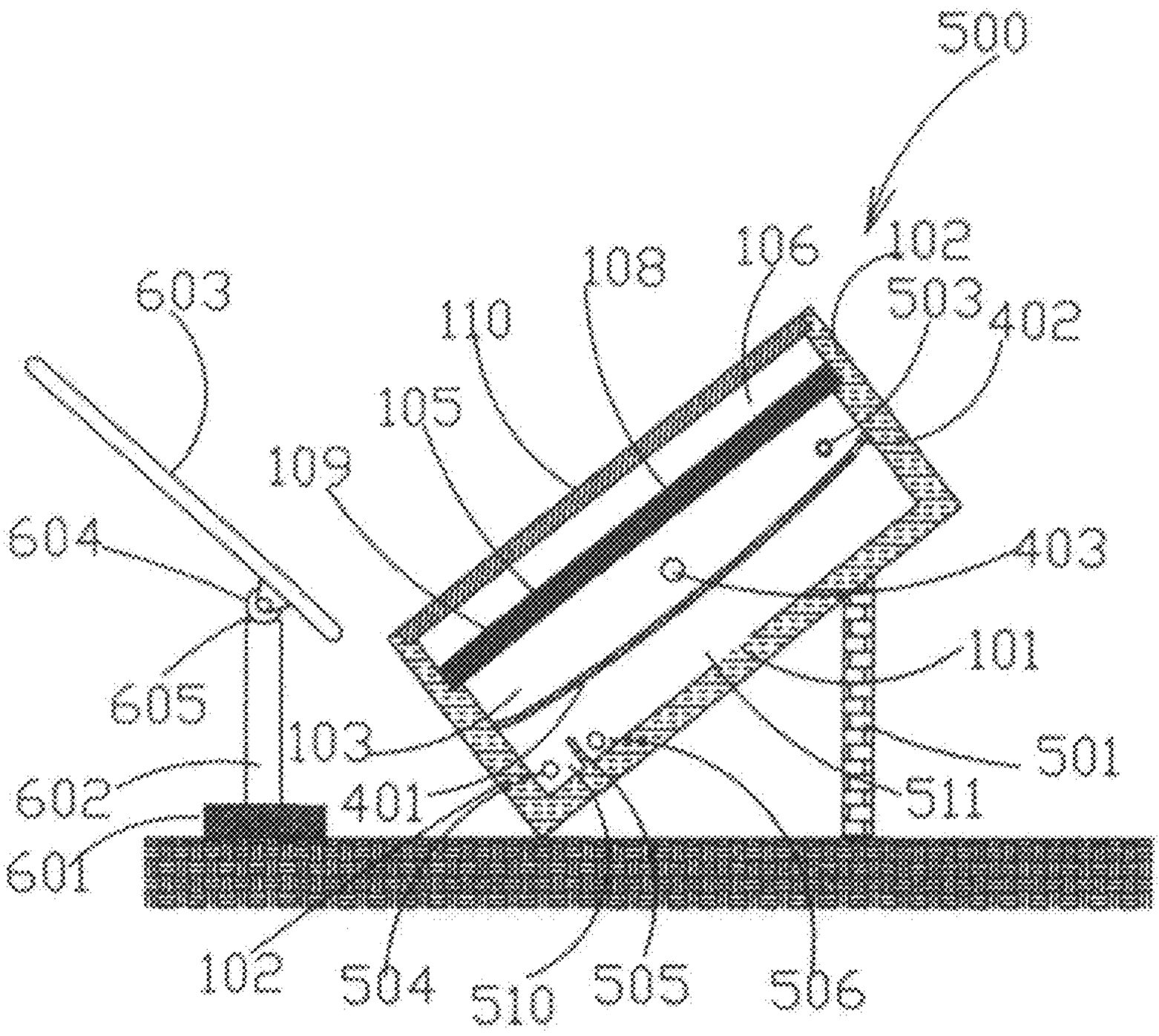
(57) **ABSTRACT**

The invention is related to solar collectors intended to perform technological processes and specifically, to solar collectors used for concentration by evaporation of aqueous solutions.

The proposed solar collector concentrates the aqueous solution by combination of heating the upper thin layer of this solution (this heating is accompanied with evaporation a significant part of this layer) and carrying away of the obtained vapors from the internal space of the solar collector by air stream introduced constantly into the internal space. In another version of this invention the obtained vapors are condensing on the surface of cooling water flowing through the solar collector.



