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(72) Inventor; and

(71) Applicant : JANSSEN, Wilhelmus, Franciscus, Johannes [NL/AE]; 240 Al Raha Gardens, PO Box 31190, Abu Dhabi (AE).

(74) Agent: VELDMAN-DIJKERS, Cornelia, Geerdina, Catherina; Ab Ovo Patents BV, Platz 1 - Limbricht, NL-6141 AT Sittard-Geleen (NL).

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(54) Title: A METHOD AND DEVICE FOR TREATING A FLUID

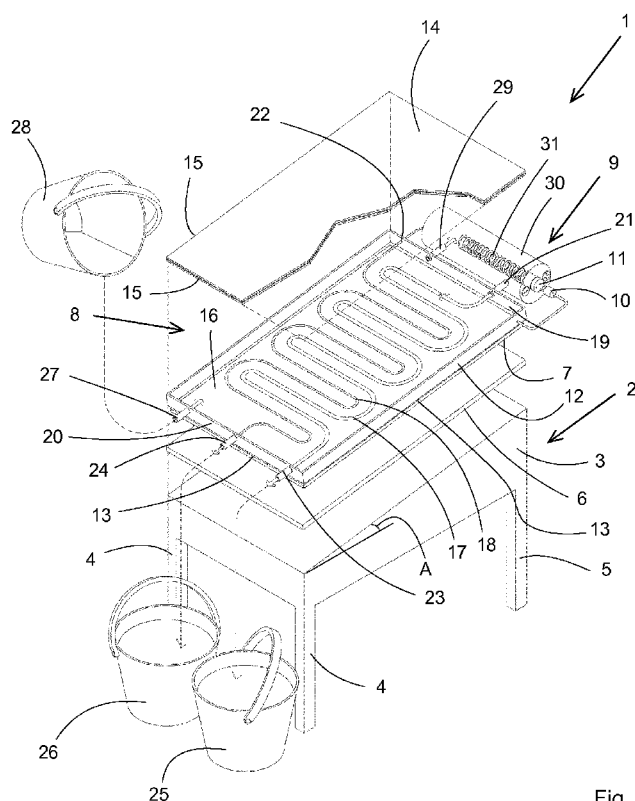


Fig. 1

(57) Abstract: With a method for treating a fluid, a fluid is divided into at least a first and second fluid part. The method comprises the steps of flowing a flow of relatively cold fluid along at least one photovoltaic solar panel being heated by solar energy towards and into a fluid treatment device, at least heating the flow of fluid in a fluid treatment device, to divide the flow of fluid into a flow of a first fluid part and a flow of a second fluid part, flowing the flows of the first fluid part and the second fluid part from the fluid treatment device along the flow of relatively cold fluid. Before entering the fluid treatment device the flow of relatively cold fluid is preheated by the relatively warm photovoltaic solar panel and the relatively warm flow of the first fluid part and the relatively warm flow of the second fluid part.



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GW, KM, ML, MR, NE, SN, TD, TG).

A method and device for treating a fluid

The invention relates to a method for treating a fluid, whereby the fluid is divided into at least a first and second fluid part.

5 The invention further relates to a device for treating a fluid, whereby the fluid is divided into at least a first and second fluid part, which device comprises at least a photovoltaic solar panel, a heat exchanger located against the photovoltaic solar panel and a fluid treatment device.

10 In such a method and device, which are known from US20110011802A1, a photovoltaic cell is cooled by a first flow of sea water flowing through a first heat exchanger due to which the sea water is heated. The heated first flow of sea water is directed into a water treatment unit, where the heat from the heated sea water is used to treat a second flow of salt water. The water treatment unit comprises a second heat exchanger and a desalinator unit to divide the second flow of sea water
15 into a flow of desalinated water and concentrated salt water.

A disadvantage of the known method is that a relatively large amount of energy is lost in the two flows of sea water and a relatively large amount of additional energy is needed for the desalination process.

