

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
24 January 2008 (24.01.2008)

PCT

(10) International Publication Number
WO 2008/010967 A2

(51) International Patent Classification:
F24J 2/42 (2006.01)

(21) International Application Number:

PCT/US2007/016074

(22) International Filing Date: 16 July 2007 (16.07.2007)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:

11/487,501

17 July 2006 (17.07.2006)

US

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(81) Designated States (*unless otherwise indicated, for every
kind of national protection available*): AE, AG, AL, AM,
AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH,
CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG,
ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL,
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TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA,
ZM, ZW.

(84) Designated States (*unless otherwise indicated, for every
kind of regional protection available*): ARIPO (BW, GH,
GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM,
ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),
European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI,
FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL,
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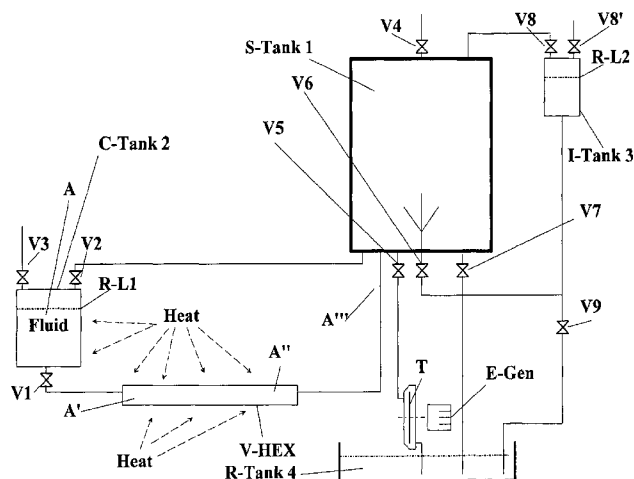
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— *without international search report and to be republished
upon receipt of that report*

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ance Notes on Codes and Abbreviations" appearing at the begin-
ning of each regular issue of the PCT Gazette.*

(54) Title: ELECTRICAL GENERATOR SYSTEMS AND RELATED METHODS



(57) Abstract: Various embodiments of electric generator systems are disclosed. The systems may include an electric generator whose energy source is provided by the displacement of a first fluid. The first fluid may be in a liquid state contained in a reservoir hydraulically connected to a first chamber. The first chamber may be configured to receive thermal energy utilized to convert the first fluid into a vapor. The system may also include a second chamber hydraulically connected to the first chamber to receive the vaporized fluid from the first chamber. The second chamber may be configured to condense the vaporized first fluid, causing depressurization in the second chamber. The system may be configured such that the depressurization of the second chamber may drive a second fluid through an energy converter (e.g. Turbine Generator) able to convert the first fluid condensing energy into mechanical or electrical energy. Alternatively, the system may be configured such that the depressurization of the second chamber may drive a third fluid into an energy converter (e.g. Expander) able to convert the fluid energy into mechanical or electrical energy.

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ELECTRICAL GENERATOR SYSTEMS AND RELATED METHODS

FIELD OF THE INVENTION

[001] The present invention relates to an electric generator driven by pressure differences induced by first superheating and later condensing a suitable fluid. In particular, the present invention relates to various energy producing devices (e.g., electric generators) that utilize heat energy, for example solar energy, to drive a thermodynamic process based on induced and controlled fluid specific volume contraction. Overall, the energy producing devices here described execute the conversion of heat energy into electric energy.

DESCRIPTION OF RELATED ART

[002] In all developed and most underdeveloped regions of the world, the demand for electric energy is increasing at accelerating rates. The cost of energy is also increasing as most of the energy producing systems operate by burning fossil fuels. Cost of fossil fuels is ever increasing and extremely volatile and burning these fuels produce green house gases, thereby contributing to global warming. Furthermore, many industrial processes reject significant amounts of low-grade heat into the environment, also contributing to global warming. Renewable energy sources such as wind, solar-photovoltaic, wave, tidal and others are promising but still posing serious difficulty for their deployment on a large scale. Furthermore, most of the technologies based on the conversion of renewable energy sources are still too expensive for broader commercialization. Low-grade heat is a form of thermal energy whose temperature differential, between the environmental temperature and that of the heat source (e.g. heat waste from industrial processes, solar etc.), is normally too low for an efficient cost-effective utilization. Furthermore, in many countries, mainly depending on geographic and climate conditions, an abundance of solar energy exists, and also low-grade heat discarded by industrial processes is also available. Therefore, it would be highly beneficial to be able to cost effectively use the low-grade heat from solar energy or any low-grade heat source to generate electricity.

