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(54) JOHNSON EJECTOR WATER AND POWER GENERATOR

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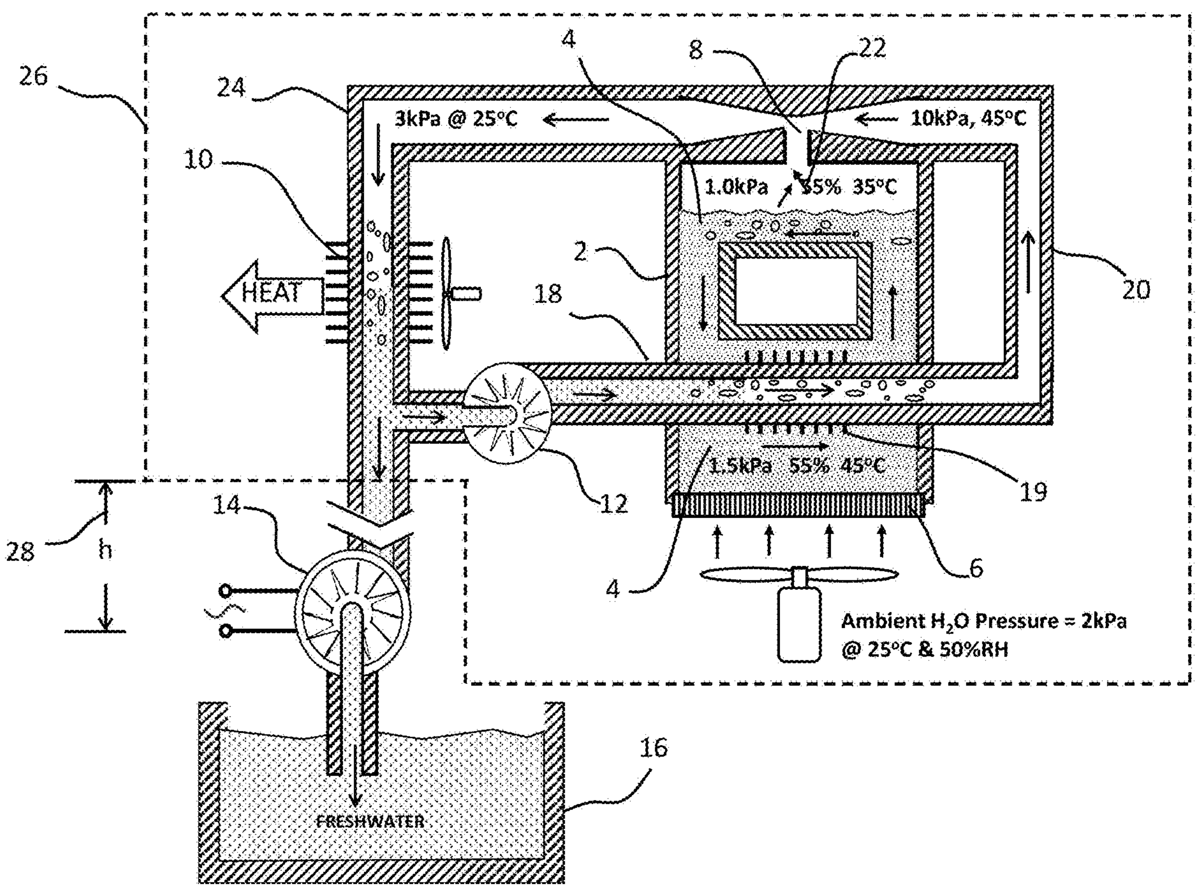
(57) **ABSTRACT**

An atmospheric water vapor extraction power generation device includes a hygroscopic solution, a hygroscopic solution reservoir, a circulation pump, a water vapor permeable barrier, a second evaporation heat exchanger, a first condensation heat exchanger, a steam ejector, a pressurized water driven generator, and condensed water reservoir. The pump supplies pressurized water flow thermally coupled to hygroscopic solution contained within reservoir. The hygroscopic solution absorbs moisture from ambient air through water vapor permeable barrier with the absorption of water, the hygroscopic solution decreases in density which causes it to rise towards the top of reservoir. Heat of ambient humidity condensation into the hygroscopic solution is coupled by second evaporation heat exchanger to the water contained within conduit. The heat of condensation of ambient humidity into solution is used as heat of evaporation of water contained within conduit to generate steam.



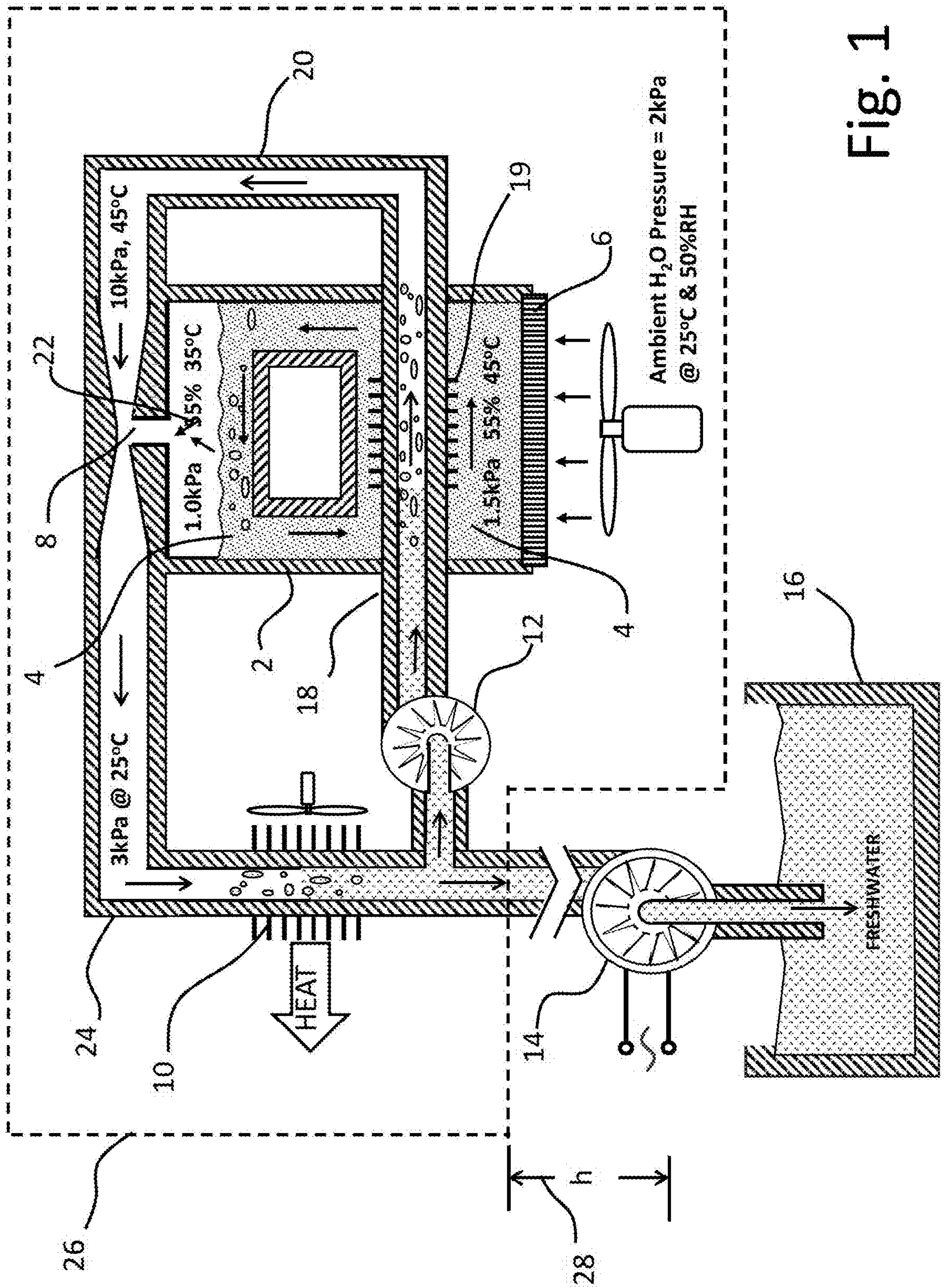

Ambient H_2O Pressure = 2kPa @ 25°C & 50%RH
10kPa, 45°C
3kPa @ 25°C
1.0kPa
55% 35°C
1.5kPa 55% 45°C
HEAT
FRESHWATER
h
2
4
6
8
10
12
14
16
18
19
20
22
24
26
28