20 The object of the invention is to provide a method to divide a fluid into at least a first and second fluid part in an efficient and energy-saving manner.

This object is accomplished with the method according to the invention in that the method comprises the steps of:

- flowing a flow of relatively cold fluid along at least one photovoltaic solar panel being heated by solar energy towards and into a fluid treatment device;
- 25 - at least heating the flow of fluid in a fluid treatment device to divide the flow of fluid into a flow of a first fluid part and a flow of a second fluid part;
- flowing the flows of the first fluid part and the second fluid part from the fluid treatment device along the flow of relatively cold fluid;
- whereby before entering the fluid treatment device the flow of relatively
30 cold fluid is being preheated by the relatively warm photovoltaic solar panel, the

relatively warm flow of the first fluid part and the relatively warm flow of the second fluid part.

Since the relatively cold fluid is being preheated less energy is needed in the fluid treatment device to heat the fluid to a desired temperature which is needed
5 for the process to divide the fluid into the two (or more) fluid parts.

Furthermore the photovoltaic solar panel will be cooled down by the heat transfer to the relatively cold fluid. It is known that photovoltaic solar panels work more efficiently if the temperature of the photovoltaic solar panel is not too high and being less than 75 degrees Celsius, for example.

10 By also transferring the heat both of the flows of the first and second fluid part leaving the fluid treatment device to the flow of fluid entering the fluid treatment device, the additional energy needed for raising the temperature of the fluid to be treated is relatively low and nearly no energy is lost.

The fluid and fluid parts may be a liquid or a gas. The fluid to be treated
15 can be saline water, sea water, polluted water or other kinds of liquids or gasses which need to be divided into at least two fluid parts.

It has to be noted that US4749447 discloses a solar still wherein raw liquid becomes evaporated. The vapor is collected from evaporator conduits into vapor conduits and than guided into a condensor conduit. The flows in all
20 conduits are all along a same continuous down slope.

The solar still of US4749447 does not comprise photovoltaic solar panels, does not comprise a fluid treatment device to divide the flow of fluid into a flow of a first fluid part and a flow of a second fluid part and the flow of relatively cold fluid is not being preheated by three different sources, being the relatively warm
25 photovoltaic solar panel, the relatively warm flow of the first fluid part and the relatively warm flow of the second fluid part.

An embodiment of the method according to the invention is characterised in that by means of the photovoltaic solar panel solar energy is converted into electrical energy, which electrical energy is at least partly used to operate at least
30 partly the fluid treatment device.

Preferably the amount of electrical energy generated by the photovoltaic solar panel is sufficient to operate the fluid treatment device. In this manner a self sustainable system is obtained whereby no external energy other than solar energy is needed. If more electrical energy is generated by the photovoltaic solar panel than needed, the surplus of electric energy can be stored in an accumulator, which energy can be used when there is not enough sun to generate the desired amount of electrical energy.

Another embodiment of the method according to the invention is characterised in that by heating the flow of fluid in the fluid treatment device, a part of the flow of fluid is evaporated into a vapor forming the first fluid part.

Such method of separating one fluid part of the other is relatively simple, especially if the boiling temperature of the two fluid parts differs. Also if the fluid comprises a solution of a solute and a solvent, the solvent can be partly evaporated as the first fluid part, while a remaining part of the solvent together with the solute will form the second fluid part. In the second part the concentration of the solute is much higher than in the original fluid.

Another embodiment of the method according to the invention is characterised in that the vapor is being flown along the flow of relatively cold fluid.

The vapor is relatively hot and a relatively large amount of energy can be recovered from the vapor and transferred to the flow of fluid. During the transfer of energy the vapor will condense.

Another embodiment of the method according to the invention is characterised in that the direction of the flows of the first and second fluid part is opposite to the direction of the flow of relatively cold fluid.

By flowing in opposite directions a good heat transfer is obtained.

Another embodiment of the method according to the invention is characterised in that the fluid is salt water, the first part is treated water and the second fluid part is brine.