[003] The possibility of utilizing solar energy as a useable source of energy has been widely explored, however the commercial diffusion of solar or low-grade heat driven generators has not been very successful. Most of the devices for

converting solar or low-grade heat energy to useable energy are very expensive, and too inefficient to justify large-scale investments.

[004] For example, various solar power driven mechanical and electrical devices have been widely used in the past. Some of these devices use solar generated heat-absorbing panels that convert the absorbed solar energy to heat water or other suitable fluids. The fluid in these devices is always kept in a sub-cooled liquid state, well below its boiling point. These devices are typically equipped with one (or more) electrically or mechanically driven pump(s) to force fluid circulation within the devices. Generally, these devices yield very low efficiency mainly due to their generally low thermal gradients. Most importantly, for their operation they rely on electricity for example to feed the recirculation electric pump. The main purpose of the heat absorbing panels in these devices is to absorb solar heat and transfer it to a fluid so as to heat up the fluid. The heated fluid is then circulated by a pumping device, typically driven by an external source of power, to transport the heat produced in the heat absorbing panel to locations where heat is needed (e.g. household radiators, or heating system). Therefore, the overall solar driven heating system utilizing these principles is normally unable to provide electricity and it actually requires an external source of electricity for its proper functioning.

[005] There have been some electric generator devices that utilize solar energy as a direct conversion of photon energy into electric current. These devices include a solar panel formed by so-called "photovoltaic cells" that convert solar rays directly into electricity. The electricity thus generated in the solar panel is then supplied to an electronic conditioner that converts the voltage and current from the photovoltaic cells into a form of electricity compatible with most appliances (e.g. electric motors, TV sets, etc.). Such electronic conditioners, however, are very expensive and decrease an overall already low photovoltaic cell efficiency. There are several types of solar cells, or photovoltaic cells. Most of the last decades have been dedicated to increase the photo-voltaic cell's efficiency and despite progress their recent market advancement has only been possible through heavy economic incentives.

[006] The main purpose of the present invention is to provide a technology that does not require costly manufacturing processes, that is inherently rugged, and

easy to maintain while converting low-grade heat energy into a usable form of energy in a cost effective manner.

SUMMARY OF THE INVENTION

[007] It is accordingly an object of the present invention to provide a more reliable and less expensive electric generator system by converting solar thermal energy, or low-grade heat energy from any source, to heat-up and condense a fluid system whose induced pressure variations are utilized to drive an electric generator.

[008] This may be achieved by utilizing one or more sources of heat (e.g. solar, waste heat from industrial processes, waste heat from household oil or gas burners, etc.) in which this thermal energy is utilized to convert for example water, or any other suitable fluid, into vapor. Subsequently, generated vapor may be condensed in a controlled manner so as to generate a controlled pressure-drop inside a properly designed tank. The system is arranged in such a way that the pressure-drop may cause displacement of a desired amount of fluid. While the fluid is displaced it may drive an electric generator. Alternatively, the system is configured in such a way that the pressure-drop may cause the expansion of another fluid (e.g. Air) through an expander, thereby generating electricity or torque

[009] To attain the advantages and in accordance with the purpose of the invention, as embodied and broadly described herein, one aspect of the invention provides means to utilize pressure differences to drive a turbine or a "positive-and-negative" displacement system, for example, to produce electricity or mechanical energy.

[010] Additional objects and advantages of the invention will be set forth in part in the description which follows, and in part will be obvious from the description, or may be learned by practice of the invention. Additional objects and advantages of the invention will be set forth in part in the description which follows, and in part will be obvious from the description, or may be learned by practice of the invention. The objects and advantages of the invention will be realized and attained by means of the elements and combinations particularly pointed out in the appended claims.

