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(54) **Title:** SEA WATER PURIFICATION SYSTEM FOR DRINKING AND AGRICULTURAL USAGES, BY USING RENEWABLE ENERGIES.

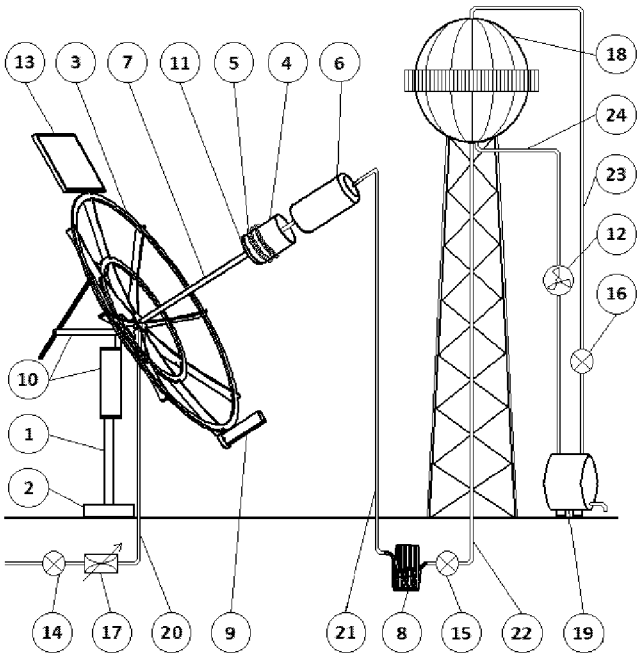

Fig. 1- Sea water purification apparatus in home size.[AA]

AA Appareil de purification de l'eau de mer de taille domestique.

(57) **Abstract:** An apparatus for seawater purification for agricultural and industrial and drinking applies by the distillation process using solar energy comprising a mirrored parabolic light concentrator with receiver seat placed at its focal point. The receiver seat is coiled by a heating element that receives electric energy from the potential energy of water through the turbine generator during the night and cloudy days. A thermoelectric generator mounted on the bottom portion of said receiver seat to provide the electrical energy needed all over the system during the day.

[Continued on next page]

Declarations under Rule 4.17:

— *as to non-prejudicial disclosures or exceptions to lack of novelty (Rule 4.17(v))*

Published:

— *with international search report (Art. 21(3))*

Description

Title of invention:

Sea water purification system for drinking and agricultural usages, by using renewable energies

Technical field:

Energy, Environmental protection, Agriculture

My invention is related to those technologies which have been used for the purification of sea water for drinking, for agricultural uses and for environmental protection by using renewable energy

Background art:

The former purification systems can be classified into the type of process and the type of energy consumed.

A: The division of the purification systems according to the type of process they use includes:

1. Processes of purifying water which are associated with water phase change. (such as distillation systems)
2. Processes acting on the properties of membrane surfaces. (such as reverse osmosis)
3. Processes using ion-selective properties of solids and fluids. (such as ion exchange and solvent extraction)

B: the division of purification systems based on the type of energy they consume contains:

1. Evaporative systems. (thermal system)
2. Reverse osmosis systems. (mechanical system)
3. Electro dialysis systems. (electrical system)
4. Ion exchange systems. (chemical system)

As it is clear, the thermal system is the cheapest and the chemical system is the most expensive.

A major problem that can be addressed in all former purification systems is the fact that all of them are based on fossil fuels.

But renewable energies (merely solar energy and coldness of sea water and the water's potential energy stored in the air water tank in my invention) can be used instead of all types mentioned above, to provide in high efficiency suitable water for drinking and agricultural usages.

This is despite the fact that more than 97 percent of the Earth's surface water is stored in the oceans, seas and so forth, which are not useful for drinking and agriculture because of the salt.

The ultimate goal in my invention is the prevention of confronting the "energy crisis", "crisis of environmental pollution" and "water shortage crisis" that we will face in near future.