Since the method according to the invention can be self sustainable or need only a small amount of external energy, the method is very suitable for

desalination of water in areas with a large amount of sea water and with a sunny climate. If the salt water is sea water the brine can easily be dropped back into the sea.

Another embodiment of the method according to the invention is
5 characterised in that the treated water is potable.

If the desalination is done to a sufficient level, the water can be used for human and/or animal consumption and irrigation. Such level of desalination will be obtained by evaporation of part of the fluid.

The invention also relates to a device for dividing a fluid into at least a first
10 and second fluid parts in an efficient and energy-saving manner.

This object is accomplished with the device according to the invention in that, the fluid treatment device comprises a heating element to heat the fluid and to divide the fluid into the first and second fluid part wherein the heat exchanger comprises at least three separated flow channels, a first flow channel for a flow of
15 the fluid to be treated and a second and third flow channel for a flow of the first fluid part and a flow of the second fluid part and wherein the three separated flow channels are connected to the fluid treatment device, whereby before entering the fluid treatment device the flow of relatively cold fluid in the first flow channel is being preheated by the relatively warm photovoltaic solar panel, the relatively
20 warm flow of the first fluid part in the second flow channel and the relatively warm flow of the second fluid part in the third flow channel.

In case that the photovoltaic solar panel, first fluid part and the second fluid part have a higher temperature than the fluid to be treated, heat will be transferred in the heat exchanger from the photovoltaic solar panel, first fluid part and the
25 second fluid part to the fluid to be treated so that the fluid will be preheated before entering the fluid treatment device. Due to the heat transfer the device can be operated with a relatively small amount of external energy, preferably the electric energy of the photovoltaic solar panel.

An embodiment of the device according to the invention is characterised in that the photovoltaic solar panel is electrically connected to the fluid treatment device.

In this manner the electrical energy generated by the photovoltaic solar panel can be used for operating the fluid treatment device so that less external energy or even none external energy is needed for separating the fluid into two fluid parts.

Another embodiment of the device according to the invention is characterised in that the fluid treatment device comprises a boiling vessel.

Such a boiling vessel can easily be electrically operated to heat the fluid to any desired temperature, for example the boiling temperature of the fluid.

Another embodiment of the device according to the invention is characterised in that a first side of the photovoltaic solar panel and the heat exchanger is located at a lower level than a second side thereof, whereby the fluid treatment device is located near the second side at about the same level thereof.

In such an arrangement the first fluid part and second fluid part will flow from the fluid treatment device downwardly to the lower level of the second side under the force of gravity. The fluid to be treated will enter the heat exchanger preferably at the lower level and will, as soon as the device is operating, flow upwardly by means of a pump or by locating a reservoir of the fluid to be treated at a higher level than the second side.

Another embodiment of the device according to the invention is characterised in that the heat exchanger comprises a pane extending parallel to the photovoltaic solar panel at a distance thereof, which heat exchanger comprises a circumferential wall connected with a first side to edges of the photovoltaic solar panel and with a second side to edges of the pane, wherein a space bounded by the photovoltaic solar panel, the pane and the circumferential wall forms the first flow channel, whilst two tubes located in the space form the second and third flow channels.

Such heat exchanger is relatively easy to manufacture. The fluid to be treated will flow over the photovoltaic solar panel so that heat from the photovoltaic solar panel can easily be transferred to the fluid. Furthermore since the tubes for transporting the first and second fluid parts are located in the space
5 filled with the fluid, also heat transfer from the first and second fluid parts through the walls of the tubes to the fluid will easily take place.

Another embodiment of the device according to the invention is characterised in that the heat exchanger is located on top of the photovoltaic solar panel, wherein the pane is at least transparent for solar energy.

10 The solar energy can easily reach the photovoltaic solar panel through the pane and the space between the pane and the photovoltaic solar panel. Furthermore, a person checking the device can easily look through the pane inside the heat exchanger and check if the fluid is still flowing. Preferably the pane is made of glass or plastic and forms an insulating layer for the heat of the fluid and
15 fluid parts.