Fig. 1

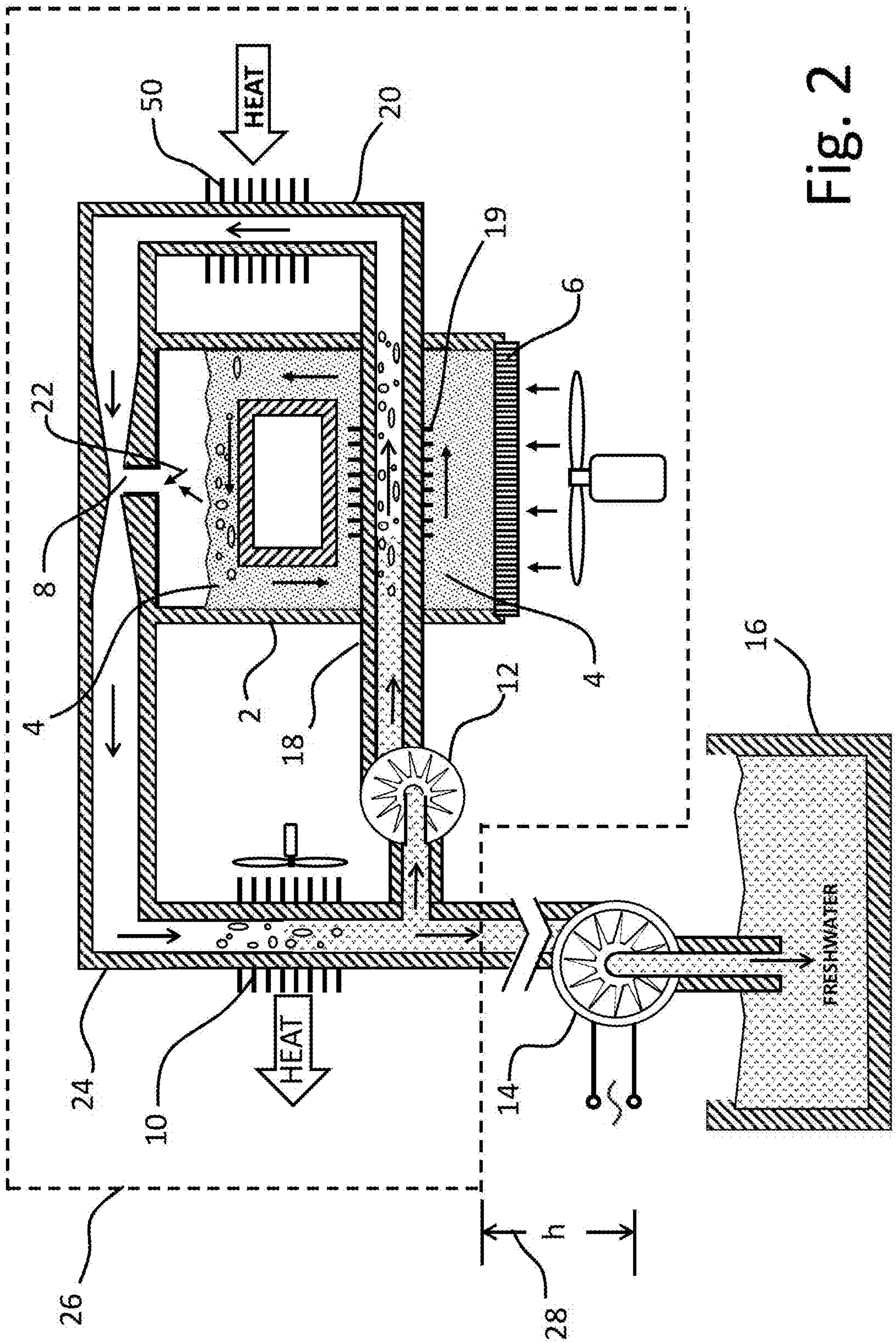


Fig. 2

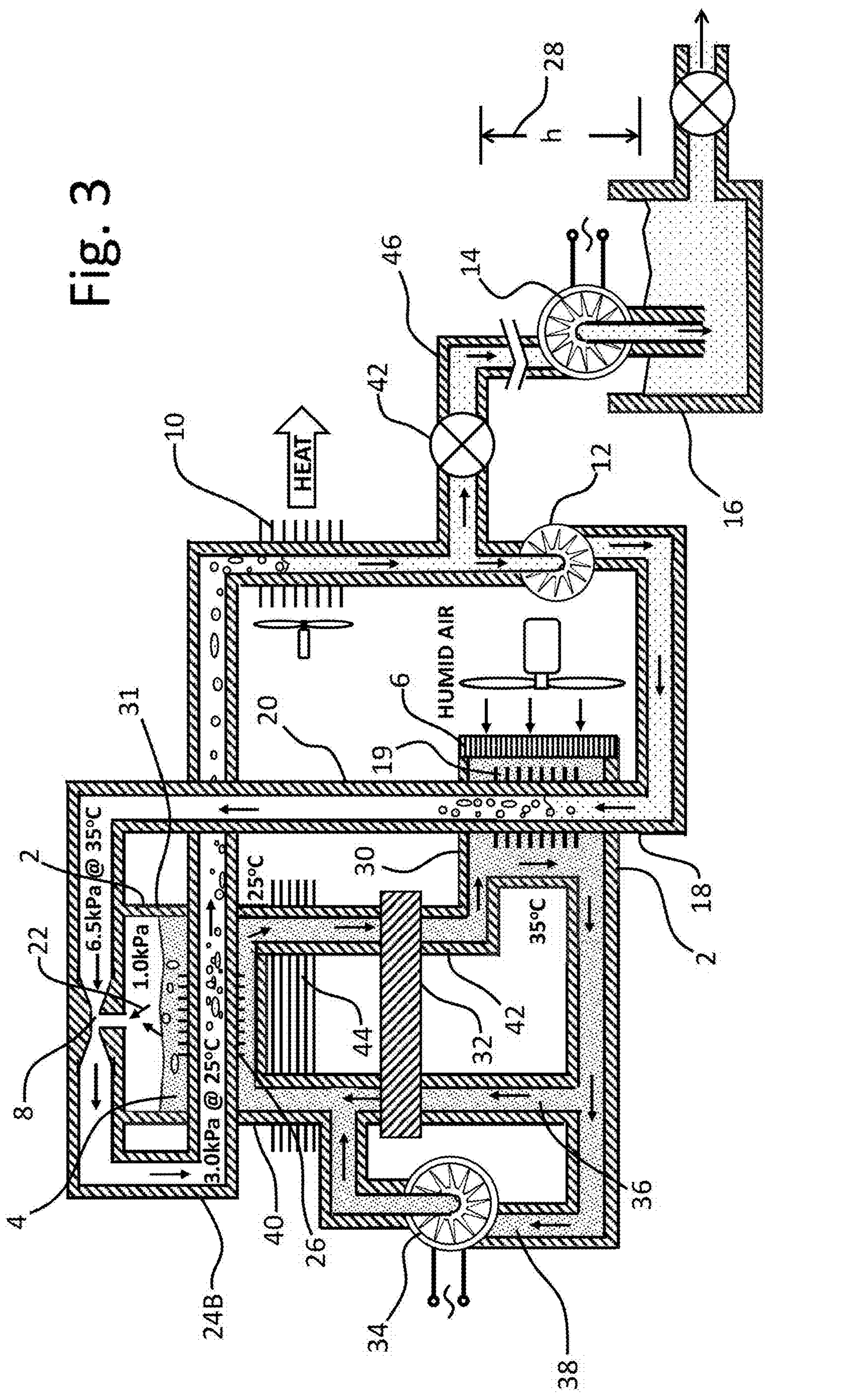
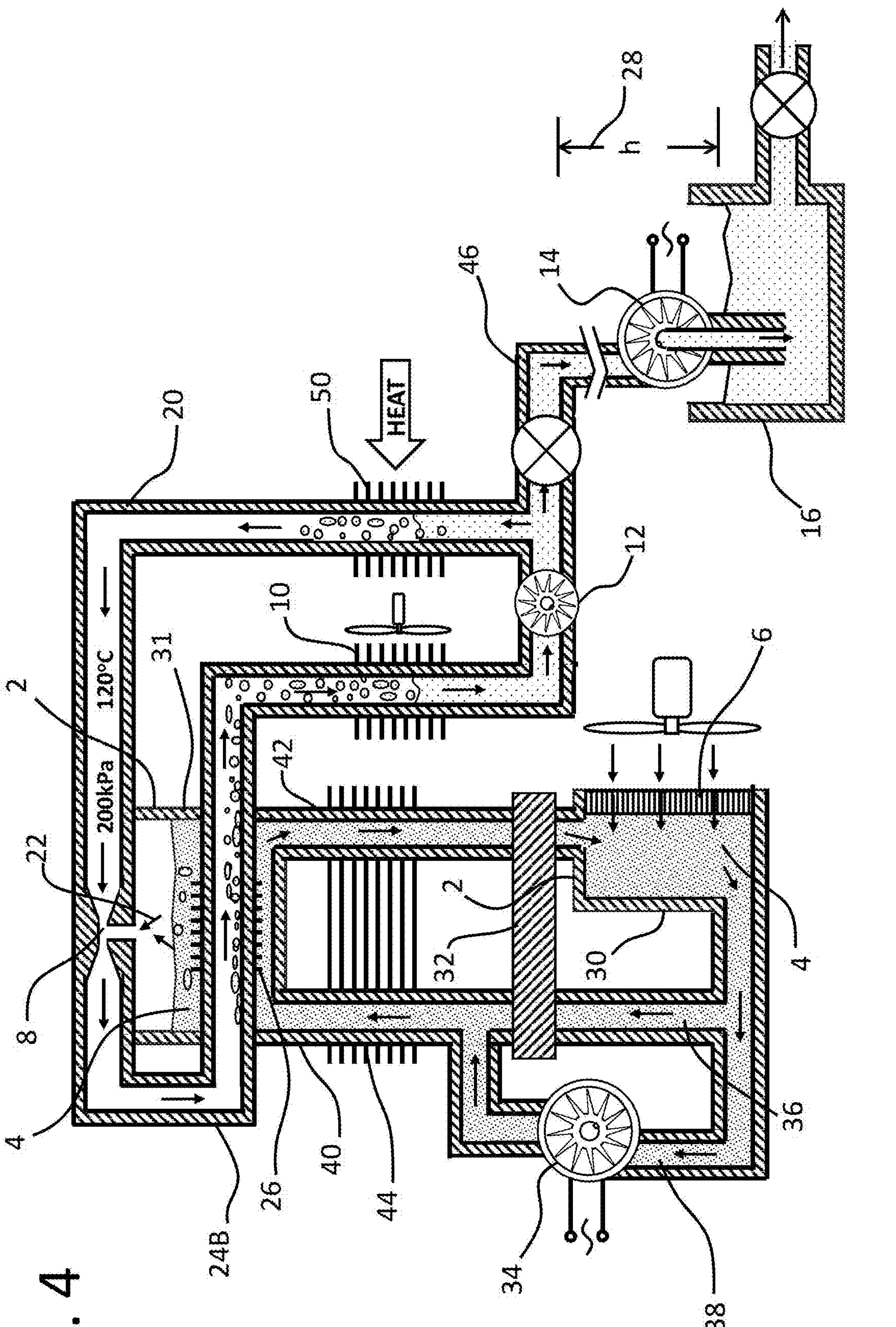

HEAT
HUMID AIR
6.5kPa @ 35°C
1.0kPa
3.0kPa @ 25°C
25°C
35°C
h
2
4
6
8
10
12
14
16
18
19
20
22
24B
26
28
30
31
32
34
36
38
40
42
44
46

Fig. 3



2
22
8
4
200kPa
120°C
31
20
50
HEAT
46
14
28
h
16
12
10
42
2
32
30
4
6
26
40
44
24B
34
36
38