[011] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention, as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[012] The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate several embodiments of the invention and together with the description, serve to explain the principles of the invention.

[013] Fig. 1 is a schematic illustration of an electric generator system, according to an exemplary embodiment of the invention, illustrating an exemplary application of generating electricity by displacing a fluid.

[014] Fig. 2 is a schematic of an electric generator system, shown in Fig. 1, illustrating various components thereof and utilizing a turbine generator able to take advantage of fluid displacement back and forth from-and-to a fluid reservoir.

[015] Fig. 3 is a Temperature-Entropy (T-S) diagram illustrating various exemplary thermodynamic processes of the heat addition and induced condensation.

[016] Fig. 4 is a schematic of an electric generator system utilizing the expansion of air inside a specially designed tank within which a pressure differential has been induced by condensation according to an exemplary embodiment of the invention.

DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

[017] Reference will now be made in detail to the exemplary embodiments of the invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers or letters will be used throughout the drawings to refer to the same or like parts.

[018] The electric generator systems, according to an exemplary embodiment of the invention, utilize heat energy to displace a controlled volume of fluid (e.g., liquid), between different locations to cause a turbine-generator system to generate electricity. The system converts generally heat energy, for example solar energy, to vaporize (e.g., to a super-heated thermodynamic state) a working fluid inside one or more heat absorbing heat exchangers (i.e., referred hereinafter as Vapor-Heat Exchanger "V-HEX"). The system then condenses the vapor, by inducing sudden cooling inside a Super Tank (S-Tank) designed to sustain a vacuum as well as pressures above atmospheric pressure.

[019] Induced condensation of the vapor may be achieved by injecting vapor cooling liquids (e.g., in the form of spray, jets) into the vapor-filled S-Tank, or by

exposing the vapor filled inner portions of S-Tank to controlled cooling means. The timing, and degree, of the condensation processes may be controlled by adjusting, for example, the fluid injection timing, flow rate, and temperature of the cooling liquid. As heat and mass transfer occurs between the cooling liquid and the vapor, the vapor inside the S-Tank may be rapidly condensed, resulting in a pressure drop close to a vacuum. The S-Tank may be designed to withstand such a pressure drop as well as pressure above atmospheric pressures if the vapor accumulated becomes super-heated and pressurized. This pressure drop may be used in a variety of applications, including, for example, generating electricity.

[020] As is apparent, the electric generator systems of the present invention may utilize an unusual thermodynamic cycle. For example, while most thermodynamic cycles operate on the principle of fluid expansion to drive turbines or expanders, thereby converting the expansion energy of the fluid into mechanical energy, the electric generator system of the present invention may operate based on fluid "contraction." Although a fluid contraction cycle may be generally less efficient than the classical expansion cycles, such systems may be simpler to manufacture (i.e., thereby less expensive), may not quickly deteriorate with the passing of time, and may not require forced fluid circulation for its operation.

[021] According to an exemplary embodiment of the invention, Fig. 1 schematically illustrates an electric generator system configured to displace a volume of liquid from different locations. While the invention will be described in connection with a particular electric generator arrangement (i.e., utilizing kinetic and potential energy of a liquid while transiting between different locations), the invention may be applied to, or used in connection with, any other types of fluid displacement situation, such as, for example, transporting fluid from one place to another. Naturally, it should be understood that the invention may be used in various applications other than electric generation.

[022] As shown in Fig. 1, the electric generator system may comprise a Reservoir Tank (R-Tank 4) containing the working fluid (e.g., water), one or more heat absorbing and vapor generating V-HEX for evaporating the working fluid, the super tank, S-Tank 1 for rapidly condensing the vaporized fluid, and the injector water tank (I-Tank 3) containing fluid in a liquid state and used for cooling the vaporized fluid inside S-Tank 1. Water will be used to describe the exemplary embodiments of the invention, particularly for the application illustrated with

reference to Fig. 1. It should be understood, however, that any other fluid having suitable thermodynamic properties may be used alternatively or additionally. Fluids represented in Figs. 1, 2 and 4 and contained within C-Tank 2, R-Tank 4, and I-Tank 3 may have the same thermal physical characteristics as well as different thermal-physical characteristics as long as they are compatible with the thermodynamic cycle indicated in Fig. 3. The elevation difference between the various tanks (e.g. C-Tank 2, R-Tank 4, etc.) of this invention may be arbitrary as R-Tank 4 may be positioned above C-Tank 2.