An example of invention that has used the same method to solve these problems:

Publication Number: 106495265

Title: Solar cooker sea water purification device with automatic tracking system

"A solar cooker sea water purification device with an automatic tracking system is characterized by comprising a solar cooker sea water evaporator and a cooler; the solar cooker sea water evaporator comprises an automatic tracking system base, a concave light collection plate, an evaporator support rod and a sea water evaporator; the cooler comprises one or more sealed cooling box and a cooling barrel. The solar cooker sea water purification device with the automatic tracking system has the advantages that the structure is simple, and sea water can be made into drinkable purified water after distillation and condensation; by the design, mixing of preheated water and normal-temperature water is prevented effectively, water heating time of a solar cooker is reduced, water heating speed and heat energy utilization of the solar cooker are increased, preheated warm sea water can be delivered to the solar cooker sea water evaporator constantly, to-be-consumed heat energy is ingeniously developed to be combined with the solar cooker to achieve complementary effect, the

drinking water production function of the solar cooker sea water purification device with the automatic tracking system is developed to the greatest extent, and the sea water is purified to meet corresponding drinking needs of seamen and islanders."

The used method is completely different from that in my invention, which is described as follows:

1- In mentioned published invention, a light reflector plate is used as **solar cooker** for **cooking**. After due consideration of different applications of this device, it should be noted that this device has a home appliance and cannot be used in industrial scale. But my invention has been designed exclusively for the evaporation and purification of seawater to produce fresh water in high volume and high efficiency for drinking, agricultural and industrial uses and it can also be produced in domestic scale.

2- In mentioned published invention, there is no possibility for separation and usage of salts and substances that remain in reservoir portion as residuals and they should be washed back and released in sea water. But in my invention, I have provided this opportunity in central reservoir portion to be easily separated from the central receiver seat portion and so residuals can be processed and used in the lateral industries without being wasted and representing any contamination for the environment.

3- In my invention, the anti-corrosion and anti-sludge poly urea condenser is made in the form of network pipe that is placed directly in seawater, therefore the cooling energy for distillation will directly receive from seawater and so there is no need to any other types of energy.
But a useless and costly method has been used in published invention, by usage of barrel.

4- In my invention all parts operate by using natural energies such as solar and the coldness of sea water and the water's potential energy that has been stored in the air water tank, whereby all the electronic parts of solar tracking system and pumps will be supplied by thermoelectric generator or solar panel during the day and a turbine generator or wind turbine at night, which are very affordable and functional.

But usage of other energies (fossil based energies) are indispensable in the published mentioned invention, especially in condenser and solar tracking portion.

5- The mentioned published invention does not allow the system to operate during 24 hours a day (because of sun set) but my invention has been designed to product fresh water during all 24 hours a day.

Summary of invention

Technical problem:

Some technical problems in preceding devices follow as:

1- Failure of possibility to recycling the residual substances those are separated from seawater and using them in lateral industries.

2- Necessity of previous devices to periodical maintenance and washing back inner parts.

3- The presence of environmental pollution in previous devices because of the washing back and releasing residuals into the sea water.

4- Dependence of the performance on at least one type of fossil fuel to work in high efficiency, in some parts of previous devices, such as tracking system, condensing and pumping.

5- The presence of corrosion, sedimentation and sludge in some parts of previous devices, such as brine reservoir, condenser and transmission pipes.

6- The necessity of using manpower in the operation of previous devices such as condenser cooling method (because of the usage of barrel).

7- Inability to build former devices at desired sizes (because of the usage as cooker).

8- Failure of possibility to produce fresh water during 24 hours in a day because of the sun set.

9- Intricacy and lack of cost-effectiveness on previous devices.

Solution to problem:

In comparison to other resembling devices, in my invention, it has been tried to present a new scheme for providing fresh water needed for agricultural, industrial and drinking usages in a high and acceptable efficiency during all 24 hours a day, which can be made possible by adding some portions or making changes in some parts of previous devices namely the combination of greenhouse and parabolic light concentrator systems.

In my invention, a "parabolic light concentrator" (3) with mirrored surface (concave mirror) is used for reflecting and concentrating sun rays in focal point of 1meter length.

A central receiver consisting of a "central receiver seat" (4) and a transparent "central reservoir" (6) has been placed in said focal point to receive the maximum sun rays.

The lower part of the central receiver is made of copper and has been covered with black silicon layer to absorb maximum sun rays, that I named it "central receiver seat" (4).