Fig. 4

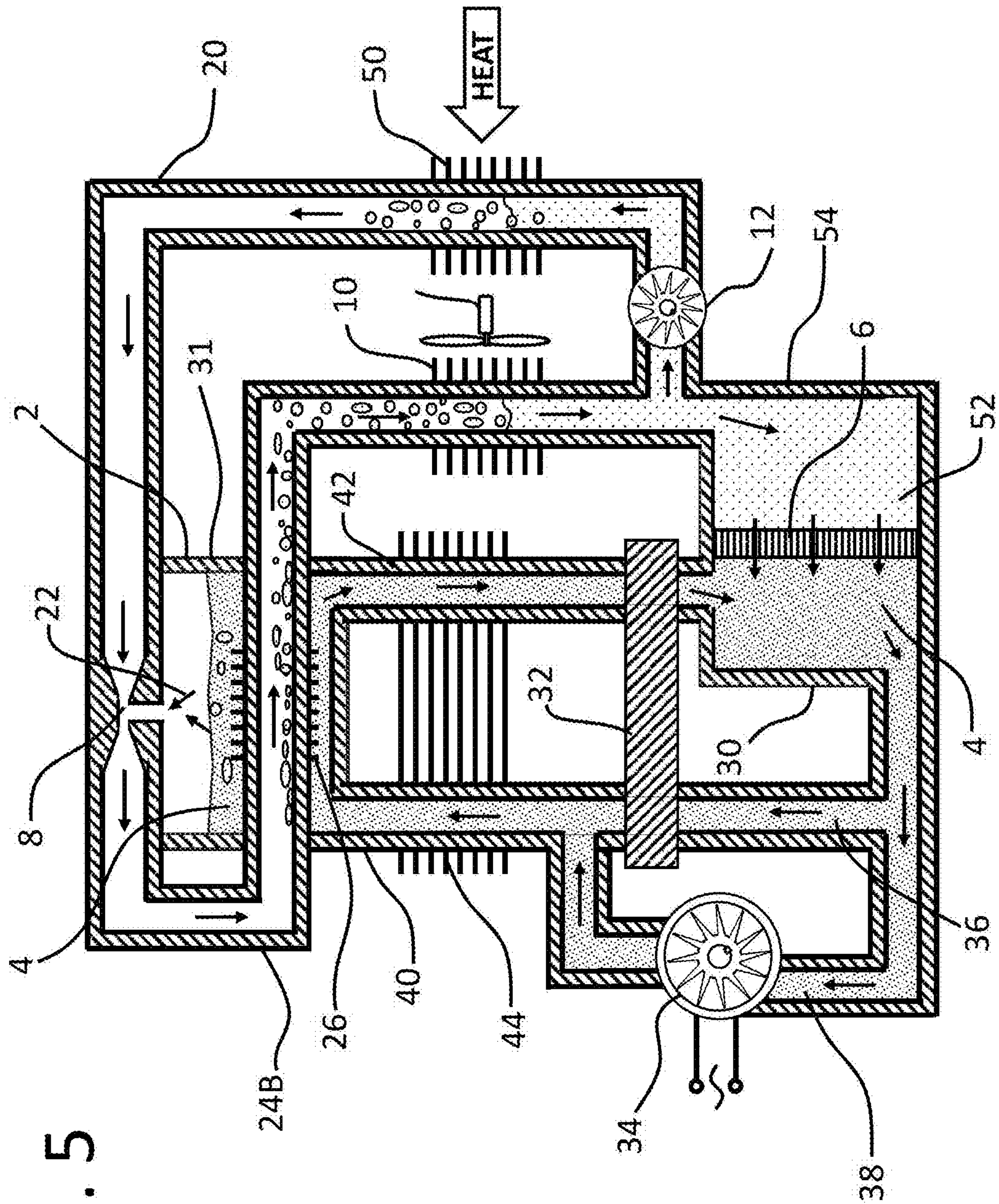


Fig. 5

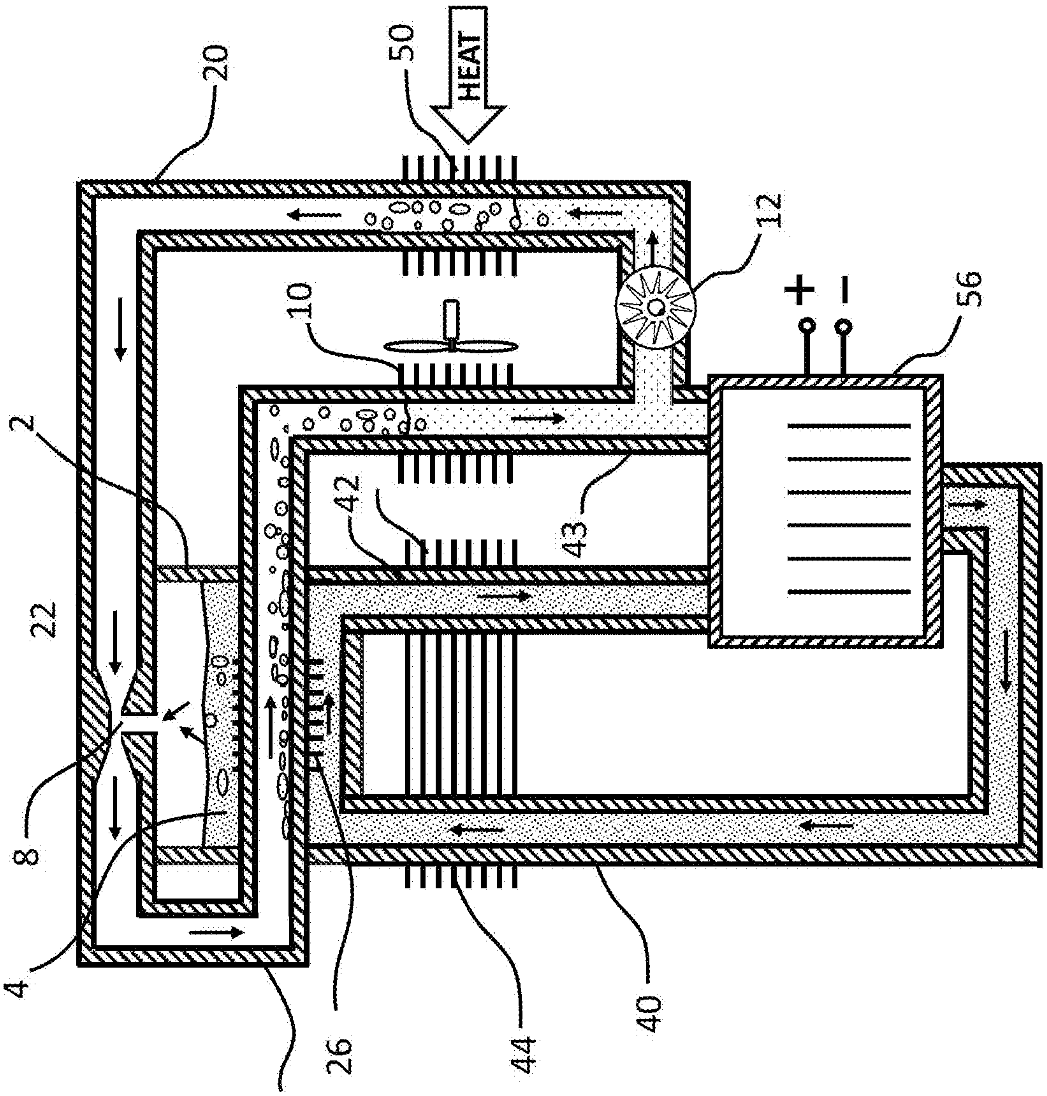
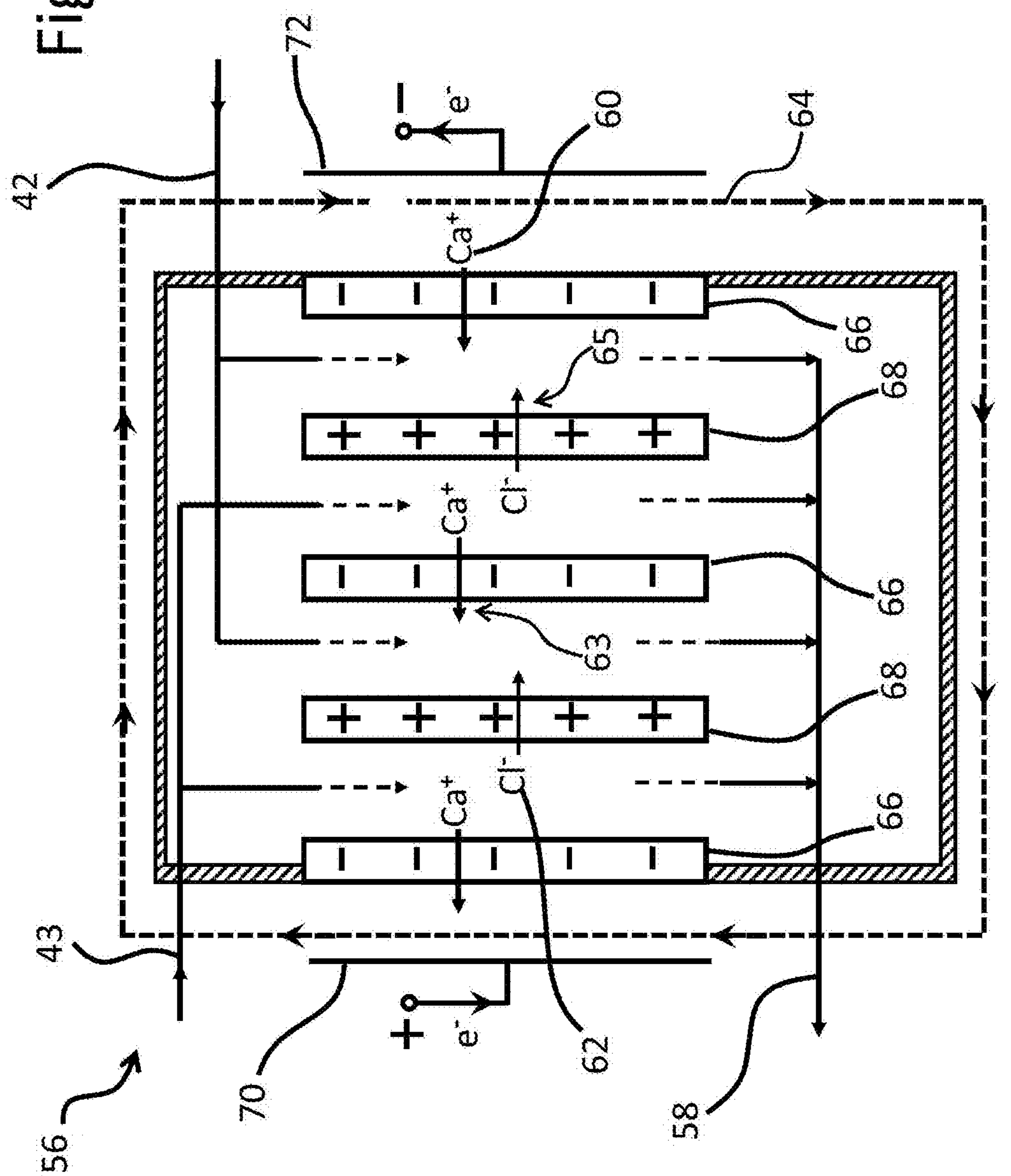