The invention will now be explained in more detail with reference to the drawing, in which:

Figure 1 is a perspective view of the device according to the invention.

Figure 1 shows a device 1 according to the invention. The device 1 comprises
20 a table-like support structure 2 provided with a table top 3, two relative short front legs 4 and two relatively longer rear legs 5. Due to the difference in length of the front legs 4 and the rear legs 5, the table top 3 is tilted forwardly and encloses an angle A with the horizontal of about 30 degrees, for example.

The device 1 comprises an insulation layer 6 located on the table top 3, a
25 photovoltaic solar panel 7 located on the insulation layer 6 and a heat exchanger 8 located on and against the solar panel 7. Near the top rear side the device 1 is provided with a fluid treatment device 9.

The photovoltaic solar panel 7 may compose a number of interconnected PV-cells and may have a length of 1,5 metre and a width of 1 metre.

The photovoltaic solar panel 7 is electrically connected to the fluid treatment device 9 by means of a plug 10 and socket 11.

The heat exchanger 8 comprises a circumferential wall 12 connected with a first side to edges 13 of the photovoltaic solar panel 7. The heat exchanger 8 also comprises a pane 14 extending parallel to the photovoltaic solar panel 12 at a distance thereof. The pane 14 is preferably made of glass or plastic being transparent for sun light. The circumferential wall 12 is connected with a second side to edges 15 of the pane 14. The photovoltaic solar panel 7, the pane 14 and the circumferential wall 12 bound a space 16. Inside the space 16 two tubes 17, 18 are located. The tubes 17, 18 meander from an upper part 19 of the circumferential wall 12 to a lower part 20 of the circumferential wall 12. At the upper part 19 the tubes 17, 18 are provided with fluid inlets 21, 22, whilst near the lower part 20 the tubes 17, 18 are provided with fluid outlets 23, 24. The device 1 comprises means for collecting fluid from the fluid outlets 23, 24, shown as buckets 25, 26 respectively.

Since the fluid inlet 27 to the space 16 is located at a lower level than the fluid outlet 29 of the space 16, the sea water entering the space 16 will automatically be located against the photovoltaic solar panel 7, the pane 14 and the circumferential wall 12. In this manner a good transfer of the heat of the solar panel 7 and the pane 14 to the sea water will be obtained. Furthermore, since the sea water will fill the space 16 from below, there will be no air between the sea water and the photovoltaic solar panel 7 and the pane 14.

The lower part 20 is furthermore provided with a fluid inlet 27 to the space 16, which fluid inlet 27 is connected on the other side to a sea water supply, shown as a bucket 28. The upper part 19 is provided with a fluid outlet 29 of the space 16.

The fluid treatment device 9 comprises a cylindrical vessel 30 with a spiral-shaped heating element 31. The heating element 31 is electrically connected to the socket 11. The fluid outlet 29 of the space 16 as well as the fluid inlets 21, 22 of the tubes 17, 18 are connected to the vessel 30.

The device 1 is suitable for desalination of salt water to obtain a potable water part and a brine in a self sustainable manner. To obtain the potable water,

the device 1 is placed outdoors in the sun and close to a source of saline water, like the sea.

Radiation of the sun passes the pane 14 and the space 16 and reaches the photovoltaic solar panel 7, where the solar energy is converted into electrical energy. The radiation will also heat up the pane 14, the space 16 and the photovoltaic solar panel 7. Relative cold salt water is allowed to enter via the fluid inlet 27 the space 16 and will flow upwards towards the fluid outlet 29 of the space 16 and will continue to flow into the vessel 30. Since the bucket 28, representing a reservoir of salt water, is located at a higher level than the vessel 30, the salt water will automatically flow upwardly. If the device 1 is used, for example in the United Arab Emirates, the sea water may have a temperature in the summer of more than 30 degrees Celsius when entering the fluid inlet 27. Inside the vessel 30, the heating element 31 is powered by the electrical energy obtained from the photovoltaic solar panel 7. The salt water will be heated by the heating element 31 to the boiling temperature of the salt water. At the boiling temperature, part of the salt water will evaporate and become a vapor. The vapor is guided into the fluid inlet 21 and will flow under the force of gravity downwards through the tube 17 to the fluid outlet 23 and into the bucket 25. The vapor will condense between the vessel 30 and the bucket 25 to liquid water. This water is potable. To avoid that the vessel 30 will be filled with salt, brine being water containing a larger amount of salt and remaining at the bottom of the vessel 30, will be guided into the fluid inlet 22 and will flow under the force of gravity downwards through the tube 18 to the fluid outlet 24 and into the bucket 26.