A transparent enclosure that I named it "central reservoir" (6) is designed like a greenhouse system and is placed inside the copper central receiver seat, that has a fully tangency with internal part of central receiver seat to transfer maximum absorbed temperature to the brine inside.

The remarkable point in designing of the central reservoir is the ability to remove and replace central reservoir portion, to separate the residuals accompanying the central reservoir and using them to recycle in lateral industries without being wasted and representing any contamination for the environment.

This central reservoir is made of disposable materials and can be recycled along with the accompanying residuals inside.

A "heating element" (5) has been coiled around the central receiver seat to provide the heat needed for operation after the sun set through all the night and cloudy days.

In the next step, when the apparatus was started, the brine will be transferred to the central reservoir via "brine transmission pipeline" (20) that is made of poly urea.

After stood facing the sun, the stored brine in the central reservoir starts to boil, and consequently the Purified steam will be transferred to a "condenser" (8) via a "steam transmission pipeline" (21).

The condenser is designed in the form of network pipe, which is placed directly in the cold sea water to make this apparatus completely independent from any other kind of energy other than natural.

The condenser and all the transmission pipelines are made of poly urea to have anti-corrosive, anti-sediment and anti-sludge properties.

In the next step, the distilled water will be transferred to an "air water tank" (18) in a high level stage via a "purified water transmission pipeline" (22) to be stored. This action provides the water's potential energy needed for generating the electrical energy during the night and cloudy days.

In the next step, after filling the air water tank, the stored water in the air water tank will be transferred to "final fiberglass tank" (19) via "outlet circulation pipeline" (24) by using the gravity and in this process the electrical energy needed during the nights and cloudy days will be generated which will be explained in next steps.

In designing of my apparatus, three electrical pumps have been used.

1- Inlet pump (14): to transfer brine from the sea to the central reservoir.
2- Outlet pump (15): to transfer distillated water from the condenser to the air water tank.
3- "Circulation pump" (16): to transfer the distilled water from the final fiberglass tank to the air water tank via "inlet circulation pipeline" (23).

Notable points of these pumps are:

1- Due to the high temperature in the central receiver and the rapid arrival into the boiling point, the inlet pump's flow can be set up through an "adjustable valve" (17) to operates

continuously and therefore there is no necessity to turn on and off the pump frequently to charge the reservoir while waiting for the brine to reach in to the boiling point.

2- The outlet pump will be played a dual-roles, namely:

a) Discharging purified water from the condenser and transferring it to the air water tank.

b) Producing a vacuum space inside the (6) (8) (21) parts for reducing the air pressure inside said parts and consequently obtain the maximum surface evaporation and preventing the central reservoir from exploding and thus to maximize the machine's efficiency.

3- The circulation pump will transfer the distilled water from the final fiberglass tank to the air water tank, where to be stored again to compensate the lack of water in air water tank and create a circulation process as long as both tanks will be filled and also during this process the distilled water that is stored in the final fiberglass tank can be consumed.

As substantially described, the purified water will be eventually transferred via said outlet circulation pipeline to be stored in final fiberglass tank for household usage or in volumes required, such as a fresh water pool for agricultural and industrial usage and also for circulation process again during the nights and cloudy days.

To supply the electrical energy needed during all the day (during the night an auxiliary part is needed), a "thermoelectric generator" (11) has been mounted on the bottom portion of said copper central receiver seat, where the temperature is very high.

By taking advantage of the heat flux (the temperature difference) of over 70 ° C between the central receiver seat and the air around, I could easily provide the electrical energy needed all over the system.

"Solar panel" (13) can also be used as auxiliary under certain circumstances like **partly** cloudy days.

To supply the electrical energy needed during the nights and also cloudy days, a "turbine generator" (12) has been mounted amid said outlet way of circulation pipeline, between the air water tank and final fiberglass tank, where said water's potential energy which is stored in the said air water tank will

cause the turbine rotation and consequently provide the electrical energy needed all over the system, companying said thermoelectric generator.

By taking advantage of the windy coasts, wind turbine generators can also be used instead of turbine generator and air water tank to provide the electrical energy needed during all the nights and cloudy days.