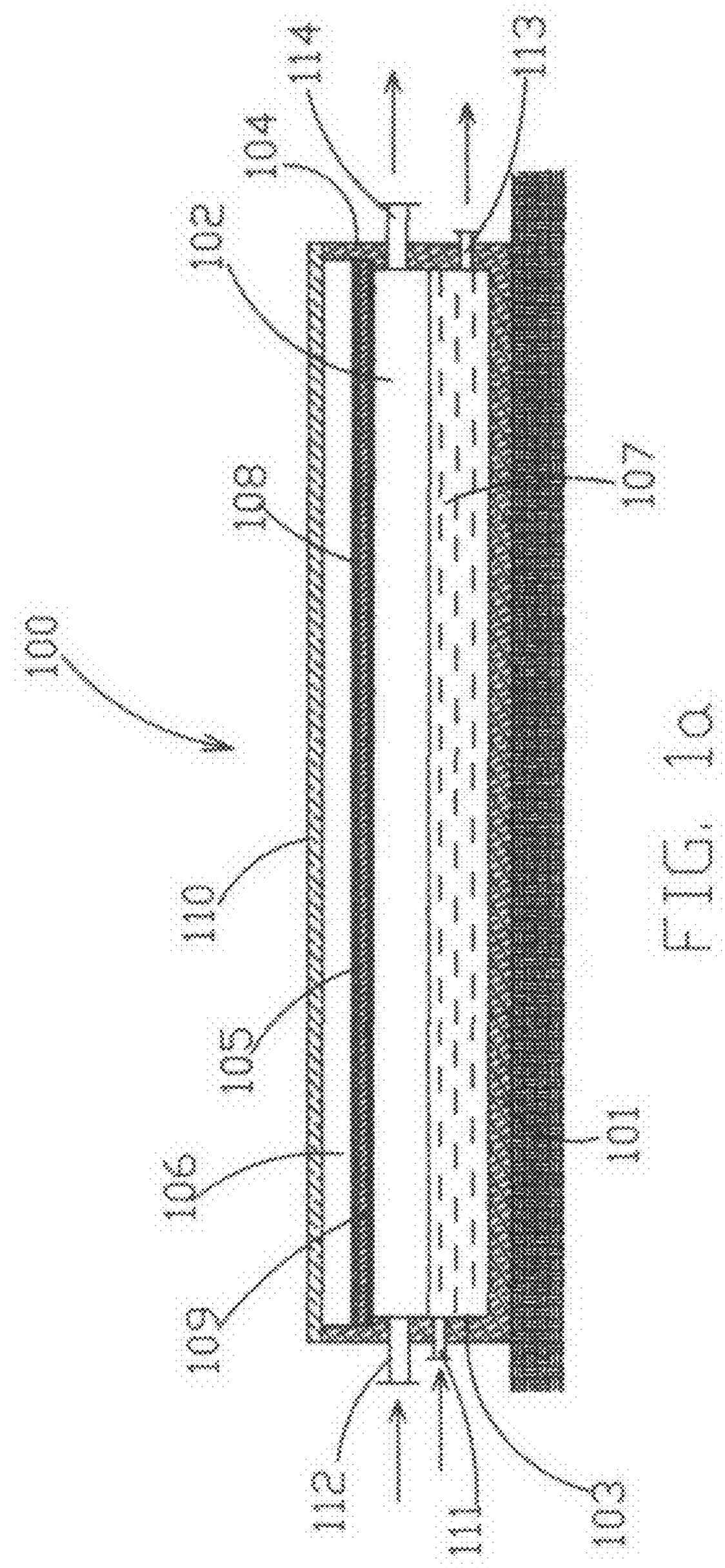


FIG. 1a

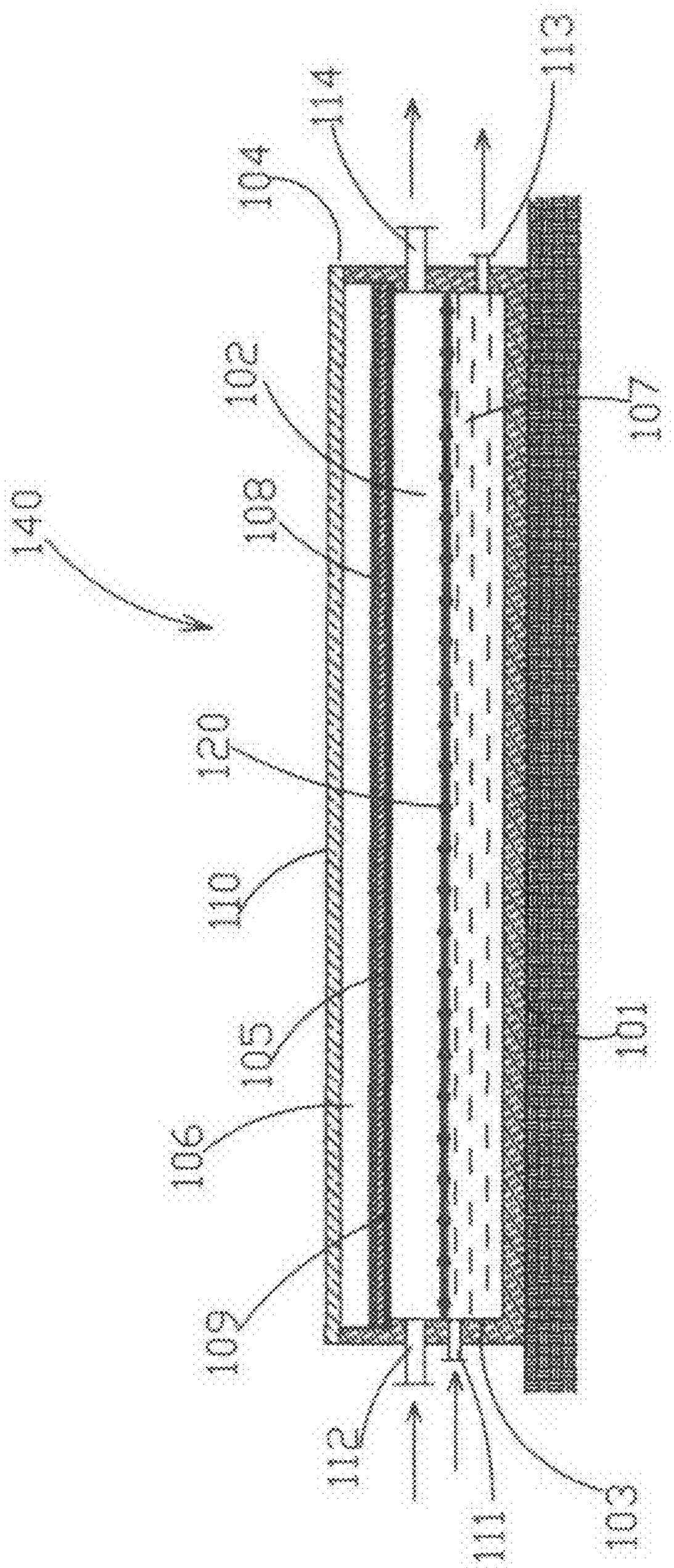


FIG. 1b

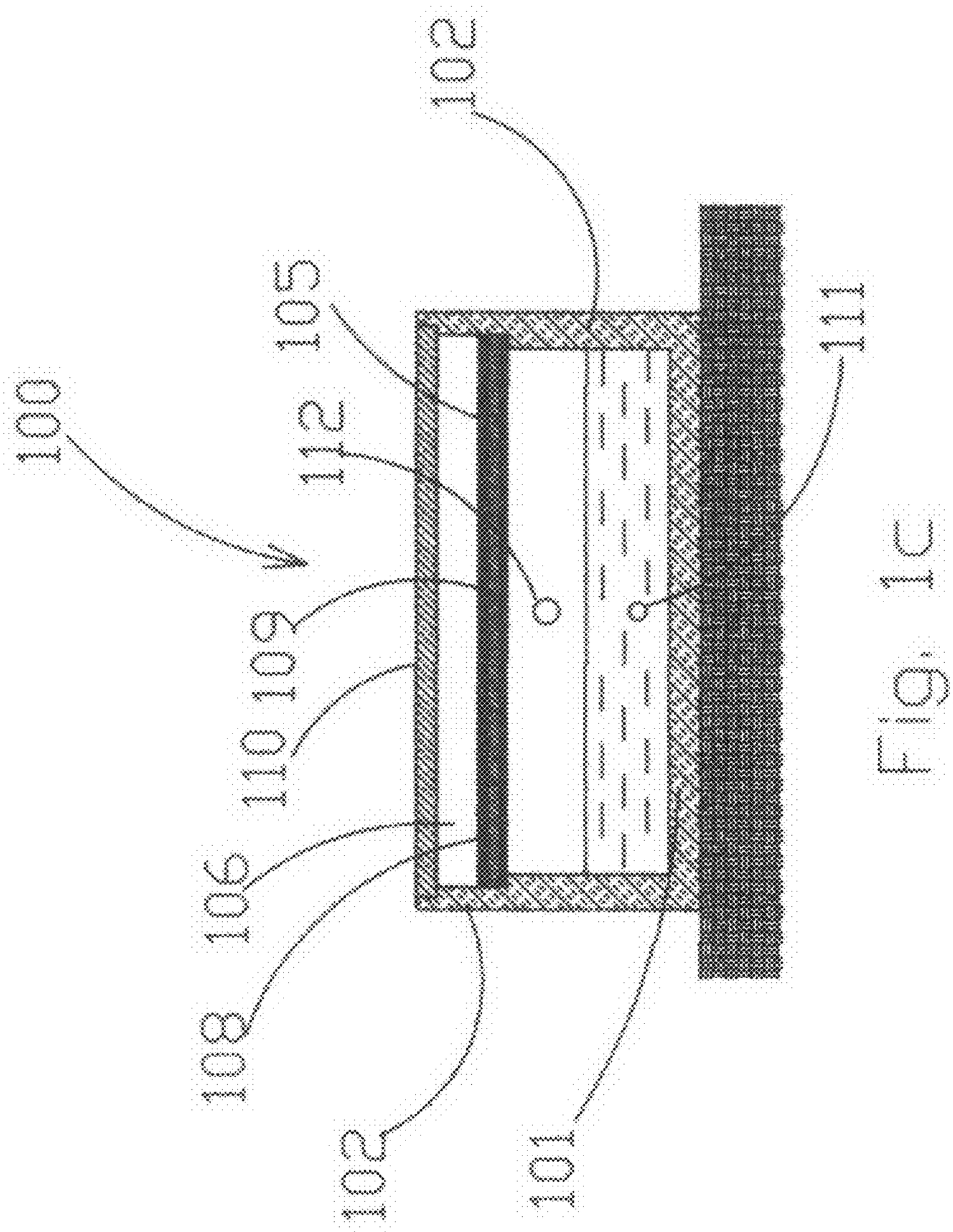
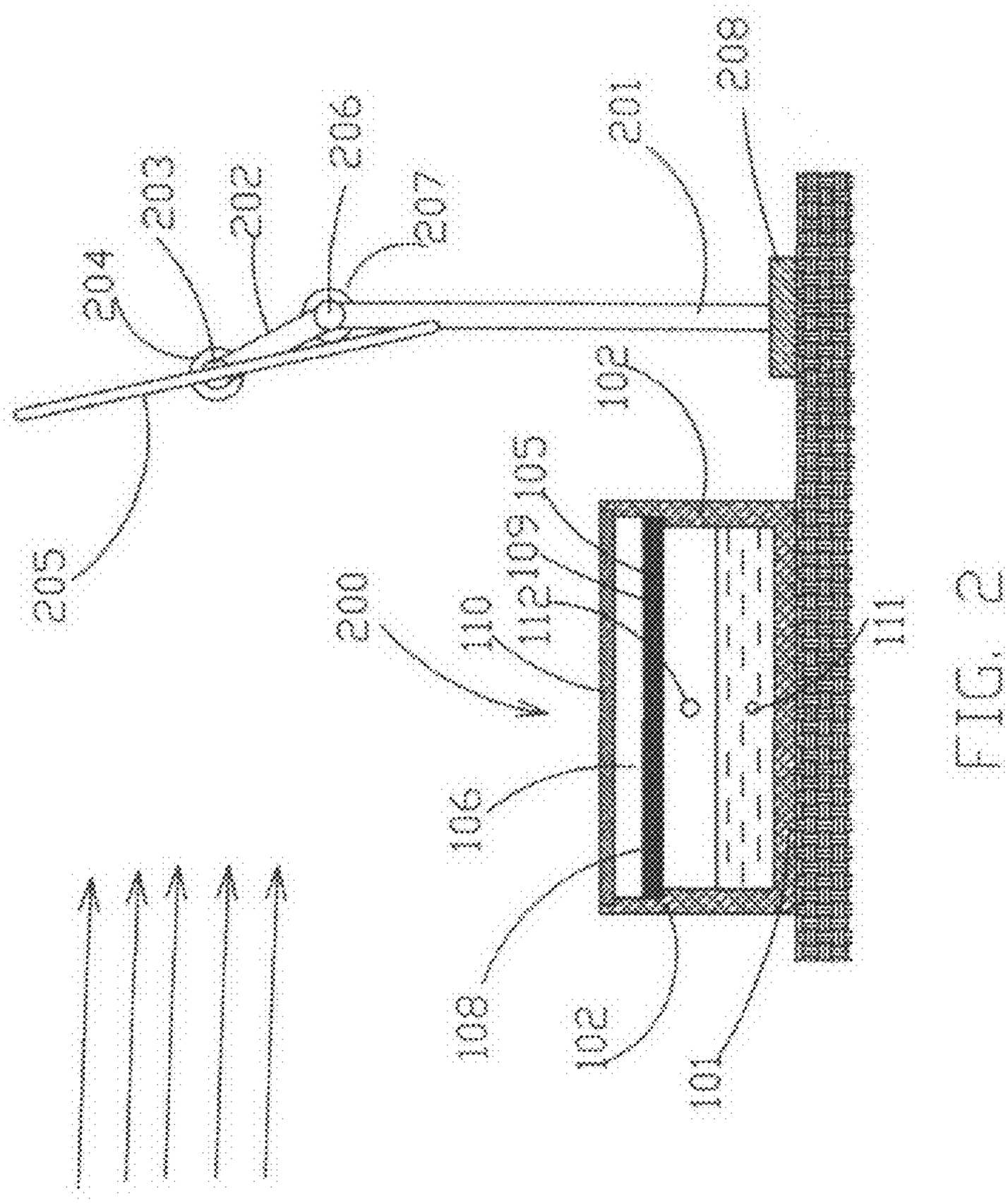


Fig. 1C


201
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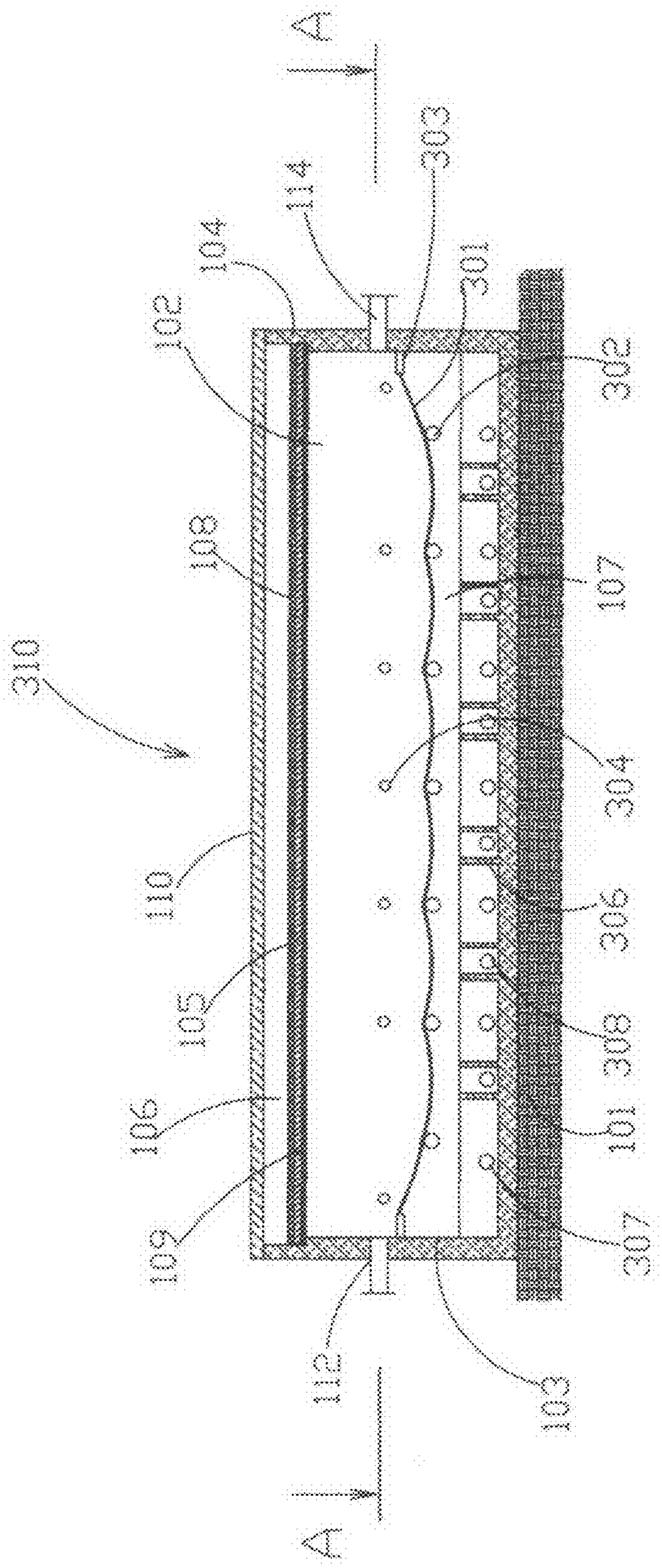
103
101