Fig. 6

Fig. 7



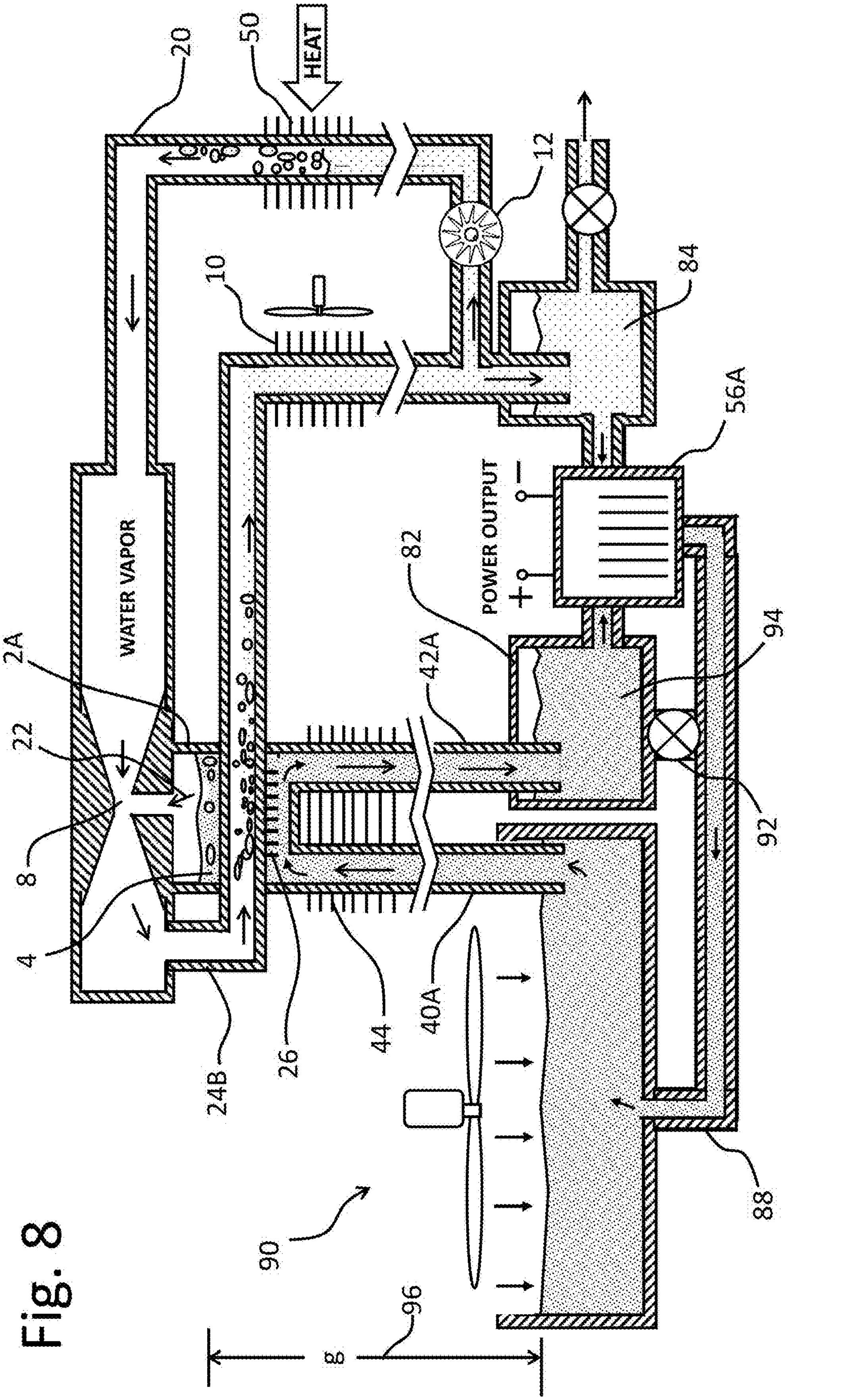

HEAT
WATER VAPOR
POWER OUTPUT
+
−
20
50
12
10
84
56A
82
42A
94
2A
22
8
4
24B
26
44
40A
92
88
90
96
g

Fig. 8

JOHNSON EJECTOR WATER AND POWER GENERATOR

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] Applicant claims the benefit of U.S. Provisional Patent Application Ser. No. 63/626,185 filed Jan. 29, 2024 and entitled "Johnson Ejector Water and Power Generator".

SUMMARY OF THE INVENTION

[0002] The present invention uses a hygroscopic solution to condense atmospheric water in combination with a steam ejector driven distillation process to extract the water from the solution and a pressure retarded osmosis power generator to produce freshwater and electrical power. The steam ejector creates a pressure differential that enables recuperation of heat of condensation from steam exiting the distillation process for use as heat of evaporation of water from the hygroscopic solution. There are numerous applications where an inexpensive device that extracts water from the ambient atmosphere would be useful. Applications range from supplying power and water for farm irrigation, power and freshwater in geographically remote locations where power and freshwater is scarce, to reducing the grid load of buildings for HVAC and other applications. The heat to drive the process may be provided from a range of sources depending on the application including geothermal, solar or waste heat such as that released by industrial processes. The invention can be used for large scale production of drinking water in arid climates or supplying dry air to buildings, solar could be an attractive heat source. On the other hand, waste heat from cooking stoves could be used for production of water in smaller scale applications such as watering household flower plants or building dehumidification.