In order to track the sun accurately, a mechatronic system has been used, which is consisting of a "solar tracker sensor" (9) and two electro gearboxes for parabolic light concentrator's "movement mechanism" (10).

A stored pre-written program on an AVR is prepared to adjust the parabolic light concentrator's direction in different times (sunny days, cloudy days and during the night).

The pre-written program operates by adjustment of the parabolic light concentrator angles (altitude and longitude) to track the sun during all the days and also it will be kept the parabolic light concentrator motionless through the nights.

In order to use my invention in large sizes as industrial and agricultural scales, a permanent truss "central tower" (25) can be used instead of "central receiver's base" (7) with mounted central receiver on top. Adjustable "heliostats" (26) with flat mirrored surface can be arranged around the tower and can be used instead of parabolic light concentrator (concave mirror).

Each one of heliostats that arranged around the tower, will singly reflect the sun rays to the central receiver seat (like a finite element on said parabolic light concentrator) in an aggregated reflection point and so all other steps are as the same as described.

Advantageous effects of invention:

1- Preventing the loss of non-renewable energies by replacing renewable energies in all stages.

2- Ability to set up lateral industries by recycling remains.

3- Preventing the parts against corrosion, sediment and sludge by usage of poly urea in the manufacturing process of some parts.

4- Possibility to produce fresh water during all 24 hours a day by using renewable energies.

5- Ability to produce in different dimensions and capacities for different usages such as drinking, industrial and agricultural.

6- No necessity to manpower due to the elimination of barrel of water to make the condenser cool or to repair by corrosion, sediment and sludge damaged parts.

7- Helping to reduce environmental pollution.

8- Reduction in depreciation expenses and maintenance costs by usage of anti-corrosive, anti-sediment and anti-sludge materials in production process of some parts.

9- Reduction in continuous maintenance.

10- Reduction in initial and imposed costs.

11- High efficiency compared to other methods.

Brief description of drawings:

[Fig. 1]

1- Mainstay (A Steel base).

2- Foundation (A reinforced concrete).

3- Parabolic light concentrator (A concave mirror with a focal length of 1 meter).

4- Central receiver seat (A copper receptacle).

5- Heating element (An element to convert electrical energy into heat).

6- Central reservoir (A transparent, replaceable and disposable enclosure).

7- Central receiver's base (A steel pipe).

8- Condenser (A poly urea pipe network).

9- Solar tracker sensor (Consisting of plural light detector).

10- Solar tracker movement mechanism (Consisting of two electro gearboxes).

11- Thermoelectric generator (A solid state device that converts heat flux directly into electricity).

12- Turbine generator (A small generator to generate electricity by using water's potential energy).

13- Solar panel (An electrical device that converts the energy of light directly into electricity).

14- Inlet pump (A Centrifuge pump).

15- Outlet pump (A Centrifuge pump).

16- Circulation pump (A Centrifuge pump).

17- Adjustable valve (An electronic valve to adjust Water flow continuously).

18- Air water tank (A steel tank that is mounted on top of a truss tower).

19- Final fiberglass tank (A fiberglass tank or fresh water pool).

20- Brine transmission pipeline.

21- Steam transmission pipeline.

22- Purified water transmission pipeline.

23- Inlet circulation pipelines.

24- Outlet circulation pipelines.

[Fig. 2]

25- Central tower (A fixed, rigid and permanent truss tower to hold central receiver (Central receiver seat + Central reservoir) on top and in heliostats reflect aggregation point).

26- Heliostat (A flat and framed reflector mounted on solar tracker movement mechanism).

- Other parts are numbered as the same as [Fig. 1]

Description of embodiments:

As substantially described according to the type of design, my apparatus can be used to purify and desalinate any type of water on the margin of the Oceans, Seas, lakes, Wetlands, Ponds and so forth during all 24 hours in a day without needing to a variety of fossil fuels.

This apparatus operates independently and only based on using renewable energy.

The device is completely automatic to purify brine in different sizes for inhabitant areas like Islands, Ports, Coastal towns and villages, Quays, Oil platforms and etc. to prepare drinking water, and even in big sizes for agricultural and industrial usages, which are located on the coasts.

Actually home size apparatuses can be used in parallel to provide more fresh water and this choice depends on how many of them we need to get the right amount of fresh water.