FIG. 2


A
114
303
104
301
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310
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101
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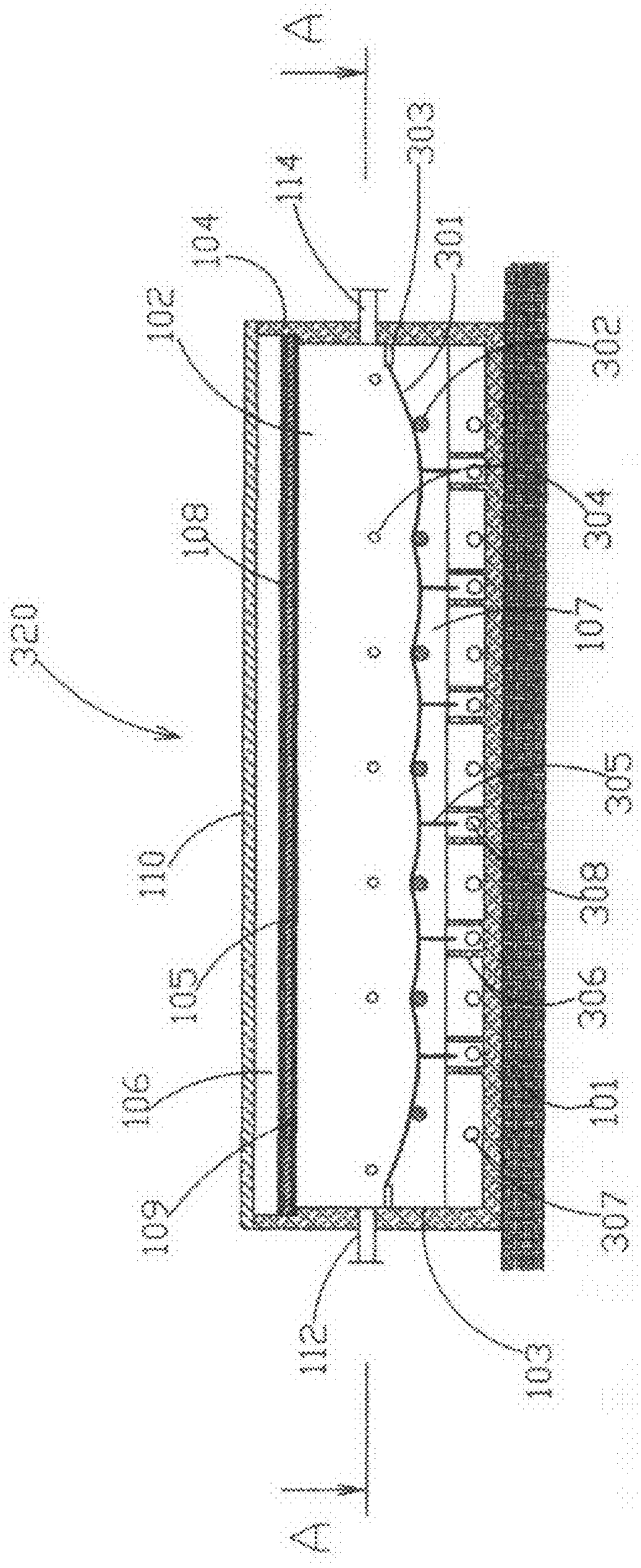
307
112
103
A

FIG. 3a


A
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104
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112
103
A

FIG. 3b

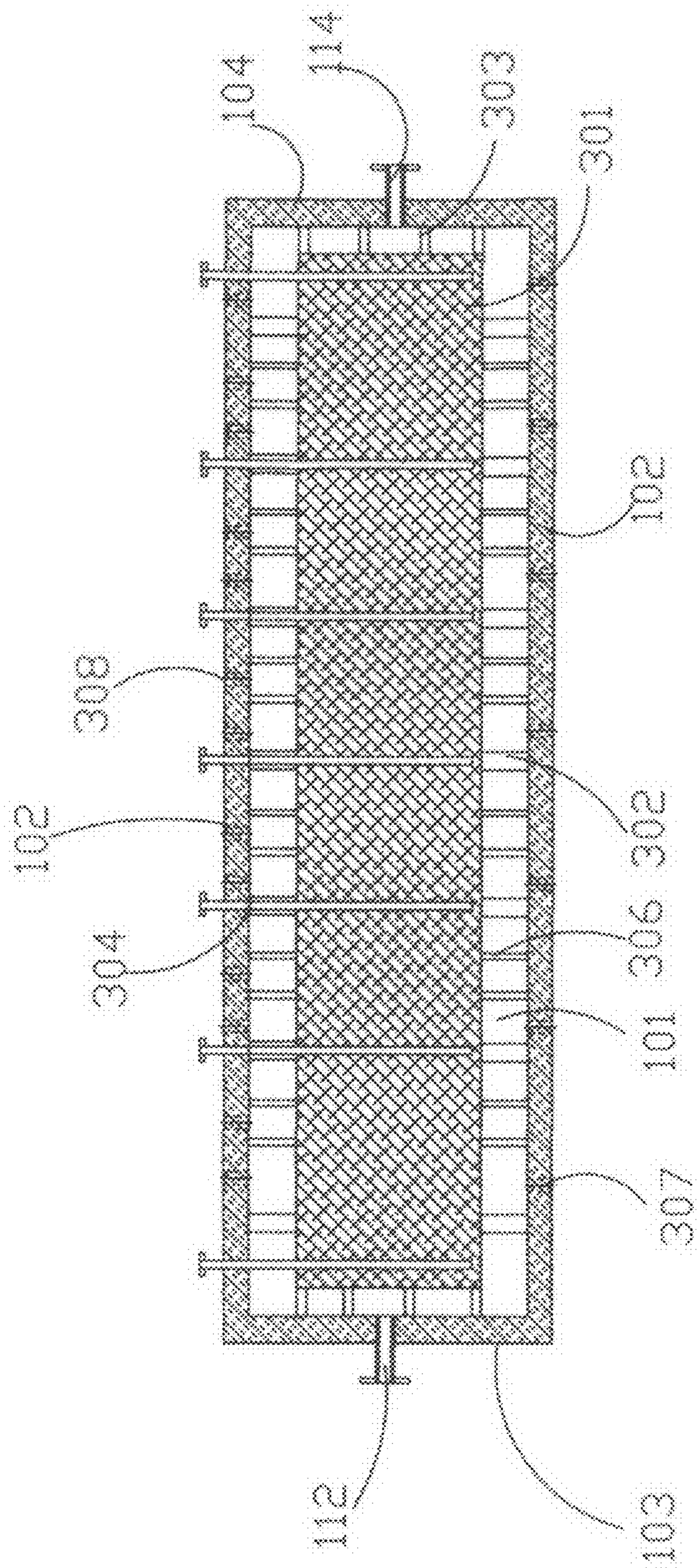
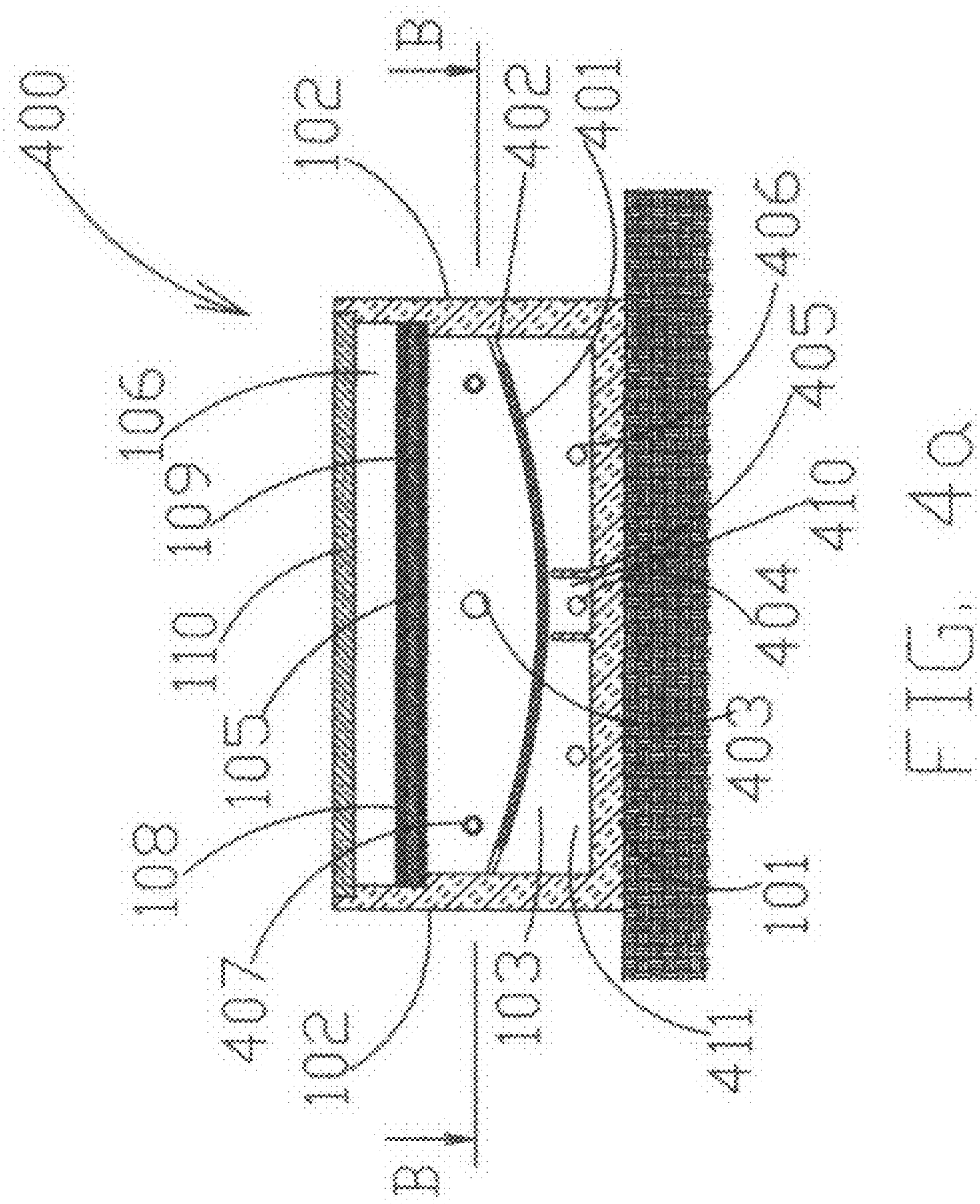