As the cold water is flowing from the fluid inlet 27 to the fluid outlet 29, water will cool down the photovoltaic solar panel 7 due to which a better performance of the photovoltaic solar panel 7 will be obtained. By cooling down the photovoltaic solar panel 7, the temperature of the relative cold water will rise. The fluid parts flowing through the tubes 17, 18 have a higher temperature than the salt water flowing into the space 16, so that heat will also be transferred from the fluid parts in the tubes 17, 18 through the walls of the tubes 17, 18 to the salt water

due to which the temperature of the salt water will further raise. By entering the vessel 30 the temperature of the salt water will be about 75 to 85 and preferably 90 to 95 degrees Celsius. In this manner the amount of energy to raise the temperature to the boiling temperature is relatively low since a large amount of the heating energy is obtained from cooling down the photovoltaic solar panel 7 and the fluid parts in the tubes 17, 18.

If the photovoltaic solar panel 7 delivers more electrical energy than needed for the heating element 31, the surplus of electrical energy can be stored in an accumulator like an battery. If the photovoltaic solar panel 7 delivers not enough electrical energy, additional electrical energy can be obtained from said accumulator or from an external energy source.

The device 1 is also suitable for dividing other kinds of fluids into at least two fluid parts, like ethanol-methanol-mixtures.

It is also possible that only one fluid part flows through the heat exchanger. However, in such a case the heat energy in the other fluid part will not be used to heat up the flow of fluid to be treated and will be lost.

It is also possible that the fluid treatment device 9 is another kind of device for separating the fluid into different fluid parts, for example a high-temperature reverse osmosis device or a multi-stage flash evaporation distillation device.

It will be clear that instead of buckets, reservoirs, containers and piping can be used to transport the fluid and fluid parts.

The upward flow of the incoming relatively cold salt water can also be realized by means of a pump being operated preferably by the energy generated by the photovoltaic solar panel 7.

It is also possible to mount the heat exchanger between the photovoltaic solar panel 7 and the insulation layer 6. One-way valves may be mounted in the heat exchanger to direct the flow of the fluid and/or fluid parts.

Reference list

	1	device
	2	support structure
	3	table top
	4	front leg
5	5	rear leg
	6	insulation layer
	7	photovoltaic solar panel
	8	heat exchanger
	9	fluid treatment device
10	10	plug
	11	socket
	12	circumferential wall
	13	edge
	14	pane
15	15	edge
	16	space
	17	tube
	18	tube
	19	upper part
20	20	lower part
	21	fluid inlet
	22	fluid inlet
	23	fluid outlet
	24	fluid outlet
25	25	bucket
	26	bucket
	27	fluid inlet
	28	bucket
	29	fluid outlet
30	30	cylindrical vessel