Claims

Claim 1- An apparatus for sea water purification for agricultural and industrial and drinking applies by using renewable energies, comprising:

- A mirrored parabolic light concentrator (3) with a focal length of 1 meter, wherein can be manufactured in different sizes;
- A copper central receiver seat (4) mounted at said focal point, means that it will receive maximum reflected solar rays; and
- A black silicone coverage coated on said receiver seat, means that it will absorb maximum solar rays; and
- A heating element (5) coiled around said receiver seat, means that the receiver seat will be heated through all the night and cloudy days; and
- A transparent enclosure central reservoir (6) placed inside said receiver seat with completely internal tangency, means that it will transfer maximum absorbed heat to brine; and
- A network pipe condenser (8) directly placed inside the sea water, whereby generated steam in said central reservoir will be distilled directly with coldness of sea water; and
- A thermoelectric generator (11) mounted on the bottom portion of said receiver seat, whereby heat flux of over 70 ° C will provide the electrical energy needed all over the system during the day; and
- An air water tank (18) used to store distilled water, means that water's potential energy needed for supplying electrical energy will be provided during the night; and
- A final fiberglass tank (19) used to store distilled water as well, means that distilled water will be ready to be used externally as well as internally in circulation process; and
- A turbine generator (12) mounted on outlet circulation pipeline (24), means that said stored water's potential energy will rotate the turbine to provide the electrical energy needed all over the system during the night and cloudy days; and

- An electric pump (16) used to transfer distilled water via inlet circulation pipeline (23) to said air water tank, means that distilled water will be circulated between said air water tank and said final fiberglass tank to provide water's potential energy needed again; and
- Two electric pumps (14) (15) used to transfer water, wherein the first one will transfer sea water to said central reservoir and the second will transfer distillated water to said air water tank; and
- A sun tracker system used to adjust said parabolic light concentrator direction, means that parabolic light concentrator will turn toward the sun all during the day.

Claim 2- The method of claim 1 wherein the parabolic light concentrator can produce in a big size, means that heliostat (26) parts will be arranged around a central tower receiver (25).

Claim 3- The method of claim 1 wherein the turbine generator and air water tank can be excluded, means that wind turbine generators can be used instead of them in windy areas to provide the electrical energy needed during all 24 hours a day and cloudy days.

Claim 4- The transparent enclosure central reservoir according to claim 1 substantially as described is disposable and replaceable, means that residuals can be recycled in lateral industries.

Claim 5- The condenser and all said transmission pipelines according to claim 1 substantially as described have been made of poly urea, means that they will be anti-corrosion and anti-sediment and anti-sludge.

Claim 6- The apparatus according to claim 1 substantially as described can operate independently, means that the operation only based on using renewable energies.

Claim 7- The apparatus according to claim 1 substantially as described can be manufactured in different sizes, means that apparatus can be used to prepare fresh water in different quantities for drinking and agricultural and industrial usages.

Claim 8- The apparatus according to claim 1 substantially as described can operate during the nights and the days, means that apparatus can be used to prepare fresh water during 24 hours a day.

Drawings

[Fig. 1]