FIG. 3C


400
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402
401
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411
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B

FIG. 4C

B — B

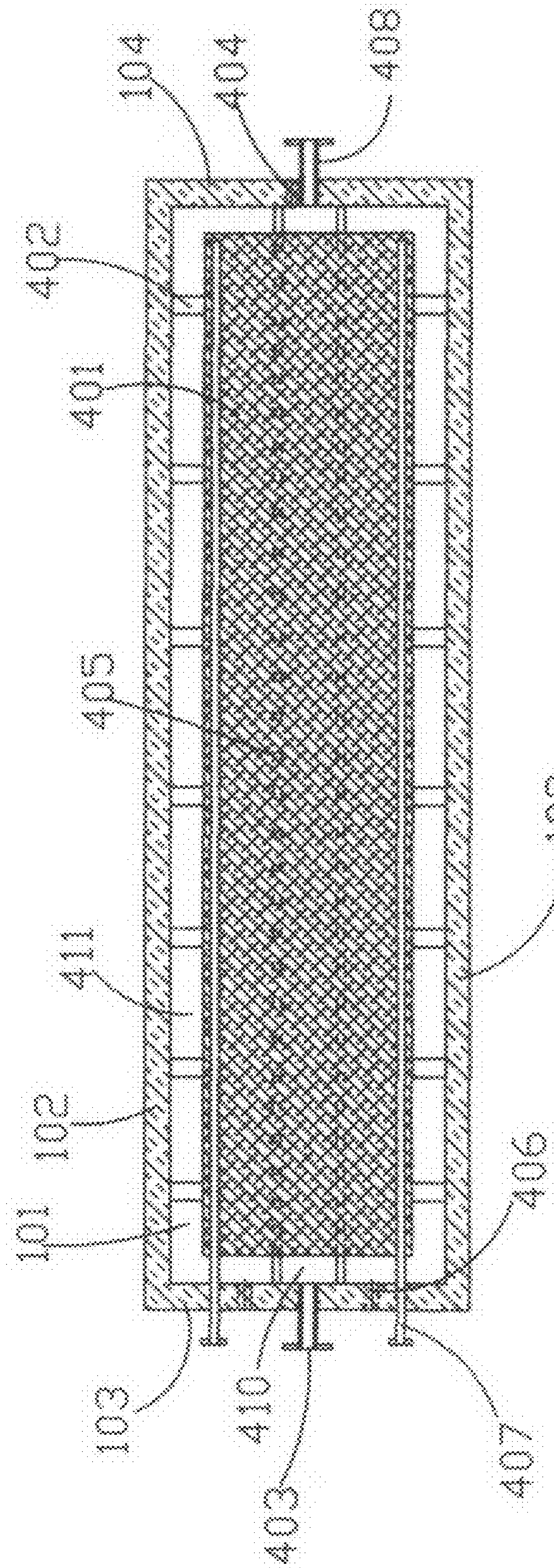
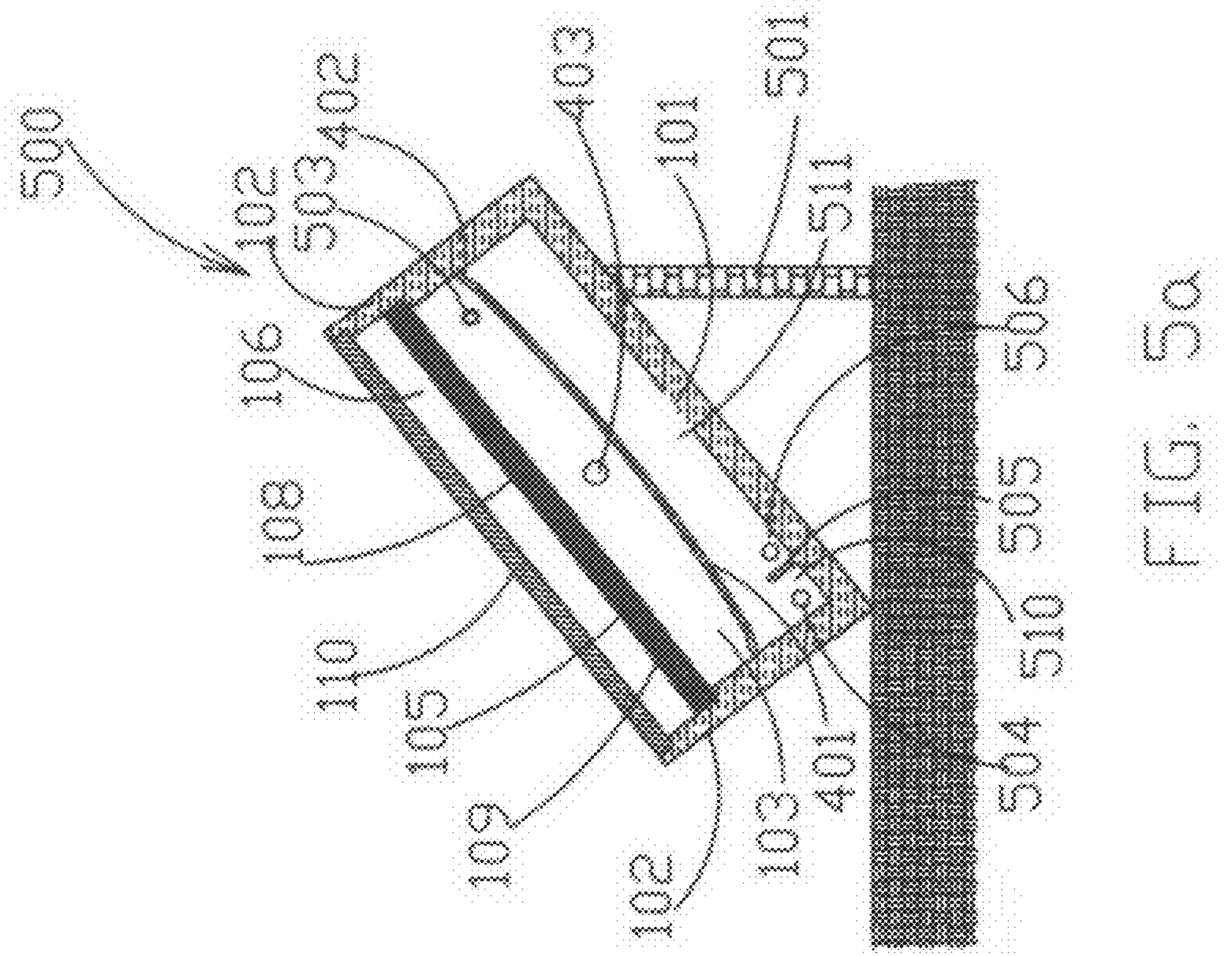


FIG. 4b


500
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403
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107
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504
505
510

FIG. 5a

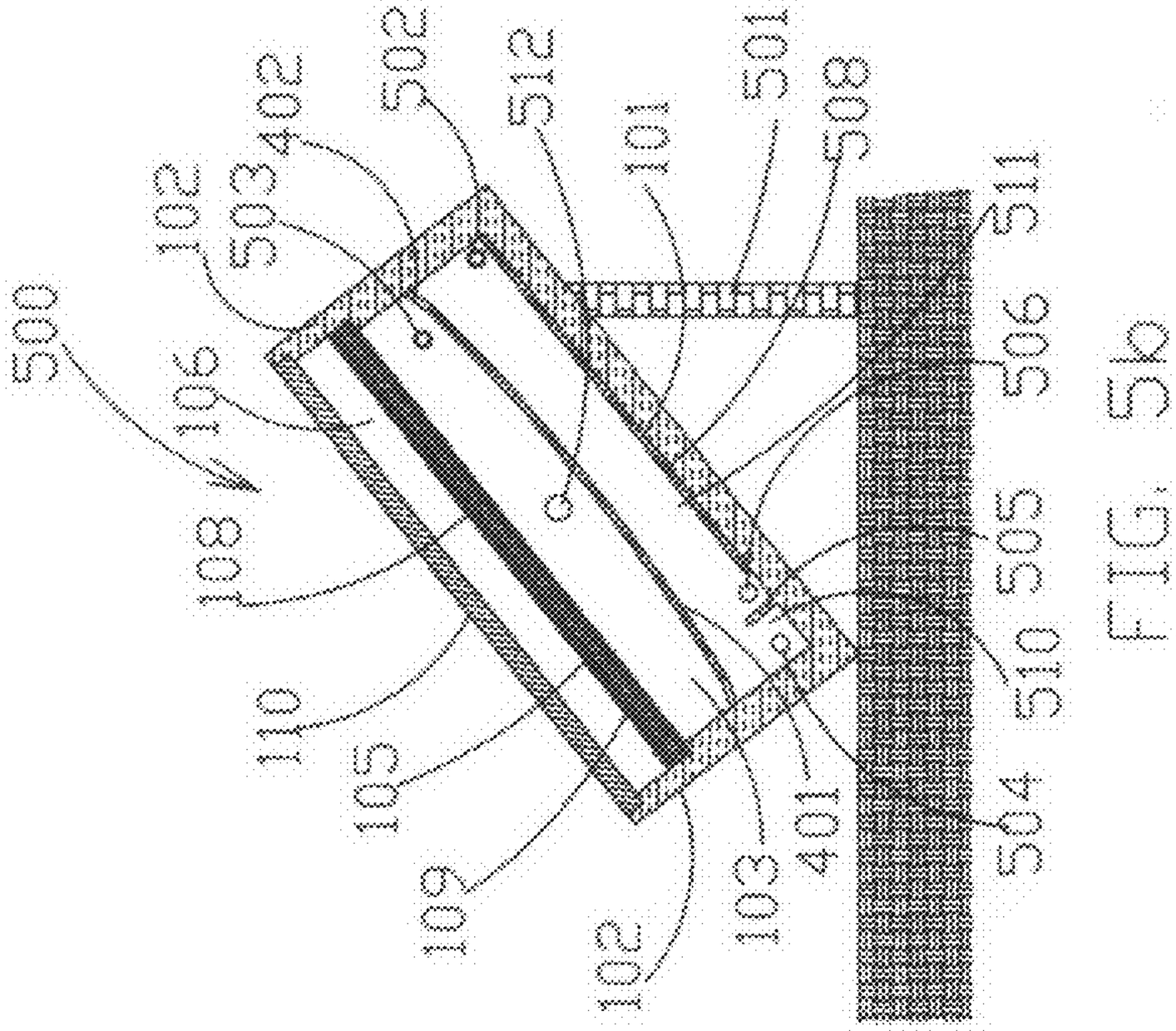
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FIG. 5b