FIELD OF THE INVENTION

[0003] The present invention relates, in general, to an improved power generator and ambient water condenser device, system and method. More specifically, the present invention relates to improved power generation and ambient humidity condenser apparatuses, assemblies, methods, and systems having components operative in an enclosed environment wherein all components are placed in an enclosed space configured to provide potable water extracted from ambient air.

BACKGROUND OF THE INVENTION

[0004] Although the Earth's surface is approximately seventy-one percent water, over ninety-five percent of this water is found in oceans making it non-potable. The remaining approximately fifteen percent of the Earth's water exists as water vapor, in rivers, in lakes, in icecaps, in glaciers, in ground water, and in aquifers. With the Earth's population exceeding seven billion people, there is an increasing need to provide sources of fresh potable water, especially in arid climates and underdeveloped areas with limited access to water.

[0005] Atmospheric humidity condensers utilizing are a known art for extracting water from the ambient atmosphere. However, many of these systems are expensive requiring bulky inefficient components operating in sizable water condensation systems. The predominant process for extracting water from ambient air is by use of electrical energy driven refrigeration cycles which consume very large amounts of energy. Other solutions include water distillation and reverse osmosis systems for harvesting water from salty ocean or sea water and fog harvesters that are used specialized membranes to collect potable water ambient air. In general, these solutions are quite cumbersome, inefficient, and expensive as well. None of them produce electricity during the condensation process. In fact, a major challenge with existing systems is associated with the large amounts of energy required for their operation. The energy challenge is made even more difficult by the existing global need to reduce dependance on fossil fuels for power generation.

[0006] Accordingly, there remains a need for improved, efficient, inexpensive atmospheric water extraction system that generates electrical power at the same time. This need and other needs are satisfied by the various aspects of the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. **1** is a schematic view of the atmospheric water vapor extraction power generation device embodying principles of the invention in a preferred form.

[0008] FIG. **2** is a schematic view of the atmospheric water vapor extraction power generation device embodying principles of the invention in another preferred form.

[0009] FIG. **3** is a schematic view of the atmospheric water vapor extraction power generation device embodying principles of the invention in another preferred form.

[0010] FIG. **4** is a schematic view of the atmospheric water vapor extraction power generation device embodying principles of the invention in another preferred form.

[0011] FIG. **5** is a schematic view of the atmospheric water vapor extraction power generation device embodying principes of the invention in another preferred form.

[0012] FIG. **6** is a schematic view of the atmospheric water vapor extraction power generation device embodying principles of the invention in another preferred form.

[0013] FIG. **7** is a schematic view of the atmospheric water vapor extraction power generation device embodying principles of the invention in another preferred form.

[0014] FIG. **8** is a schematic view of the atmospheric water vapor extraction power generation device embodying principes of the invention in another preferred form.

DETAILED DESCRIPTION AND PREFERRED EMBODIMENT

[0015] FIG. **1** shows an atmospheric water vapor extraction power generation device that is representative of the present invention. The basic device consists of hygroscopic solution **4**, hygroscopic solution reservoir **2**, circulation pump **12**, water vapor permeable barrier **6**, second evaporation heat exchanger **19**, first condensation heat exchanger **10**, steam ejector **8**, pressurized water driven generator **14**, and condensed water reservoir **16**.

[0016] Pump **12** supplies pressurized water flow to conduit **18** which is thermally coupled to hygroscopic solution **4** contained within reservoir **2**. Hygroscopic solution **15** absorbs moisture from ambient air through water vapor permeable barrier **6**. With absorption of water, the hygroscopic solution decreases in density which causes it to rise towards the top of reservoir **2**. Heat of ambient humidity condensation into the hygroscopic solution is coupled by second evaporation heat exchanger **19** to the water contained within conduit **18**. The heat of condensation of ambient humidity into solution **4** is used as heat of evaporation of water contained within conduit **18** to generate steam. The resulting steam is supplied to ejector **8** by conduit **20**. High pressure steam supplied to ejector **8** evacuates water vapor from hygroscopic solution contained in reservoir **2**, section **31** in this configuration. The resulting pressurized steam is coupled to ejector **8** by conduit **20**. The flow of steam through ejector **8** creates a low pressure above solution **4** within reservoir **2** resulting in evaporation of water from the solution as indicated by arrows **22**. Evaporation of water from the solution within reservoir **2** causes it to cool and increase in concentration. The solution becomes more dense and more hygroscopic. The dense solution flows back to barrier **6** where it once again absorbs ambient moisture as the process continues. The mixture of motive steam supplied by conduit **20** plus extracted steam from reservoir **2** exiting ejector **8** is supplied to first condensing heat exchanger **10** by conduit **24**. Pump **12** supplies a portion of the water condensed in heat exchanger **10** to conduit **18** to maintain a continuous process. The additional water extracted from ambient by the hygroscopic solution is supplied to gravitational pressure head driven generator **14**. Preferably, portion **26** of the invention is mounted at some height "h" above generator **14** as indicated by arrows **28**. Water condensed in heat exchanger **10** is supplied to water turbine **14** under gravitational pressure head. The efficiency of such a system is not limited to Carnot because the water within the column is extracted from the atmosphere at height and therefore does not have to be considered in the efficiency calculation. Solar driven ambient air circulation does the work in carrying the water to the top of the converter. The net power output depends primarily on the height above generator **14** at which section **26** is mounted. Fresh condensed water collected in reservoir **16** is available for external consumption.

[0017] FIG. **2** illustrates the inclusion of heat source heat exchanger **50** to supply additional energy to steam supplied to ejector **8** to achieve increased performance. The higher pressure superheated steam increases the velocity through the throat of ejector **8** to achieve a greater vapor hygroscopic solution pressure differential between the absorption interface at permeable barrier **6** and its evaporation interface at ejector **8**.

[0018] Referring now to FIG. **3**, hygroscopic reservoir **2** has been expanded to include evaporation reservoir section **30** and condensation reservoir section **31** with a pressure retarded osmosis power generator coupled in between. As previously described, pump **12** supplies pressurized water through conduit **18** to hygroscopic solution **4** contained within reservoir **2**, section **30** in this configuration. Heat of condensation of ambient humidity into hygroscopic solution **4** is coupled by second evaporation heat exchanger **19** to the water contained within conduit **18**. The heat of condensation of ambient humidity into solution **4** is used as heat of evaporation of water contained within conduit **18** to generate steam. The resulting steam is supplied to ejector **8** by conduit **20**. High pressure steam supplied to ejector **8** evacuates water vapor from hygroscopic solution contained in reservoir **2**, section **31** in this configuration. Conduit **24**B couples steam flow from the ejector to heat exchanger **26** which thermally couples the steam flow to the hygroscopic solution contained within section **31**. In this configuration, the heat of condensation released by water condensing within conduit **18** is used as heat of evaporation for water evaporating from solution **4** contained within reservoir **2** section **31**. The mixture of motive steam supplied by conduit **20** plus extracted steam from reservoir **2** exiting ejector **8** is supplied to condensing heat exchanger **10** by conduit **24**. Pump **12** supplies a portion of the water condensed in heat exchanger **10** to conduit **18** to maintain a continuous process. The additional water extracted from ambient by the hygroscopic solution is supplied to pressure driven generator **14**. Preferably, portion **26** of the invention is mounted at some height "h" above generator **14** as indicated by arrows **28**. Water condensed in heat exchanger **10** is supplied to water turbine **14** under gravitational pressure head. It is subsequently available for external consumption. Electrical power and water are continuously produced as water is condensed from air passing through barrier **6** into solution **4** and subsequently extracted from solution **4** by ejector **8**.