[023] With reference to Fig. 1, the Collector Tank C-Tank 2 may use gravity to inject a certain amount of water inside the V-HEX where heating of the water takes place via heat energy absorption, (e.g. solar, waste heat absorption, or more generally "Heat" as indicated by the generalized notation in Fig. 1). The water in the V-HEX may then be transformed into vapors (e.g., super-heated steam), and the vapors may flow (e.g., via natural circulation and pressure) to the S-Tank 1, where the vapors may be accumulated. The S-Tank 1 may be designed to sustain a substantial amount of negative pressure, and may be equipped with one or more valves (shown in, for example, Fig. 1, 2, and 4) to purge substantially all non-condensable gases (e.g. Air) present in the S-Tank 1. Once a predetermined amount of vapors are accumulated in the S-Tank 1, the I-Tank 3 injects sub-cooled water jet (e.g., via gravity) inside the S-Tank 1 by controlled actuation of Valve V6, causing an instant cooling and pressure drop inside the S-Tank 1. At this time, the system may reset the water levels "Reference Level 2" (R-L2) inside the I-Tank 3, by means of proper timing valves V8 and V9 (described with reference to Figs. 1, 2, and 4). V8 may be actuated to allow suction of water from R-Tank 4 through valve V9 while S-Tank 1 pressure is close to a vacuum as a result of vapor condensation. Once R-L2 is reset I-Tank 3 is also reset for the next cycle. At this time V5 may be actuated so as to allow suction of water from R-Tank 4 to S-Tank 1 through one or more turbine system T coupled to an electric generator E-Gen. At equilibrium a certain amount of water may be transferred from R-Tank 4 to S-Tank 1. To reset Reference Level 1 (R-L1) in C-Tank 2, valves V3, V2, and V4 may be actuated so as to allow water from S-Tank 1 to flow into C-Tank 2 and R-Tank 4. While water returns to R-Tank 4 it also generates electricity through turbine T and Electric Generator E-Gen. At this time the system is re-set to its initial conditions wherein V1 may be actuated again and vapor

is newly formed inside V-HEX, thereby accumulating inside S-Tank 1, and restarting the thermodynamic cycle.

[024] With reference to Fig. 2, various operational processes are described in detail. In this figure, the V-HEX here represented absorbs heat energy for example from the sun. In this case the V-HEX has to be constructed in a way that allows solar energy to enter the heat exchanger while minimizing convective heat transfer effects with the surrounding environment. When the heat source is mainly radiative (e.g. solar), the V-HEX may be formed by a frame F within which a coil of a pressure tube "P-Tube" (for example coated with solar radiation absorbing materials) is suspended in a vacuum. At least one side of frame F allows sun radiation absorption into the P-Tube for example by means of a glass G with high transmissivity and low reflectivity. Inside the evacuated frame F and acting as support mechanisms for the glass surface G, and to withstand the buckling generated by the vacuum a series of spacers S of suitable geometry may be found. To optimize solar radiation absorption into the P-Tube, and placed on the side opposite to the glass G at the bottom side a series of mirrors M may be placed inside the frame F so as to re-direct sun radiation not directly absorbed by the P-Tube. Depending on the geometry adopted for the coil formed by the P-Tube the mirrors M may be of different geometry (e.g. corrugated, conical, cylindrical etc.). The V-HEX is not limited to a particular dimensional and/or geometric configuration, and multiple V-HEX may be installed side-by-side for example on a surface exposed to the sun, or, for example as part of a heat exchanger within which waste heat fluids flow without mixing with the working fluid. Multiple V-HEX may be hydraulically connected by means of suitable hydraulic fittings. To summarize on the V-HEX, each of the V-HEX may include at least one inlet and at least one outlet for hydraulic connection and fluid flow between the various components of the electric generator system.