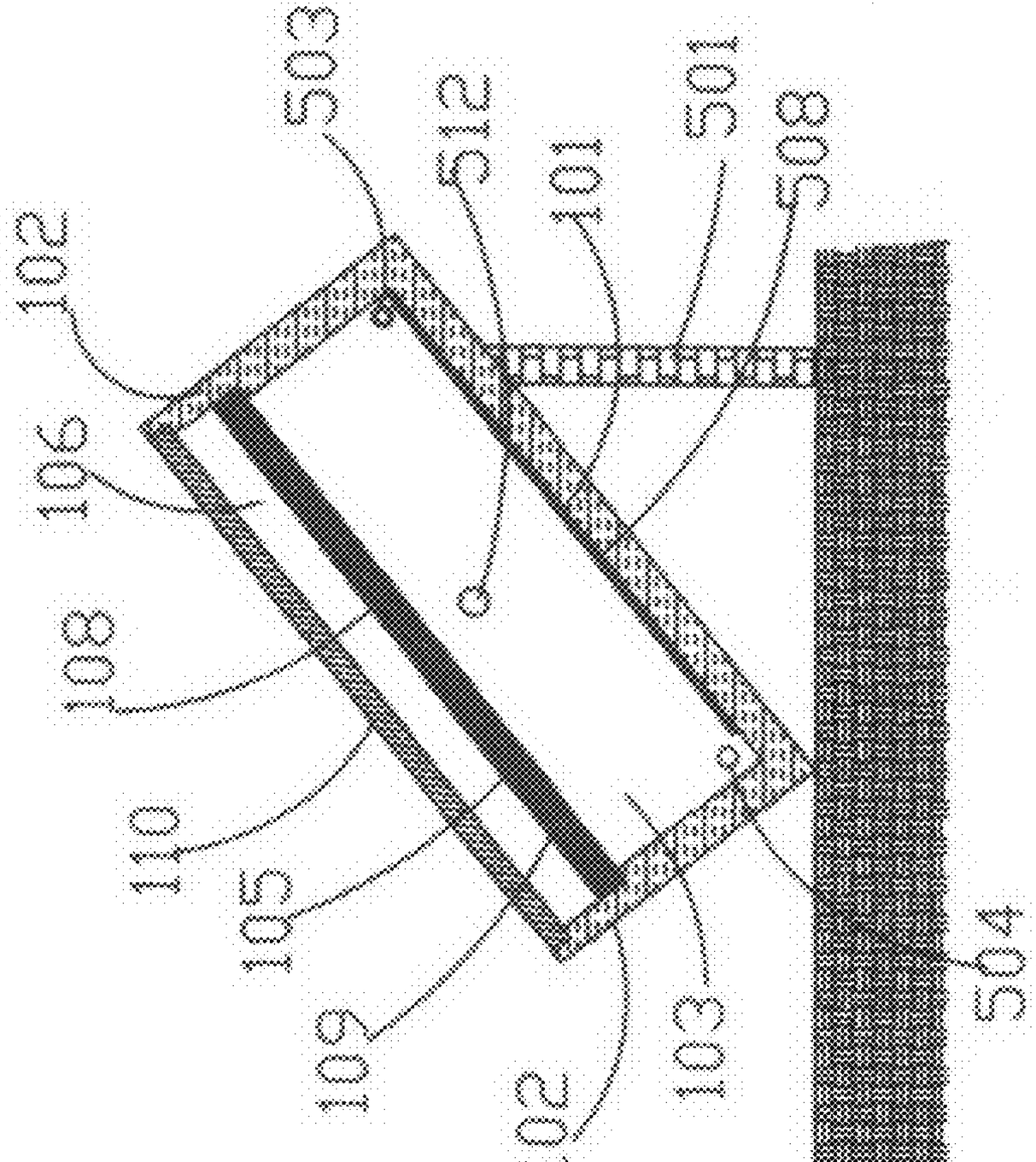
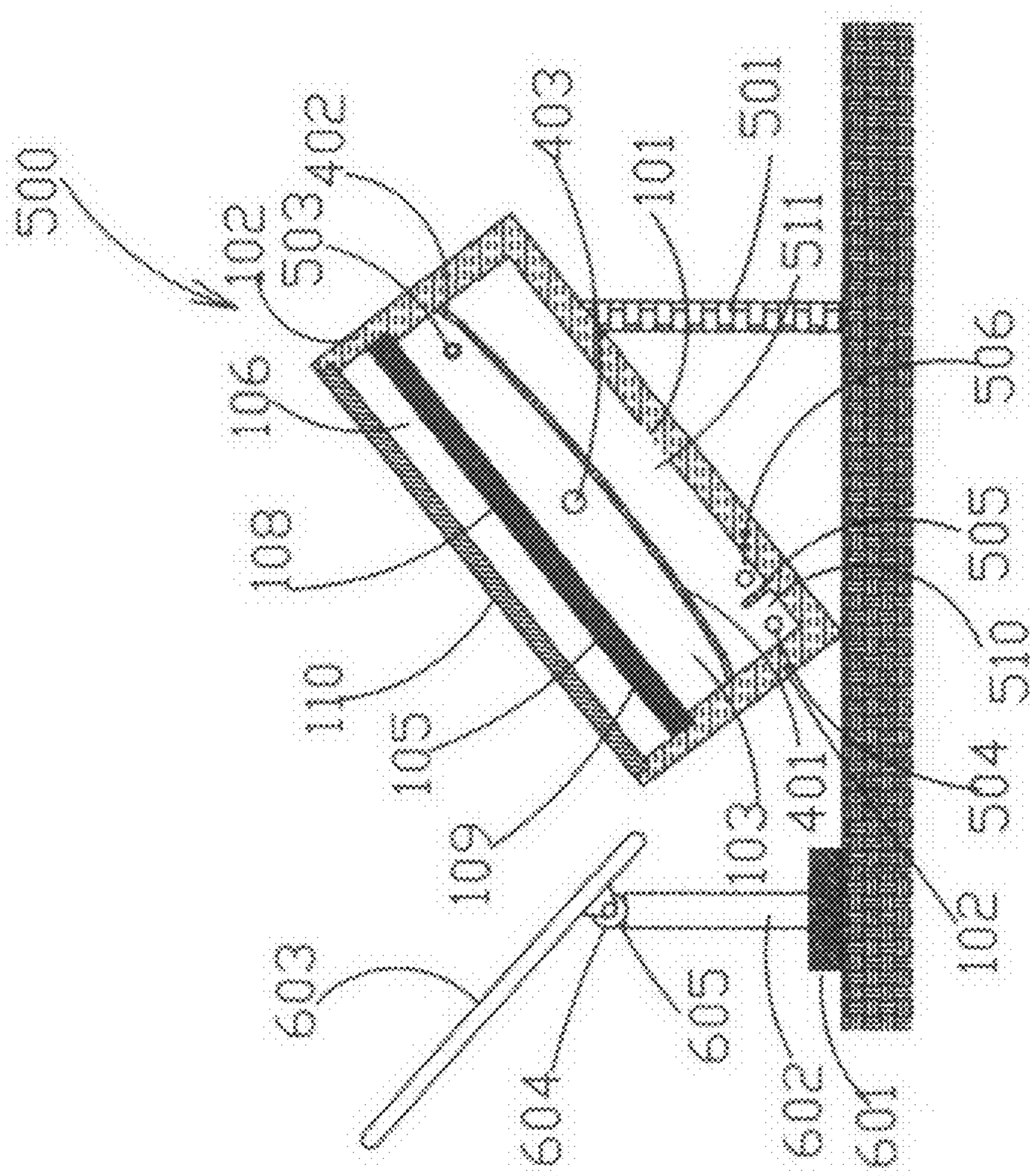


FIG. 5C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408
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106
108
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604
605
602
601

FIG. 6

SOLAR COLLECTOR FOR EVAPORATION OF AQUEOUS SOLUTIONS

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH

[0001] Not applicable.

BACKGROUND OF THE INVENTION

[0002] The invention is related to solar collectors intended to perform technological processes and specifically, to solar collectors used for concentration by evaporation of aqueous solutions.

[0003] There are two main systems intended to evaporate an aqueous solution with usage of solar heating this aqueous solution.

[0004] Open ponds for concentration and crystallization of brines are widely used in chemical industry. It is a cheap but, at the same time, very extensive process, which requires large-size ponds. On the other hand, if the aqueous solution contains volatile contaminants, then the vapors of these contaminants are entering immediately into the atmosphere.

[0005] There are some closed systems disclosed in patent literature, which use combination of heating aqueous solutions by solar radiation with absorption of obtained vapors by a gas stream.

[0006] U.S. Pat. No. 4,310,382 "Method of and a device for vaporizing and recovering water from aqueous solutions" describes the method of recovering water by vaporizing aqueous solutions; this method employs a heat pump circuit having a compressor, condenser, extension valve and evaporator for a heat transfer medium. The circulation channel for a gas stream which is capable of absorbing water vapor includes a gas washing station into which is sprayed the aqueous solution to be vaporized. The gas stream is guided past the condenser of the heat pump which acts as a heater and the heated gas is delivered into the gas washing station where is absorbs water. The water saturated gas stream is fed past the evaporator which acts as a refrigerating device and the water contents from the gas stream is condensed on the evaporator and returned into a galvanizing bath for example.

[0007] U.S. Pat. No. 4,344,824 "Recirculating natural convection solar still" describes a solar still utilizing recirculating air driven by natural convection to evaporate pure water from saline water. The pure water evaporated into the air is removed by a condenser and the condenser also cools the air thereby causing its density to increase. The air density difference within the still, due to temperature differences, causes the air to flow in the desired pattern. This natural convection may be augmented by a fan or fans, if desired, to increase the output of the still. The same air is continuously circulated thereby reducing the thermal losses that occur when moist air is removed from the still. A recirculating pump is the only mechanical device required when the still is in the natural convection mode of operation.