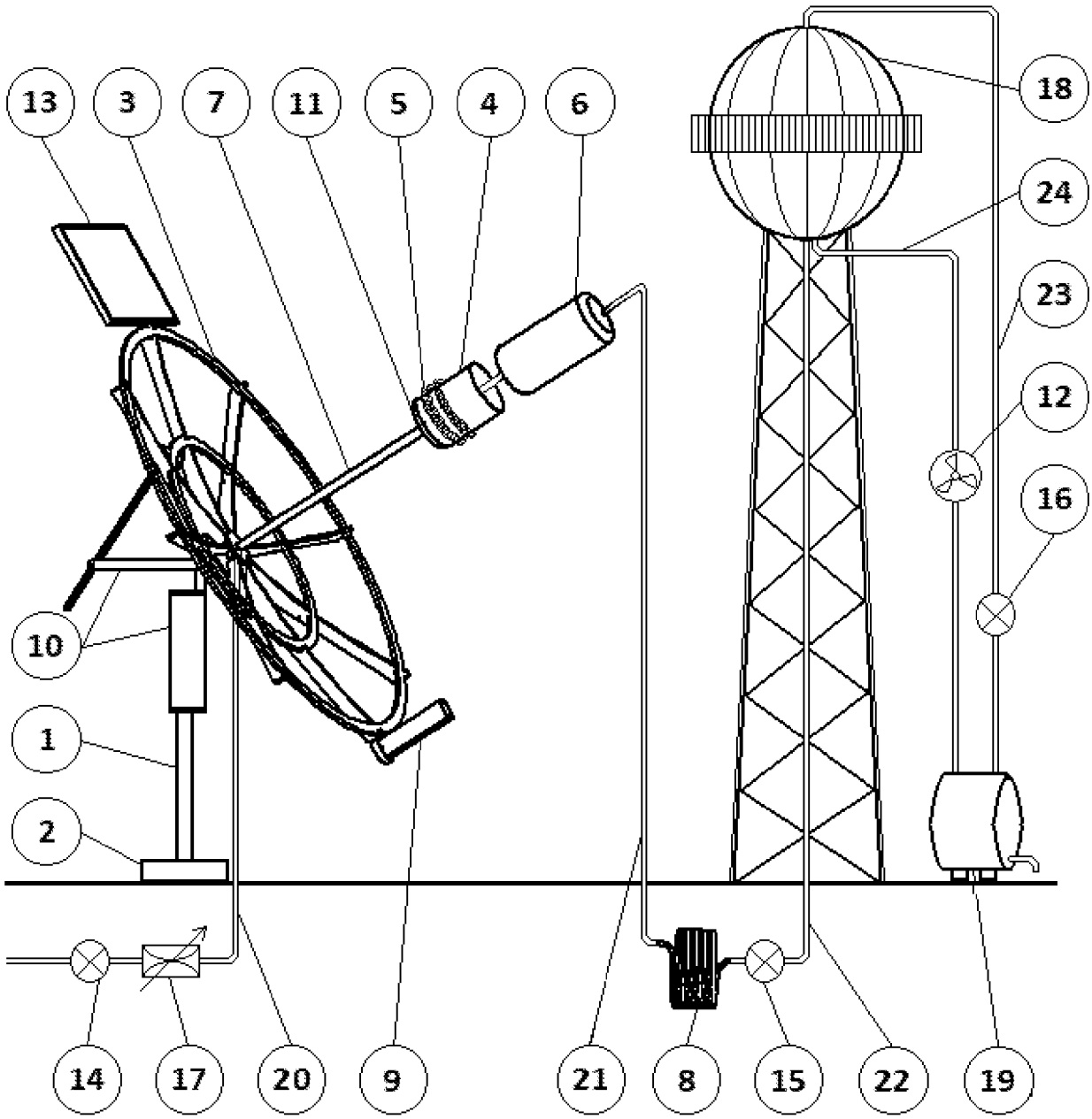

Fig. 1- Sea water purification apparatus in home size.

[Fig. 2]