[0019] Pressure retarded osmosis driven electrical generator **34** and pressure exchanger **32** are fluidically coupled between section **30** and **31** of hygroscopic solution reservoir **2**. Reservoir section **30** operates at a higher pressure relative to reservoir section **31**. The pressure differential is applied across osmosis pressure generator **34** and pressure exchanger **32**. An elevated pressure in condensation section **30** relative to evaporation section **31** is maintained as moisture condenses into section **31** and evaporates from section **31**. Moisture entering section **30** through vapor permeable barrier **6** increases the volume of the solution contained in that section. The increased volume leaves section **30** by passing through pressure exchanger **32** and turbine generator **34**. The volume of fluid flowing through conduit **32** from low section **31** through pressure exchanger **32** to section high pressure section **30** is essentially equal to the volume of solution flowing in the opposite direction, through conduit **36** from high pressure section **30** through pressure exchanger **32** to low pressure section **31** to high pressure section **30**. Sufficient energy is exchanged within pressure exchanger **32** to substantially maintain the pressure differential as solution circulates between the two sections of reservoir **2**. The excess volume of solution resulting from water absorption into solution **4** through water vapor permeable barrier **6** is supplied to passes through conduit **38** to generator **34**. Generator **34** generates electricity operating on the pressure difference between fluid flowing therethrough from high pressure section **30** to low pressure section **31**.

[0020] Water condensed within heat exchanger **12** is supplied to water pressure generator **14** under gravitational pressure head produced at water column height h as indicated by arrows **28**. The efficiency of such a system is not limited to Carnot because the water within the column is extracted from the atmosphere at height and therefore, does not have to be considered in the efficiency calculation. The solar driven ambient air circulation does the work in carrying the water to the top of the converter.

[0021] FIG. **4** shows an embodiment of the invention for atmospheric water vapor extraction power generator that operates on external heat source **50**. It includes hygroscopic solution **4**, hygroscopic solution reservoir **2**, pressure exchanger **32**, pressurized fluid powered generator **34**, recuperative heat exchanger **44**, ejector **8**, heat output heat exchanger **10**, heat input heat exchanger **50** and pump **12**. Hygroscopic solution circulation conduits **40** and **42** couple hygroscopic solution flow between low pressure section **31** and high-pressure section **30** of reservoir **2**. Conduit **40**

couples flow from section **30** through pressure exchanger **32** and generator **34** to section **31**. Conduit **42** couples flow from section **31** through pressure exchanger **32** to section **30**. Conduits **40** and **42** carry their respective flows through recuperative heat exchanger **44**. The water and power generator further includes a freshwater circulation loop that includes pump **12**, heat exchanger **50**, conduit **20**, ejector **8**, conduit **24**B, heat exchanger **26**, and heat exchanger **10**.

[0022] During operation, pressure exchanger **32** supplies concentrated (water depleted), pressurized, hygroscopic solution **4** to high pressure section **30** of reservoir **2**. Water vapor permeable barrier **6** functions as a solution to ambient interface. Solution **4** attracts water vapor from ambient through water vapor permeable barrier **6**. The volume of the pressurized solution increases as ambient water vapor condenses into it. The absorption results in sufficient pressurized solution volume to power pressure exchanger **32** to continuously repressurize water depleted solution leaving section **31** as well as power pressure driven generator **34**. Low-pressure, diluted (water rich) solution leaving generator **34** and exchanger **32** is supplied by conduit **40** to low pressure section **31** of reservoir **2**.

[0023] Pump **12** supplies pressurized water to heat source **50** whereby the water is converted into steam and supplied at high pressure through conduit **20** to ejector **8**. Steam flow through the throat of ejector **8** creates low pressure which draws vapor from water rich solution contained in section **31** of reservoir **2** to maintain a low pressure therein. Steam exiting ejector **8** slows to low speed and increases in pressure as it enters conduit **24**B. The increased pressure steam condenses inside recuperative heat exchanger **26** as its heat of condensation is transferred to hygroscopic solution **4** in section **31** for consumption as heat of evaporation of steam therefrom. Ejector **8** evaporates water from the low vapor pressure hygroscopic solution and condenses it at the higher pressure of freshwater contained in heat exchanger **26**. Remaining steam leaving heat exchanger **26** condenses as it passes through heat exchanger **10** with its heat of condensation being rejected to ambience. The resulting fully liquid fresh water is supplied to pump **12** and the resulting water depleted hygroscopic solution is pumped to high pressure by pressure exchanger **32** and supplied to section **30** of reservoir **2** as the process continues.

[0024] FIG. **5** shows a closed configuration of the invention that does not utilize ambient water vapor or output freshwater. Fresh water reservoir **54** is fluidically coupled between water permeable barrier **6** and condenser heat exchanger **10**. Except for the addition of reservoir **54**, the components of invention operate as previously described. Reservoir **54** supplies freshwater extracted from solution **4** by ejector **8** back to high pressure solution **4** contained in reservoir section **30** for reabsorption. In this configuration, the invention functions as a heat engine operating on heat input at the temperature of heat source **50** and heat rejection and the temperature of heat sink **10** to produce the electrical power output by generator **34**.

[0025] FIG. **6** illustrates a configuration of the invention where the pressure retarded osmoses generator is replaced by a reverse electrodialysis converter that generates power from water concentration difference between concentrated (water depleted) hygroscopic solution supplied by conduit **42** and freshwater (substantially pure water) supplied condenser heat exchanger **10**. The mixed solution that results from the power generation process is supplied to hygroscopic solution reservoir **2** by conduit **40**.

[0026] FIG. **7** illustrates operation of a representative reverse electrodialysis cell representative of cell **52**. In this example, the hygroscopic solution is aqueous calcium chloride ($CaCl:H_2O$). Positive ion conductors **66** and negative ion conductors **68** are interleaved to form the electrodialysis stack. For a given application, the number of interleaved conductors are selected to achieve a desired voltage. As illustrated, conduit **43** supplies concentrated salt solution to the space between electrode pairs sequenced with a negative electrode **66** to the left and a positive electrode **68** to the right. On the other hand, conduit **42** supplies substantially pure water to the space between pairs sequenced with a negative electrode **66** to the right and a positive electrode **68** to the left. A voltage potential is generated with current under the salt concentration differential as positive calcium ions **60** and negative chlorine ions **62** are conducted through positive ion conductors **66** and negative ion conductors **68** respectively. Electrolyte **64** is circulated between electrodes **70** and **72** to maintain concentration equilibrium between the two electrodes.

[0027] FIG. **8** shows an embodiment of the invention for atmospheric water vapor extraction power generator that operates on external heat source **50**. Reverse electrodialysis (RED) cell **56**A generates electrical power from the salt concentration differential between freshwater and concentrated hygroscopic salt solution. It includes hygroscopic solution **4**, hygroscopic solution reservoir **2**A, pressure exchanger **32**, pressurized fluid powered generator **34**, recuperative heat exchanger **44**, ejector **8**, heat output heat exchanger **10**, heat input heat exchanger **50** and pump **12**. It further includes concentrated solution reservoir **82**, aeration reservoir **90** reverse electrodialysis stack **56**A and freshwater storage reservoir **84**.

[0028] Conduit **42**A couples water depleted solution flow from evaporation reservoir **2**A through heat exchanger **44** to concentrated solution reservoir **82**. Conduit **40**A couples water rich solution flow from aeration reservoir **90** through heat exchanger **44** to evaporation reservoir **2**A. The water and power generator further includes a freshwater circulation loop that includes pump **12**, heat exchanger **50**, conduit **20**, ejector **8**, conduit **24**B, heat exchanger **26**, and heat exchanger **10**.