31 spiral-shaped heating element

Claims

1. A method for treating a fluid, whereby the fluid is divided into at least a first and second fluid part, characterized in that, the method comprises the steps of:
 - 5 - flowing a flow of relatively cold fluid along at least one photovoltaic solar panel (7) being heated by solar energy towards and into a fluid treatment device (9);
 - at least heating the flow of fluid in a fluid treatment device (9) to divide the flow of fluid into a flow of a first fluid part and a flow of a second fluid part;
 - 10 - flowing of the flows of the first fluid part and the second fluid part from the fluid treatment device (9) along the flow of relatively cold fluid;
 - whereby before entering the fluid treatment device (9) the flow of relatively cold fluid is being preheated by the relatively warm photovoltaic solar panel (7), the relatively warm flow of the first fluid part and the relatively warm
 - 15 flow of the second fluid part.
2. A method according to claim 1, characterized in that by means of the photovoltaic solar panel (7) solar energy is converted into electrical energy, which electrical energy is at least partly used to operate at least partly the fluid treatment
- 20 device (9).
3. A method according to claim 1 or 2, characterized in that by heating the flow of fluid in the fluid treatment device (9), a part of the flow of fluid is evaporated into a vapor, forming the first fluid part.
- 25
4. A method according to claim 3, characterized in that the vapor is being flown along the flow of relatively cold fluid.

5. A method according to one of the preceding claims, characterized in that the direction of the flows of the first and second fluid part is opposite to the direction of the flow of relatively cold fluid.

5 6. A method according to one of the preceding claims, characterized in that the fluid is salt water, the first part is treated water and the second fluid part is brine.

7. A method according to claim 6, characterized in that the treated water is potable.

10

8. A device (1) for treating a fluid, whereby the fluid is divided into at least a first and second fluid part, which device (1) comprises at least photovoltaic a solar panel (7), a heat exchanger (8) located against the photovoltaic solar panel (7) and a fluid treatment device (9), characterized in that, the fluid treatment device (9)
15 comprises a heating element (30) to heat the fluid and to divide the fluid into the first and second fluid part wherein the heat exchanger (8) comprises at least three separated flow channels, a first flow channel for a flow of the fluid to be treated and a second and third flow channel for a flow of the first fluid part and a flow of the second fluid part respectively, and wherein the three separated flow channels
20 are connected to the fluid treatment device (9), whereby before entering the fluid treatment device (9) the flow of relatively cold fluid in the first flow channel is being preheated by the relatively warm photovoltaic solar panel (7), the relatively warm flow of the first fluid part in the second flow channel and the relatively warm flow of the second fluid part in the third flow channel.

25

9. A device (1) according to claim 8, characterized in that the photovoltaic solar panel (7) is electrically connected to the fluid treatment device (9).

10. A device (1) according to claim 8 or 9, characterized in that the fluid
30 treatment device (9) comprises a boiling vessel (30).

11. A device (1) according to one of the preceding claims 8-10, characterized in that a first side of the photovoltaic solar panel (7) and the heat exchanger (8) is located at a lower level than a second side thereof, whereby the fluid treatment
5 device (9) is located near the second side at about the same level thereof.

12. A device (1) according to one of the preceding claims 8-11, characterized in that the heat exchanger (8) comprises a pane (14) extending parallel to the photovoltaic solar panel (7) at a distance thereof, which heat exchanger (8)
10 comprises a circumferential wall (12) connected with a first side to edges (13) of the photovoltaic solar panel (7) and with a second side to edges (15) of the pane (14), wherein a space (16) bounded by the photovoltaic solar panel (7), the pane (14) and the circumferential wall (12) forms the first flow channel, whilst two tubes (17, 18) located in the space (16) form the second and third flow channels.

15

13. A device (1) according to claim 12, characterized in that the heat exchanger (8) is located on top of the photovoltaic solar panel (7), wherein the pane (14) is at least transparent for solar energy.