[025] Once vapor is formed inside V-HEX it may flow into S-Tank 1. S-Tank 1 may be thermally separated from the environment by a jacket structure (JS). JS may be actuated so as to have a vacuum or free convection by operating a suitable set of valves, or through a combination of mechanical means. When inside JS there is a vacuum the S-Tank 1 can more efficiently fill-up with vapors as the rate of natural condensation on the S-Tank 1 inner surfaces is decreased. When inside JS environmental air or cooling fluids are allowed to flow the rate of condensation is increased, thereby optimizing the depressurization process inside S-Tank 1.

Therefore, JS may be represented by a dynamic heat transfer/heat insulating mechanism. When JS is set to form a high insulation, for example via a vacuum or insulating materials, JS favors the vapor process accumulation process inside S-Tank 1. When, free convection or actuation of cooling systems induce increased heat transfer through JS, from the surfaces of S-Tank 1 to a cooler environment, then JS favors condensation inducing the vapor inside S-Tank 1 to condense.

[026] In Fig. 2, V1 represents a check valve, while V1' may be actuated to increase the super-heating pressure of the vapor prior to its inlet into S-Tank 1. V8', V3 and V4 represent valves allowing venting to atmospheric pressures and to be actuated according to the thermodynamic cycle represented in Fig. 3. The water in the C-Tank 2 may be at the atmospheric pressure and temperature. Alternatively, the water may be heated and/or pressurized. In some exemplary embodiments, the water may be pre-heated. Pre-heating may occur by solar heat or any other source of heat, and may speed-up the vaporization process inside the V-HEX. For this purpose C-Tank 2 itself may be configured to receive solar or thermal energy (e.g. waste heat). For example, at least a portion of C-Tank 2 may be made of a material that is transparent to solar irradiation, such that the solar rays may heat-up the inner portions of the tank and heat up fluid A (Fig 1, 2, and 4). In an exemplary embodiment, the inner portions of C-Tank 2 may be coated with a material having a relatively high absorbability and low reflectivity. Alternatively, if the heat source is heat in the form of a fluid carrying the heat (e.g. waste heat) C-Tank 2, as for V-HEX, may be embedded with the heat source and exposed to the heat stream (e.g. hot gases, hot fluids), or directly in contact with the waste heat source wherein the heat transfer mechanism may be conduction for example through the waste heat generating equipment of some industrial processes.

[027] According to another exemplary embodiment of the invention shown in Fig. 4, the electric generator system may include a turbine and electric generator system T1, E-GEN1 system operated by the expansion of an External Fluid (EXT.F). The EXT.F may be in a gaseous (e.g. Air), or liquid form. In this configuration nozzle valves VN may be actuated when S-Tank 1 pressure is close to a vacuum as a result of the thermodynamic cycle described earlier and represented in Figs. 1, 2, and 3. EXT.F may flow or expand through T1 as a result of the pressure difference between the environment outside S-Tank 1 and the inner S-Tank 1 volume. To minimize heating of the EXT.F a flexible body or flexible membrane F-MEM may be made to

separate the vapor and vapor-condensing areas of S-Tank 1 from EXT.F. The inner walls of S-Tank 1 may be formed by insulating materials so as to minimize heating of the external fluid EXT.F fluid inside S-Tank 1. VPV represents vapor-purging valves hydraulically connected to the F-MEM which may be actuated during the S-Tank 1 vapor accumulation processes.

[028] With reference to Fig. 3 (and Fig. 1) a more detailed illustration of the principles and thermodynamic processes occurring inside the various components of the invention is now provided. Once a predetermined amount of water (e.g. A), is introduced into the V-HEX, the heat addition received therein may be transferred to the water. This is process A, A', A'', and A''' as indicated in the T-S diagram of Fig. 3. Process A-A''' is a heat addition process moving along the isobaric line P1 in which water transforms from sub-cooled liquid into superheated steam. At this point the fluid may be at a superheated thermodynamic state A''-A''' on isobaric line P1. P1 may be atmospheric pressure.