[0008] U.S. Pat. No. 4,853,088 "Solar enhanced separation of volatile components from a liquid" describes an apparatus for separating a volatile component from a volatile-containing liquid to produce a substantially volatile-free liquid; this apparatus comprising: an inclined enclosure; a volatile-containing liquid inlet and a volatile-containing stripping gas outlet at an upper end of said enclosure; a substantially volatile-free liquid outlet and a stripping gas inlet at a lower end of said enclosure; a transparent face panel for admitting solar radiation into said enclosure; a flow plate positioned along an inclined plane within said enclosure to form a void space between said flow plate and said face panel, said flow plate having a top surface in liquid communication with said volatile-containing liquid inlet and said top surface facing said face panel to directly receive the solar radiation admitted into said enclosure; convex protrusions spaced at intervals on said top surface of said flow plate, said protrusions having a perpendicular orientation relative to the inclination of said flow plate to agitate liquids flowing down said top surface of said flow plate; a stripper gas conveying means at said stripper gas inlet for conveying a stripper gas upwards through said void space; and a volatile recovery means in fluid communication with said volatile-containing stripping gas outlet.

[0009] U.S. Pat. No. 4,363,703 "Thermal gradient humidification-dehumidification desalination system" describes solar energy desalination process utilizing solar radiation directly for the evaporation of salt water. Ambient air takes on water vapor as the air passes through an evaporative medium. It is then directed between a saline water-covered, solar absorbing surface and a solar collecting housing. The resulting heated and moisture-saturated air is cooled in a heat exchange means where condensation of fresh water occurs. Simultaneously, cool salt water is utilized as the cooling water in the heat exchange means, and takes on the heat of condensation given up by the condensing vapor. The heated salt water from the heat exchange means is partially directed over the solar absorbing surface, and at least a portion of it is also directed to wet the evaporative medium. Several optional sub-processes are described for operation of the system during periods of reduced insolation, and an alternative process is described for operation of the process on a floating platform.

[0010] However, all these patents are not suitable for concentration by evaporation of aqueous solutions with high degree of concentration of soluble components. There are some examples processes that involve such form of concentration: concentration of diluted desiccants in refrigeration systems of absorbing type; concentration of natural brines for production of mineral salts as in Dead Sea Industries; concentration mineralized wastewaters.

[0011] In addition, U.S. Pat. No. 5,195,504 should be noted. It describes an improved affordable, rugged, but lightweight box-oven-type solar cooker with the ability to overcome the recognized prior art limitations, such as: difficulty in achieving cooking temperatures in morning, evening and winter; restriction in reflector adjustment; heat loss through glazier cover; the inability to produce high temperatures in a short period of time and, more importantly, the inability of heat storage to continue cooking after sundown. The cooker assembly comprises a revolutionary round or hemispherical shaped cooking chamber allowing the maximum amount of sunlight to cover its inner surface, creating a higher and more even heat distribution for cooking; an unhinged reflector frame is pivotally mounted by arms to the housing and can adjust through a 360 degree angle. With this unlimited mobility the sun's rays can be focused into the cooking chamber substantially at any angle of the sun's position regardless of time of day, or geographic location. A glazier frame accommodates at least three glaziers and disallows much of the heat loss from the cooking chamber. A first glazier, because of its close proximity to the chamber, acts as a lid or cover and protects against further heat loss. An overhead booster reflector may be added to the reflector frame. The subject assembly

may be capable of heat storage utilizing a heat collecting fluid and allows cooking to continue during periods of cloud cover and even hours.

[0012] Therefore, there is an argent need in effective and cheap solar collectors used for concentration aqueous solutions by their evaporation.

BRIEF SUMMARY OF THE INVENTION

[0013] The invention proposes a solar collector used for concentration aqueous solutions by their evaporation; the proposed solar collector is designed as a substantially horizontal trough with following features:

[0014] the horizontal trough which comprises a base wall, two sidewalls and two opposite end walls; the horizontal trough is divided by a metal horizontal sheet into the upper section and the lower section;

[0015] the upper side of the metal horizontal sheet is provided with a selective coating and the lower side of this metal horizontal sheet is provided with coating with high emittance in the infrared range of spectrum;

[0016] the upper section of the trough is covered with glazing;

[0017] the lower section of the trough is filled up to a certain level with the aqueous solution to be partially evaporated;

[0018] the first end wall is provided with two inlet connections for supply of the aqueous solution to be partially evaporated and the air into the lower section of the trough, wherein the inlet connection for air supply is arranged above the level of the aqueous solution in the trough. In the same manner, the second opposite end wall of the horizontal trough is provided with two outlet connections for removal of the concentrated aqueous solution and the humidified hot air from the horizontal trough, wherein the outlet connection for air supply is arranged above the level of the aqueous solution in the trough.

[0019] In another version the first end wall is provided with the inlet connection for supply of the aqueous solution and with the outlet connection for removal humidified hot air, and the second end wall is provided with the outlet connection for removal of the concentrated aqueous solution and the inlet connection for supplying the air (counter-flow mode).

[0020] It is possible to apply a floating grid from foamed polymer in order to diminish mixing of the layers of the aqueous solution caused by interaction between the surface of the aqueous solution with the flowing air. In such a way, the proposed design of the solar collector utilizes the optical property of water and aqueous solution: with shifting electromagnetic radiation from visible range to infrared range absorption coefficient is increasing in such degree, that the light penetration depth in water changing from 10 m to some millimeters and less (see: W. M. Irvine and J. B. Pollack, "Infrared optical properties of water and ice spheres," Icarus, 8, 324-360, 1968). As a result, this solar collector provides sharp temperature gradient near the upper surface of the aqueous solution with maximum temperature in the upper layers and effective evaporation process from these upper layers into the internal free space of the lower section of the trough.

[0021] In another design of the proposed solar collector evaporation process of the aqueous solution is executed on a breadth from fabric; this breadth is pulled by spring-wise elements or by other fastenings between the opposite end walls in the lower section of the solar collector. In order to diminish maximum deflection of the breadth under its weight; it is possible to install in the lower section of the solar collector an array of horizontal cross bars, which are support the breadth.

[0022] Aqueous solution to be partially evaporated and concentrated is supplied on the breadth from an array of distributing pipes, which are arranged above the breadth and the supporting cross bars. Runoff of the concentrated aqueous solution from the breadth occurs at the place its maximum sagging between the supporting cross bars. In such a way, the bottom of the solar collector presents a tray for collecting the concentrated aqueous solution. This bottom can be divided by an array of transverse ribs, which form two types of sub-trays; the first one serves for collecting the concentrated aqueous solution and the second one—for collecting condensate that is obtained as a result of condensation of water vapors on the surface of these sub-trays of the second type having a lower temperature than the temperature of the water vapors in the internal space of the lower section.

[0023] In another design of the solar collector with the pulled breadth, condensation of water vapors in the internal space of the lower section is executed on the flowing cooling water, which is supplied into the sub-trays of the second type via openings in the one side and is drained via the openings in the opposite side of these sub-trays of the second type.

In this case the internal space of the lower section of the solar collector is provided with an opening for equalizing the pressure in the lower section of the solar collector with the ambient pressure.

[0024] In a further design of the invention, the breadth is pulled in the internal space of the lower section by an array of the spring-wise elements or by the other fastenings, which are installed on the opposite sidewalls of the solar collector trough. There are two distributing pipes in this case; these distributing pipes are arranged in longitudinal direction and supply aqueous solution to be concentrated on the lateral areas of the breadth.

[0025] The bottom of the trough is provided with two longitudinal ribs forming a central sub-tray and two lateral sub-trays. The central sub-tray is provided with a drainage opening, which serves for removal of concentrated aqueous solution, and the lateral sub-trays are provided with two drainage openings serving to remove condensate.

[0026] This design of the solar collector with the breadth pulled in the internal space of the lower section between the opposite sidewalls of the solar collector trough allows arranging the solar collector in a tilted position; preferably in the direction of east-west. In this case the longitudinal rib is shifted to the lower sidewall of the solar collector trough, and in the same manner openings for drainage of condensate and the concentrated aqueous solution are positioned in the vicinity of this longitudinal rib; the opening for condensate drainage—above the longitudinal rib and the opening for concentrated solution drainage—underneath the longitudinal rib. The single longitudinal distributing pipe is situated above the upper longitudinal edge of the pulled breadth.

[0027] In another design of the tilted solar collector with the pulled breadth, condensation of water vapors in the internal space of the lower section is executed on the flowing cooling water, which is supplied onto a capillary structure placed on the internal surface of the base wall; this supply is executed via a distributing pipe positioned above the upper longitudinal edge of the capillary structure. Cooling water

mixed with condensate is removed via the opening, which is arranged above the longitudinal rib.

[0028] In this case the internal space of the lower section of the solar collector is provided with an opening for equalizing the pressure in the lower section of the solar collector with the ambient pressure. The tilted solar collector can be designed without the pulled breadth with the capillary structure on the internal surface of the base wall and with a distributing pipe positioned above the upper longitudinal edge of the capillary structure.

[0029] The solar collector, which is disclosed in this invention can be applied for heating water for domestic and industrial applications.

[0030] In order to boost heating ability of the proposed solar collector, it is possible to apply a longitudinal reflector, which is pivotally mounted by an arm in a frame that can rotate itself. In such a way, combined rotations of the arm and the frame of the longitudinal reflector allow executing tracking after the sun's motion with reflecting the solar incident light on the aperture of the solar collector.

[0031] In the cases of the proposed designs of the tilted solar collector, the longitudinal reflector can be positioned near its lower longitudinal edge; the longitudinal reflector performs tracking rotation around an axis, which is in parallel with the longitudinal direction of the solar collector trough.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

[0032] FIG. **1***a* shows a longitudinal vertical cross-section of a horizontal solar collector intended for concentration of aqueous solution.

[0033] FIG. **1***b* shows a longitudinal vertical cross-section of the horizontal solar collector intended for concentration of aqueous solution, when the internal lower space of the solar collector is provided with a floating grid, which suppresses waving and prevents mixing of the aqueous solution layers in this lower internal space.

[0034] FIG. **1***c* shows a transverse vertical cross-section of the horizontal solar collector intended for concentration of aqueous solution.

[0035] FIG. **2** shows a transverse vertical cross-section of the horizontal solar collector intended for concentration of aqueous solution and a tracking reflector, which is positioned on the opposite side with respect to the solar collector and the sun.