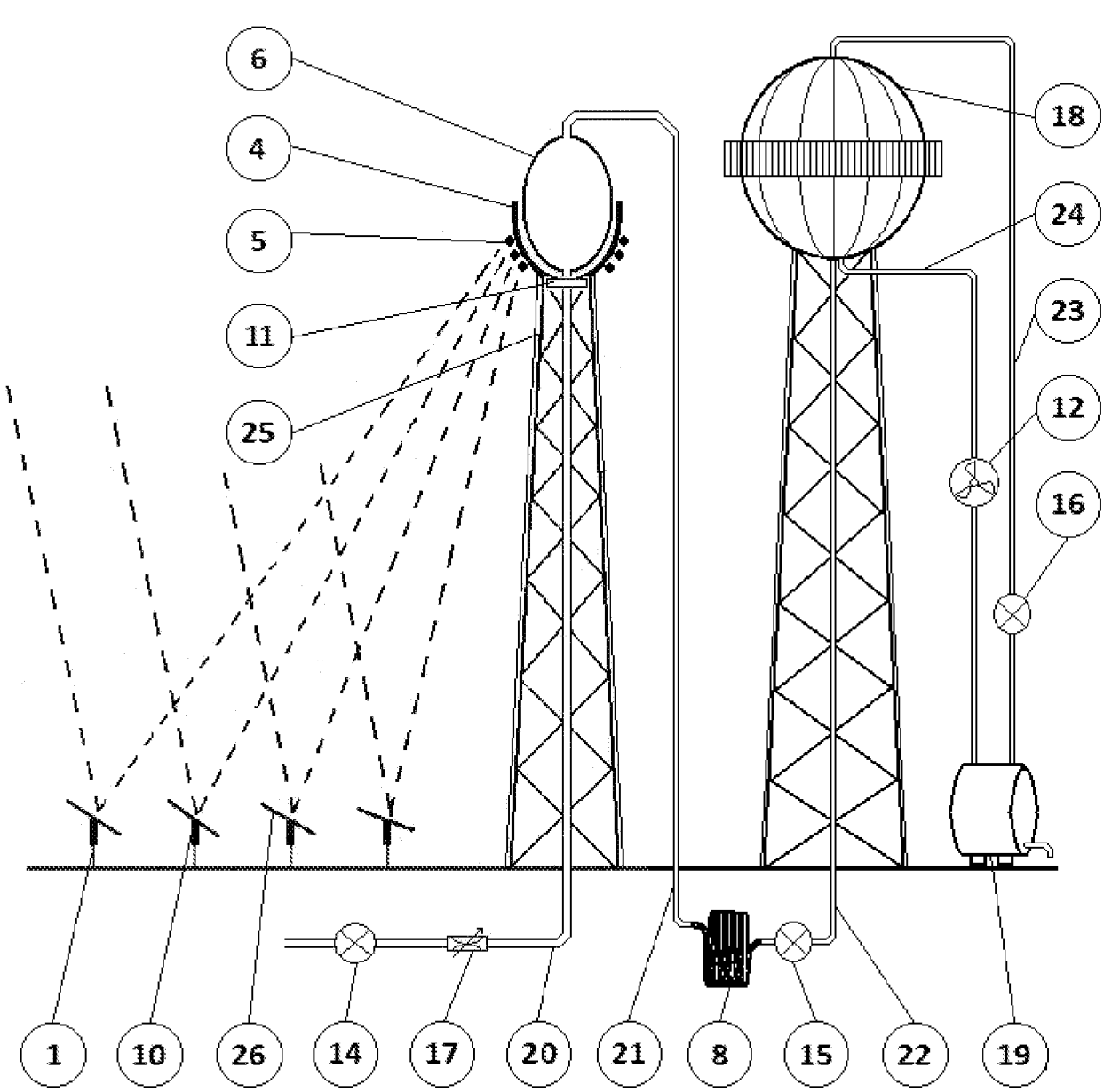

Fig. 2- Sea water purification apparatus in big size.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2018/056072

A. CLASSIFICATION OF SUBJECT MATTER
F24S23/71,C02F1/14 Version=2018.01

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)

F24S, C02F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

TotalPatent One, IPO Internal Database

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CN203728601U (NORTH CHINA ELECTRIC POWER UNIVERSITY) 23 July 2014 (23-07-2014) "NO FAMILY" Figs 1-2; abstract; claim 1;	1-8
Y	US9331258B2 (COLORADO SCHOOL OF MINES FOUNDATION INC) 03 May 2016 (03-05-2016) Claim-1; abstract;	1-8
Y	CN103595337A (ZHEJIANG UNIVERSITY OF COMMERCE AND INDUSTRY) 19 Feb 2014 (19-02-2014) "NO FAMILY" Fig. 2; abstract;	1-8
Y	CN102597649B (LIN HUA CONSULTING) 29 July 2015 (29-07-2015) para [0025]; Fig 1;	1-8
Y	CN103864164A (DU MANHE) 18 Jun 2014 (18-06-2014) "NO FAMILY" Abstract	3

☐ 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	Date of mailing of the international search report
16-11-2018	16-11-2018

Name and mailing address of the ISA/	Authorized officer
Indian Patent Office Plot No.32, Sector 14,Dwarka,New Delhi-110075 Facsimile No.	Dharmendra Pal Telephone No. +91-1125300200

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IB2018/056072

Citation	Pub.Date	Family	Pub.Date
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