[0029] During operation, solution **4** attracts and condenses water vapor from ambient air while flowing through aerator **90**. The resulting water rich, lower density solution **4** flows through conduit **40**A to evaporation chamber **2**A.

[0030] Pump **12** supplies pressurized water to heat source **50** whereby the water is converted into steam and supplied at high pressure through conduit **20** to ejector **8**. Steam flow through the throat of ejector **8** creates low pressure which draws vapor from water rich solution contained in section **31** of reservoir **2** to maintain a low pressure therein. Steam exiting ejector **8** slows to low speed and increases in pressure as it enters conduit **24**B. The increased pressure steam condenses inside recuperative heat exchanger **26** as its heat of condensation is transferred to hygroscopic solution **4** in reservoir **2**A for consumption as heat of evaporation of steam therefrom. Ejector **8** evaporates water from the low vapor pressure hygroscopic solution and condenses it at the higher pressure of freshwater contained in heat exchanger **26**. Any remaining steam leaving heat exchanger **26** condenses as it passes through heat exchanger **10** as its heat of condensation is rejected to ambience. The resulting fully liquid fresh water is supplied to reservoir **84** where it accumulates with a portion of it drawn off by pump **12** as the process continues. The process results in accumulation and storage of fresh water within reservoir **84** as water vapor is condensed from ambient. The resulting water depleted concentrated hygroscopic solution leaving evaporation reservoir **2**A is coupled through conduit **42**A to concentrated solution reservoir **82** where it is accumulated and stored. Water depleted (concentrated) hygroscopic salt solution **94** and condensed (substantially pure) water from reservoir **84** are supplied to reverse electrodialysis cell stack **56**A. Stack **56**A uses the salt concentration differential to generate electrical power. The less concentrated solution resulting from the process is supplied by conduit **88** back to aeration reservoir **90** to capture more moisture. Excess water can be made available for external use by activating valve **92** to bypass the RED stack **56**A to supply depleted solution directly to aeration reservoir **90** so that freshwater accumulated in reservoir **84** can be off boarded for other use. The configuration has the additional benefit of energy storage capacity. Fresh water and concentrated salt solution accumulates within reservoirs **84** and **82** respectively can be stored and drawn out on an as needed bases to generate power.

I claim:

1. A freshwater generator comprising:

a hygroscopic solution;

an ejector;

a water permeable barrier, and

a supply of steam,

wherein the hygroscopic solution circulating between the water permeable barrier and the ejector, whereby the solution absorbs moisture through the barrier and releases it to the ejector, the ejector being driven by steam to extract water vapor from the hygroscopic solution, and the water permeable barrier permitting water to enter into the hygroscopic solution while preventing passage of solution therethrough.

2. A freshwater generator as disclosed by claim **1** wherein the generator further includes a reverse electrodialysis electrical power generator, the concentrated hydroscopic solution resulting from extraction of water therefrom by the ejector being supplied to the electrodialysis generator, the freshwater extracted by the ejector being supplied to the electrodialysis generator, the electrodialysis generator operating power using the solution concentration differential between the fresh water and the concentrated solution.

3. A freshwater generator as disclosed by claim **2** wherein concentrated hydroscopic solution resulting from extraction of water therefrom by the ejector is stored in a concentrated solution storage reservoir and the freshwater extracted by the ejector is stored in a freshwater storage reservoir, the freshwater and concentrated solution being supplied to the electrodialysis generator when power is needed.

4. A freshwater generator as disclosed by claim **1** wherein the generator further includes a first condensation heat exchanger, the heat exchanger being coupled to the exit of the ejector and operating to remove heat of condensation from steam passing therethrough for condensation thereof.

5. A freshwater generator as disclosed by claim **1** wherein the generator further includes a second evaporation heat exchanger, the second heat exchanger being coupled to the hygroscopic solution and coupling water flow therethrough from the pump whereby heat of evaporation of water therein is supplied by water condensing into the solution from ambient.

6. A freshwater generator as disclosed by claim **1** wherein the generator further includes a third source heat exchanger, the second heat exchanger being coupled to the hygroscopic solution and coupling water flow therethrough from the pump whereby heat of evaporation of water therein is supplied by water condensing into the solution from ambient.

7. A freshwater generator as disclosed by claim **4** wherein the generator further includes a pressurized water flow driven electric power generator, the generator being coupled to the heat exchanger and positioned a distance below the heat exchanger such that water condensed in heat exchanger is supplied to the power generator under a gravitational pressure head.

8. A freshwater generator as disclosed by claim **1** wherein the water permeable barrier couples the solution to ambient air whereby the solution absorbs ambient humidity.

9. A freshwater generator as disclosed by claim **1** wherein the water permeable barrier couples the solution to water extracted by the ejector.

10. A freshwater generation comprising:

an ejector;

a pressure exchanger;

a supply of steam;

a hygroscopic solution;

a pressure retarded osmosis barrier;

a pressure exchanger, and

a second pressurized water flow driven electric power generator,

wherein the hygroscopic solution circulating between the osmosis barrier and the ejector, whereby it extracts moisture through the pressure retarded osmosis barrier and releases it to the ejector, the ejector being driven by the steam to extract water vapor from the hygroscopic solution, the water permeable barrier permitting water enter into the hygroscopic solution from while preventing passage of solution therethrough, the pressure exchanger and pressurized water flow driven electric power generator being coupled between the ejector with a solution pressure differential being applied across the two, the water permeable barrier supplying water to the higher pressure side of the generator and pressure exchanger, water condensing into the hygroscopic solution increases the volume thereof to a level sufficient to maintain the pressure differential an generate electrical power.

11. A freshwater generator as disclosed by claim **10** wherein the generator further includes a fourth recuperative heat exchanger, the recuperative heat exchanger being coupled to the hygroscopic solution and the exit of the ejector and coupling heat from steam leaving the ejector to the hygroscopic solution whereby the exiting steam condenses as it transfers heat of evaporation to the hygroscopic solution to evaporate water therefrom as the water vapor is extracted by the ejector.

12. A freshwater generator as disclosed by claim **10** wherein the generator further includes a first condensation heat exchanger, the heat exchanger being coupled to the exit of the ejector and operating to remove heat of condensation from steam passing therethrough for condensation thereof.

13. A freshwater generator as disclosed by claim **6** wherein the generator further includes a second evaporation heat exchanger, the second heat exchanger being coupled between the hygroscopic solution and the freshwater pump whereby ambient humidity condensing into the solution transfers heat of evaporation to the hygroscopic solution to evaporate water therefrom as the water vapor is extracted by the ejector.

14. A freshwater generator as disclosed by claim **10** wherein the generator further includes a third source heat exchanger, the second heat exchanger being coupled to the hygroscopic solution and coupling water flow therethrough from the pump whereby heat of evaporation of water therein is supplied by water condensing into the solution from ambient.

15. A freshwater generator as disclosed by claim **10** wherein the generator further includes a pressurized water flow driven electric power generator, the generator being coupled to the heat exchanger and positioned a distance below the heat exchanger such that water condensed in heat exchanger is supplied to the power generator under a gravitational pressure head.

16. A freshwater generator as disclosed by claim **10** wherein the water permeable barrier couples the solution to ambient air whereby the solution absorbs ambient humidity.

17. A freshwater generator as disclosed by claim **10** wherein the water permeable barrier couples the solution to water extracted by the ejector.

* * * * *