[029] The vapor, or superheated steam, may exit the V-HEX through a valve V1' (Fig. 2). Valve V1' may be automatically operated and may be configured to control the vapor condition (e.g., degree of super-heating of the vapor) for example to assure deployment of F-MEM (Fig. 4). Alternatively or in addition a check valve can automatically control the venting of vapors from V-HEX into S-Tank 1. The inner walls of S-Tank 1 may be built to withstand vacuum or negative pressures with materials and/or coatings to minimize cooling during the vapor filling process while maximizing cooling during vapor condensation. Overall, in a certain amount of time, for example depending on V-HEX dimensions and heat transfer from the heat source to V-HEX, super-heated vapors occupy all of the S-Tank 1 volume by purging non-condensable gases (e.g. air) through open valve V4 (Fig 1, and 2), or, in the case of F-MEM utilization, through vapor purging valve VPV (Fig. 4). A certain amount of condensation is normally generated by contact of the vapors with the walls of S-Tank 1. By opening valve V8' connected to I-Tank 3 the pressure inside I-Tank 3 may be equalized at a pressure near or atmospheric pressure, and the cooler fluid it contains can flow into S-Tank 1 via brief actuation of valve V6. This can induce cooling inside S-Tank 1, thereby causing the pressure to drop to a low level vacuum indicated by the indicative isobaric line P2 in the T-S diagram in Fig. 3. This process is a non-equilibrium-process, therefore the dashed line indicated by B is only representative of a condensation process occurring while the system pressure (S-Tank 1 pressure)

continuously decreases. At this time the super heated vapor at thermodynamic state A''' is all condensed through processes B, C and D in the T-S diagram (Fig. 3). When valve V5 in Figs. 1, and 2, or one or more nozzle valves VN in Fig. 4 are actuated in an open state the pressure inside S-Tank 1 increases from a vacuum. When the system is configured according to Figs. 1 and 2 and water is displaced from R-Tank 4 to S-Tank 1 and the final equilibrium pressure will be below P1 (Fig. 3). When the system is configured to expand or allow flow of an external fluid EXT. F as shown in Fig. 4 the final S-Tank 1 pressure may approach P1. To allow return of the condensed and displaced water inside S-Tank 1 back to R-tank 4, valve V4 in Figs. 1 and 2 may vent to atmospheric pressure. A similar process may be achieved by actuating nozzle valve(s) VN in Fig. 4.

[030] Other embodiments of the invention will be apparent to those skilled in the art from consideration of the specification and practice of the invention disclosed herein. It is intended that the specification and examples be considered as exemplary only, with a true scope and spirit of the invention being indicated by the following claims.

WHAT IS CLAIMED IS:

1. An electric generator system comprising:
 - a reservoir containing first fluid in a liquid state;
 - a first chamber hydraulically connected to the reservoir to receive the first fluid from the reservoir, the first chamber being configured to receive heat energy and configured to convert the received heat energy to vaporize the first fluid;
 - a second chamber hydraulically connected to the first chamber to receive the vaporized fluid from the first chamber, the second chamber being configured to condense the vaporized first fluid, causing depressurization in the second chamber,
 - a source of second fluid;
 - a hydraulic connection between the second chamber and the source of second fluid, the depressurization in the second chamber causing the second fluid to flow into the second chamber through the hydraulic connection; and
 - a turbine coupled to the hydraulic connection,wherein the flow of the second fluid through the hydraulic connection causes the turbine to rotate.
2. The system of claim 1, wherein at least one of the first and second fluids is water.
3. The system of claim 1, further comprising an injector configured to inject condensing liquid into the second chamber to condense the vaporized first fluid.
4. The system of claim 3, further comprising an injector tank for supplying the condensing liquid to the injector.
5. The system of claim 3, wherein the injector is configured to spray the condensing liquid into the second chamber.
6. The system of claim 1, wherein the first fluid in the reservoir flows to the first chamber via gravity.

7. The system of claim 1, wherein the hydraulic connection between the reservoir and the first chamber comprises a valve configured to be actuated automatically based on a parameter inside at least one of the reservoir, the first chamber, and the second chamber.

8. The system of claim 7, wherein the parameter comprises at least one of pressure and temperature.

9. The system of claim 7, wherein the valve comprises a flow control valve configured to control an amount of water being introduced into the first chamber.