[0036] FIG. **3***a* shows a longitudinal vertical cross-section of the solar horizontal collector with a breadth pulled between the opposite end walls in the internal space of its lower section.

[0037] FIG. **3***b* shows a longitudinal vertical cross-section of the horizontal solar collector with a breadth pulled between the opposite end walls in the internal space of its lower section and wicks joined with the breadth at the places of its maximum deflection.

[0038] FIG. **3***c* shows a horizontal cross-section A-A of the horizontal solar collector of FIG. **3***a*.

[0039] FIG. **4***a* shows a transverse vertical cross-section of the horizontal solar collector intended for concentration of aqueous solution with the breadth pulled between two sidewall of the solar collector trough.

[0040] FIG. **4***b* shows a horizontal cross-section B-B of the solar collector of FIG. **4***a*.

[0041] FIG. **5***a* shows a transverse vertical cross-section of the tilted solar collector intended for concentration of aqueous solution with the breadth pulled between two sidewalls of the solar collector trough.

[0042] FIG. **5***b* shows a transverse vertical cross-section of the tilted solar collector intended for concentration of aqueous solution with the breadth pulled between two sidewalls of the solar collector trough and a capillary structure on the internal surface of the base wall.

[0043] FIG. **5***c* shows a transverse vertical cross-section of the tilted solar collector intended for concentration of aqueous solution with the capillary structure on the internal surface of the base wall.

[0044] FIG. **6** shows a transverse vertical cross-section of the tilted solar collector intended for concentration of aqueous solution and a tracking reflector, which is positioned on the same side with respect to the solar collector as the sun.

DESCRIPTION OF PREFERRED EMBODIMENTS

[0045] FIG. **1***a* shows a longitudinal vertical cross-section of a horizontal solar collector intended for concentration of aqueous solution.

[0046] It comprises a solar collector **100** in a form of a horizontal trough, which consists of in turn a base wall **101**, sidewall **102** and two opposite end walls **103** and **104**; the horizontal trough is divided by a metal horizontal sheet **105** into the upper section **106** and the lower section **107**;

[0047] The upper side of the metal horizontal sheet **105** is provided with a selective coating **108** and the lower side of this metal horizontal sheet **105** is provided with coating **109** with high emittance in the infrared range of spectrum.

The upper section of the horizontal trough **100** is covered with glazing **110**.

[0048] The lower section of the horizontal trough **100** is filled up to a certain level with the aqueous solution to be partially evaporated;

[0049] The first end wall **103** is provided with two inlet connections **111** and **112** for supply the aqueous solution to be partially evaporated and the air into the lower section of the trough, wherein the inlet connection **112** for air supply is arranged above the level of the aqueous solution in the trough.

[0050] In the same manner, the second opposite end wall **104** of the horizontal trough is provided with two outlet connections **113** and **114** for removal of the concentrated aqueous solution and the humidified hot air from the horizontal trough, wherein the outlet connection **114** for air removal is arranged above the level of the aqueous solution in the trough.

[0051] FIG. **1***b* shows a longitudinal vertical cross-section of a horizontal solar collector **140** intended for concentration of aqueous solution with the same units as in FIG. **1***a*, when the internal lower space of the solar collector is provided with a floating grid **120**, which suppresses waving and prevents mixing of the aqueous solution layers in this lower internal space.

[0052] FIG. **1***c* shows a transverse vertical cross-section A-A of the solar collector intended for concentration of aqueous solution. It comprises the solar collector **100** in the form of a horizontal trough, which consists of, in turn, the base wall **101**, two sidewalls **102** and the end wall **104**; the horizontal trough **100** is divided by metal horizontal sheet **105** into the upper section **106** and the lower section **107**.

[0053] The upper side of the metal horizontal sheet **105** is provided with a selective coating **108** and the lower side of this metal horizontal sheet **105** is provided with coating **109** with high emittance in the infrared range of spectrum.

[0054] The upper section of the horizontal solar collector **100** is covered with glazing **110**.

[0055] The lower section of the horizontal trough **100** is filled up to a certain level with the aqueous solution to be partially evaporated. The end wall **103** of the horizontal trough is provided with two inlet connections **111** and **112** for supply of the concentrated aqueous solution and the air into the horizontal trough, wherein the inlet connection **112** for air supply is arranged above the level of the aqueous solution in the trough.

[0056] FIG. **2** shows the a transverse vertical cross-section of the solar collector intended for concentration of aqueous solution with a cross-section of a longitudinal reflector intended to boost heating ability of the solar collector.

[0057] It comprises the solar collector **100** in the form of a horizontal trough, which consists of, in turn, the base wall **101**, two sidewalls **102** and the end wall **104**; the horizontal solar collector **100** is divided by metal horizontal sheet **105** into the upper section **106** and the lower section **107**.

[0058] The upper side of the metal horizontal sheet **105** is provided with a selective coating **108** and the lower side of this metal horizontal sheet **105** is provided with coating **109** with high emittance in the infrared range of spectrum.

[0059] The upper section of the horizontal soak collector **100** is covered with glazing **110**.

[0060] The lower section of the horizontal solar collector **100** is filled up to a certain level with the aqueous solution to be partially evaporated. The end wall **103** of the horizontal trough is provided with two inlet connections **111** and **112** for supply of the concentrated aqueous solution and the air into the horizontal trough, wherein the inlet connection **112** for air supply is arranged above the level of the aqueous solution in the trough.

[0061] A longitudinal reflector **205** with its frame is pivotally mounted by arm **202** on post **201**, which, in turn, is mounted on base **208**. A first axle **206** and a first tracking mechanism **207** allow turning arm **202** with respect to post **201**, and a second axle **203** and a second tracking mechanism **204** allow turning the longitudinal reflector **205** with its frame with respect to arm **202**.

[0062] FIG. **3***a* shows a longitudinal vertical cross-section of the solar collector with a breadth pulled between the opposite end walls in the internal space of its lower section.

[0063] It comprises a solar collector **310** in a form of a horizontal trough, which consists of, in turn, a base wall **101**, two sidewalls **102** and two opposite end walls **103** and **104**; the horizontal trough is divided by a metal horizontal sheet **105** into the upper section **106** and the lower section **107**.

[0064] The upper side of the metal horizontal sheet **105** is provided with a selective coating **108** and the lower side of this metal horizontal sheet **105** is provided with coating **109** with high emittance in the infrared range of spectrum.

[0065] The upper section of the solar collector **310** is covered with glazing **110**.

[0066] The first end wall **103** is provided with the inlet **112** for supply the air into the lower section of the trough and the second opposite end wall **104** of the horizontal trough is provided with the outlet connection **114** for removal of the humidified hot air from the horizontal trough.

[0067] Breadth **301** from fabric is pulled by fastenings **303** between the opposite end walls **103** and **104** in the lower section of the solar collector.

[0068] An array of horizontal cross bars **302** is installed between the opposite sidewalls **102**.

[0069] Aqueous solution to be partially evaporated and concentrated is supplying on breadth **301** from an array of distributing pipes **304**, which are arranged above the breadth and the supporting cross bars. The base wall **101** is provided with an array of transverse ribs **306** which form two types of sub-trays; the sub-tray **311** serve for collecting the draining concentrated aqueous solution and the sub-trays **312** serve for collecting condensate that is obtained as a result of condensation of water vapors on the surface of these sub-trays **312** of the second type having a lower temperature than the temperature of the water vapors in the internal space of its lower section.

[0070] The obtained condensate is drained via openings **307** and the concentrated aqueous solution is drained via openings **308**.

[0071] FIG. **3***b* shows a longitudinal vertical cross-section of the solar collector with breadth **301** pulled between the opposite end walls in the internal space with the same parts as in FIG. **3** and wicks **305** joined with breadth **301** at the places of its maximum deflection.

[0072] FIG. **3***c* shows a horizontal cross-section A-A of the solar collector of FIG. **3***a*.

[0073] FIG. **4***a* shows a transverse vertical cross-section of the horizontal solar collector intended for concentration of aqueous solution with the breadth pulled between two sidewalls of the solar collector trough. It comprises a solar collector **400** in a form of a horizontal trough, which consists of, in turn, a base wall **101**, two sidewalls **102** and the end wall **103**; the horizontal trough is divided by a metal horizontal sheet **105** into the upper section **106** and the lower section **107**.

[0074] The upper side of the metal horizontal sheet **105** is provided with a selective coating **108** and the lower side of this metal horizontal sheet **105** is provided with coating **109** with high emittance in the infrared range of spectrum.

[0075] The upper section of the horizontal solar collector **400** is covered with glazing **110**.

[0076] The end wall **103** is provided with the inlet **403** for supply the air into the lower section of the trough.

[0077] Breadth **401** from fabric is pulled by fastenings **402** between the opposite sidewalls **102** in the lower section of the solar collector. Two distributing pipes **407** are situated above the longitudinal margins of breadth **401**.

[0078] The base wall **101** is provided with two longitudinal ribs **405**, which form two types of sub-trays; sub-tray **410** serves for collecting the draining concentrated aqueous solution and two sub-trays **411** serve for collecting condensate that is obtained as a result of condensation of water vapors on the surface of these sub-trays **411** of the second type having a lower temperature than the temperature of the water vapors in the internal space of the lower section.

[0079] The obtained condensate is drained via openings **406** and the concentrated aqueous solution is drained via openings **404**.

[0080] FIG. **4***b* shows a horizontal cross-section B-B of the solar collector of FIG. **4***a*. It comprises the same elements as in FIG. **4***a* and, additionally, the end wall **104** is provided with the outlet connection **114** for removal of the humidified hot air from the horizontal trough.

[0081] FIG. **5***a* shows a transverse vertical cross-section of the tilted solar collector intended for concentration of aqueous solution with the breadth pulled between two sidewalls of the solar collector trough. It comprises a solar collector **500** in a form of a tilted trough, which consists of in turn: a supporting wall **501**, a base wall **101**, two sidewalls **102** and the end wall **103**; the trough is divided by a metal sheet **105** into the upper section **106** and the lower section **107**.

[0082] The upper side of the metal sheet **105** is provided with a selective coating **108** and the lower side of this metal sheet **105** is provided with coating **109** with high emittance in the infrared range of spectrum.

[0083] The upper section of the tilted solar collector **500** is covered with glazing **110**.

[0084] The end wall **103** is provided with the inlet **403** for supply the air into the lower section of the trough.

[0085] Breadth **401** from fabric is pulled by fastenings **402** between the opposite sidewalls **102** in the lower section of the solar collector.

[0086] A distributing pipe **503** serves for supply the aqueous solution to be partially evaporated and concentrated on the breadth.