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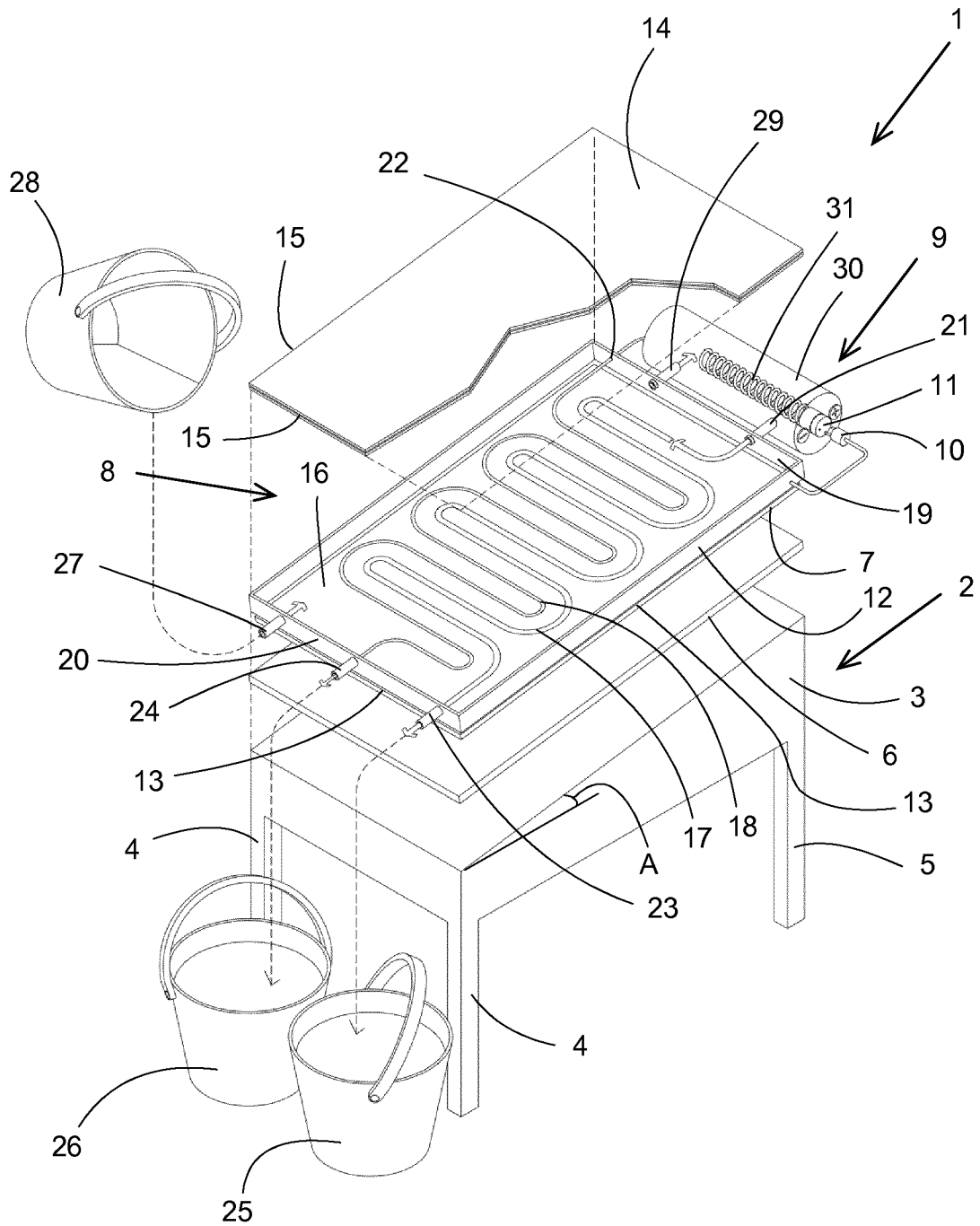


Fig. 1

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2013/069222

A. CLASSIFICATION OF SUBJECT MATTER INV. C02F1/14 H01L31/052 B01D1/00 ADD. C02F103/08 C02F1/04 C02F1/18		
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) C02F H01L B01D F28D		
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		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
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Y	US 2011/011802 A1 (MAYDAN DAN [US]) 20 January 2011 (2011-01-20) cited in the application claims 1-4,7,8,11; figure 1 ----- -/-	1-13
☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents :		
"A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family	
Date of the actual completion of the international search 31 October 2013	Date of mailing of the international search report 12/11/2013	
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 Van Iddekinge, R	

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Information on patent family members

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