[0087] The base wall **101** is provided with one longitudinal rib **505**, which forms two types of sub-trays; the sub-tray **510** serves for collecting the concentrated aqueous solution and the sub-tray **511** serves for collecting condensate that is obtained as a result of condensation of water vapors on the surface of this sub-tray **511** of the second type having a lower temperature than the temperature of the water vapors in the internal space of the lower section.

[0088] The obtained condensate is drained via opening **506** and the concentrated aqueous solution is drained via opening **504**.

[0089] FIG. **5***b* shows a transverse vertical cross-section of the tilted solar collector intended for concentration of aqueous solution with the breadth pulled between two sidewalls of the solar collector trough and a porous coating of the internal surface of the base wall.

[0090] It comprises the same parts as the solar collector in FIG. **5***a* without the inlet **403** for supply the air into the lower section of the trough and, additionally, the tilted solar collector consists of following elements: a capillary structure **508** on the internal surface of the base wall **101**; a distributing pipe **502**, which is positioned above the upper longitudinal edge of the capillary structure **508** and serves for supply cooling water; opening **512** for equalizing the pressure in the lower section of the solar collector with the ambient pressure.

[0091] Opening **506** serves for draining mixture of the cooling water with obtained condensate.

[0092] FIG. **5***c* shows a transverse vertical cross-section of the tilted solar collector intended for concentration of aqueous solution with the capillary structure on the internal surface of the base wall.

It comprises the same parts as the solar collector in FIG. **5***b* without the distributing pipes **503** and **502**, and without breadth **401** and its fastenings **402**.

[0093] A distributing pipe **513**, which is positioned above the upper longitudinal edge of the capillary structure **508**, serves for supply of the aqueous solution on this capillary structure **508**. The longitudinal rib **505**, opening **506** for draining condensate and the sub-trays **510** and **511** are cancelled too.

[0094] FIG. **6** shows a transverse vertical cross-section of the tilted solar collector intended for concentration of aqueous solution and a tracking reflector, which is positioned on the same side with respect to the solar collector as the sun.

[0095] It comprises a solar collector **500** in a form of a tilted trough, which consists of, in turn: a supporting wall **501**, a base wall **101**, two sidewalls **102** and the end wall **103**; the trough is divided by a metal sheet **105** into the upper section **106** and the lower section **107**.

[0096] The upper side of the metal sheet **105** is provided with a selective coating **108** and the lower side of this metal sheet **105** is provided with coating **109** with high emittance in the infrared range of spectrum.

[0097] The upper section of the tilted solar collector **500** is covered with glazing **110**.

[0098] The end wall **103** is provided with the inlet **403** for supply the air into the lower section of the trough.

[0099] Breadth **401** from fabric is pulled by fastenings **402** between the opposite sidewalls **102** in the lower section of the solar collector. A distributing pipe **503** serves for supply the aqueous solution to be partially evaporated and concentrated on the breadth.

[0100] The base wall **101** is provided with one longitudinal rib **505**, which forms two types of sub-trays; the sub-tray **510** serves for collecting the concentrated aqueous solution and the sub-tray **511** serves for collecting condensate that is obtained as a result of condensation of water vapors on the surface of this sub-tray **511** of the second type having a lower temperature than the temperature of the water vapors in the internal space of the lower section.

[0101] The obtained condensate is drained via opening **506** and the concentrated aqueous solution is drained via opening **504**.

[0102] A boosting unit **600** comprises base **601** with post **602** mounted on it and a longitudinal reflector **603**, which is pivotally joined with post **602** through axle **604**; a tracking mechanism **605** executes turning the longitudinal reflector **603** in accordance with the sun motion.

1. A solar collector intended for concentration of aqueous solution accompanied with removal of water vapors and other volatile substances from said aqueous solution; said solar collector consists of:

a horizontal trough, which comprises, in turn, a base wall, two opposite sidewalls and two opposite end walls;

glazing covering the aperture of said horizontal trough;

a metal horizontal sheet, which is mounted in said trough and divides its internal space into a upper section and a lower section; the upper side of said metal horizontal sheet is provided with a selective coating and the lower side of said metal horizontal sheet is provided with coating with high emittance in the infrared range of spectrum;

said lower section of said horizontal trough is filled up to a certain level with said aqueous solution to be partially evaporated;

two inlet connections and two outlet connections are installed in said opposite end walls of said horizontal trough and serve for supply the aqueous solution to be partially evaporated and the air into the lower section of the trough, and removal of the concentrated aqueous solution and the humidified hot air from said horizontal trough; wherein said inlet connection for air supply is arranged above the level of the aqueous solution in the trough; said outlet connection for air removal is arranged above the level of the aqueous solution in said horizontal trough.

2. A solar collector intended for concentration of aqueous solution accompanied with removal of water vapors and other volatile substances from said aqueous solution as claimed in claim **1**, wherein said horizontal trough is oriented in direction west-east.

3. A solar collector intended for concentration of aqueous solution accompanied with removal of water vapors and other volatile substances from said aqueous solution as claimed in claim **1**, wherein a longitudinal tracking reflector is mounted along the horizontal trough.

4. A solar collector intended for concentration of aqueous solution accompanied with removal of water vapors and other volatile substances from said aqueous solution as claimed in claim **1**, wherein the one end wall of the horizontal trough is provided with two inlet connections for supply the aqueous solution to be partially evaporated and the air, and the opposite end wall is provided with two outlet connections for removal of the concentrated aqueous solution and the humidified hot air from said horizontal trough.

5. A solar collector intended for concentration of aqueous solution accompanied with removal of water vapors and other volatile substances from said aqueous solution as claimed in claim **1**, wherein the one end wall of the horizontal trough is provided with the inlet connection for supply the aqueous solution to be partially evaporated and the outlet connection for removal of the humidified hot air from said horizontal trough, and the opposite end wall is provided with the outlet connection for removal of the concentrated aqueous solution and with the inlet connection for air supply into said horizontal trough.

6. A solar collector intended for concentration of aqueous solution accompanied with removal of water vapors and other volatile substances from said aqueous solution as claimed in claim **1**, wherein there is a floating grid, which floats on the layer of said aqueous solution to be concentrated.

7. A solar collector intended for concentration of aqueous solution accompanied with removal of water vapors and other volatile substances from said aqueous solution, wherein said solar collector consists of

a horizontal trough, which comprises in turn a base wall, two opposite sidewalls and two opposite end walls;

glazing covering the aperture of said horizontal trough;

a metal horizontal sheet, which is mounted in said horizontal trough and divides its internal space into a upper section and a lower section; the upper side of said metal horizontal sheet is provided with a selective coating and the lower side of said metal horizontal sheet is provided with coating with high emittance in the infrared range of spectrum;

an inlet connection and an outlet connection are installed in said opposite end walls of said horizontal trough and serve for supply the air into the lower section of the trough and removal the humidified hot air from said horizontal trough;

a breadth from fabric is pulled by fastenings between the opposite end walls of said solar collector;

an array of horizontal cross-bars is installed between the opposite sidewall said cross-bars are supporting said breadth;

an array of distributing pipes, which are arranged above said breadth and said supporting cross-bars; said distributing pipes serve for supply the aqueous solution to be partially evaporated on said breadth;

an array of transverse ribs is mounted on the base wall of the horizontal trough; said transverse ribs form two types of sub-trays; said first type of said sub-trays serves for collecting the concentrated aqueous solution and said second type of said sub-trays serves for collecting of condensate; said side walls of said sub-trays are provided with openings for drainage of condensate and concentrated aqueous solution.

8. A solar collector intended for concentration of aqueous solution accompanied with removal of water vapors and other volatile substances from said aqueous solution as claimed in claim **7**, wherein there are wicks, which are joined with the breadth at the places of its maximum deflection.

9. A solar collector intended for concentration of aqueous solution accompanied with removal of water vapors and other volatile substances from said aqueous solution as claimed in claim **7**, wherein the sub-trays, of the second type are provided additionally with inlet connections for supply of chilling water, and the horizontal trough is provided with an opening for equalizing the pressure in the lower section of the solar collector with the ambient pressure.

10. A solar collector intended for concentration of aqueous solution accompanied with removal of water vapors and other volatile substances from said aqueous solution, wherein said solar collector consists of:

a horizontal trough, which comprises in turn a base wall, two opposite sidewalls and two opposite end walls;

glazing covering the aperture of said horizontal trough;

a metal horizontal sheet, which is mounted in said horizontal trough and divides its internal space into a upper section and a lower section; the upper side of said metal horizontal sheet is provided with a selective coating and the lower side of said metal horizontal sheet is provided with coating with high emittance in the infrared range of spectrum;

said lower section of said horizontal trough is filled up to a certain level with said aqueous solution to be partially evaporated;

an inlet connection and an outlet connection are installed in said opposite end walls of said horizontal trough and serve for supply of the air into the lower section of the trough and removal of the humidified hot air from said horizontal trough;

a breadth from fabric is pulled by fastenings between the opposite sidewalls in the lower section of said solar collector;

two distributing pipes are situated above the longitudinal margins of said breadth;

two longitudinal ribs on the internal side of said base wall form two types of sub-trays; a central sub-tray, which serves for collecting the concentrated aqueous solution and two lateral sub-trays, which serve for collecting condensate; said central and lateral sub-trays are provided with openings for drainage of concentrated aqueous solution and condensate.

11. A solar collector intended for concentration of aqueous solution accompanied with removal of water vapors and other volatile substances from said aqueous solution as claimed in claim **10**, wherein the trough is tilted and there is the sole longitudinal distributing pipe, which supplying the aqueous solution to be partially evaporated and concentrated on the upper margin of the breadth;

base wall is provided with one longitudinal rib, which forms two types of sub-trays; one sub-tray serves for

collecting the concentrated aqueous solution and the second one—for collecting the condensate; said sub-trays are provided with openings for drainage of said condensate and said concentrated aqueous solution.

12. A solar collector intended for concentration of aqueous solution accompanied with removal of water vapors and other volatile substances from said aqueous solution as claimed in claim **11**, wherein the breadth is placed on the internal surface of the base wall and there is a sole opening for drainage of said condensate and said concentrated aqueous solution.

13. A solar collector intended for concentration of aqueous solution accompanied with removal of water vapors and other volatile substances from said aqueous solution as claimed in claim **11**, wherein the tilted trough is oriented in direction east-west.

14. A solar collector intended for concentration of aqueous solution accompanied with removal of water vapors and other volatile substances from said aqueous solution as claimed in claim **11**, wherein a longitudinal tracking reflector is positioned along the tilted trough.

15. A solar collector designed as it is claimed in claim **1**, wherein said solar collector is intended for water heating.

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