10. The system of claim 1, wherein the first chamber comprises a heat absorbing material.

11. The system of claim 1, wherein the first chamber is in the form of a tile.

12. The system of claim 1, wherein the first chamber comprises an insulator surrounding at least a portion of the first chamber.

13. The system of claim 12, wherein the insulator comprises a vacuum jacket.

14. The system of claim 13, wherein the vacuum jacket comprises a reflective material placed inside the vacuum jacket.

15. The system of claim 1, wherein the first chamber comprises a plurality of first chambers.

16. The system of claim 15, wherein the plurality of first chambers are hydraulically connected in series between the reservoir and the second chamber.

17. The system of claim 15, wherein the plurality of first chambers are hydraulically interconnected to each other.

18. The system of claim 15, wherein the plurality of first chambers are placed adjacent to one another.

19. The system of claim 1, wherein the hydraulic connection between the first chamber and the second chamber comprises a valve configured to control the condition of the vaporized first fluid flowing from the first chamber into the second chamber.

20. The system of claim 19, wherein the valve is configured to be automatically actuated when pressure and/or temperature inside the first chamber exceeds a threshold value.

21. The system of claim 1, wherein the second chamber comprises a relief valve located in an upper portion of the second chamber and configured to release non-condensable fluid.

22. The system of claim 1, wherein the second chamber is hydraulically connected to the reservoir to allow the condensed first fluid to the reservoir.

23. The system of claim 1, wherein the depressurization of the second chamber causes at least a portion of the second fluid in the source of second fluid to flow into the second chamber.

24. The system of claim 1, further comprising an electric generator coupled to the turbine and configured to generate electricity.

25. The system of claim 1, wherein the second fluid comprises air from atmosphere.

26. The system of claim 1, wherein the hydraulic connection comprises a nozzle valve.

27. The system of claim 26, wherein the nozzle valve is configured to be actuated when the pressure inside the second chamber reaches a predetermined value.

28. The system of claim 1, wherein the first fluid and the second fluid do not mix one another.

29. The system of claim 28, further comprising a movable membrane configured to separate the first fluid from the second fluid.

30. The system of claim 29, wherein the membrane is flexible.

31. The system of claim 1, wherein the heat energy comprises solar energy.

32. A method of generating electricity, comprising:
heating a first fluid to vaporize the first fluid;
allowing the vaporized first fluid to flow into a chamber;
condensing the vaporized first fluid in the chamber, causing depressurization of the chamber;
using the depressurization of the chamber, causing a second fluid to flow through a hydraulic connection between the chamber and a source of second fluid;
and
coupling an electric generator system to the hydraulic connection to generate electricity from the flow of the second fluid.

33. The method of claim 32, wherein heating the first fluid comprises heating the first fluid with solar energy.

34. The method of claim 32, the first fluid and the second fluid are different from one another.

35. The method of claim 32, further comprising storing the first fluid in a reservoir.

36. The method of claim 32, wherein at least one of the first fluid and the second fluid is water.

37. The method of claim 32, wherein condensing the vaporized first fluid comprises injecting condensing liquid into the chamber.

38. The method of claim 32, further comprising controlling a vapor condition of the vaporized first fluid flowing into the chamber.

39. The method of claim 38, wherein controlling the vapor condition comprising controlling the vapor condition of the vaporized first fluid via a valve.

40. The method of claim 39, wherein the valve is configured to be automatically actuated when at least one of the pressure and temperature inside the first chamber exceeds a threshold value.

41. The method of claim 32, wherein the electric generator system comprises a turbine hydraulically coupled to the hydraulic connection.

42. The method of claim 32, wherein the second fluid comprises air from atmosphere.

43. The method of claim 32, wherein the hydraulic connection comprises a nozzle valve.

44. The method of claim 43, wherein the nozzle valve is configured to be actuated when the pressure inside the second chamber reaches a predetermined value.

45. The method of claim 32, wherein the first fluid and the second fluid do not mix one another.

46. The method of claim 45, separating the first fluid from the second fluid by a movable membrane disposed in the chamber.

47. The method of claim 46, wherein the membrane is flexible.

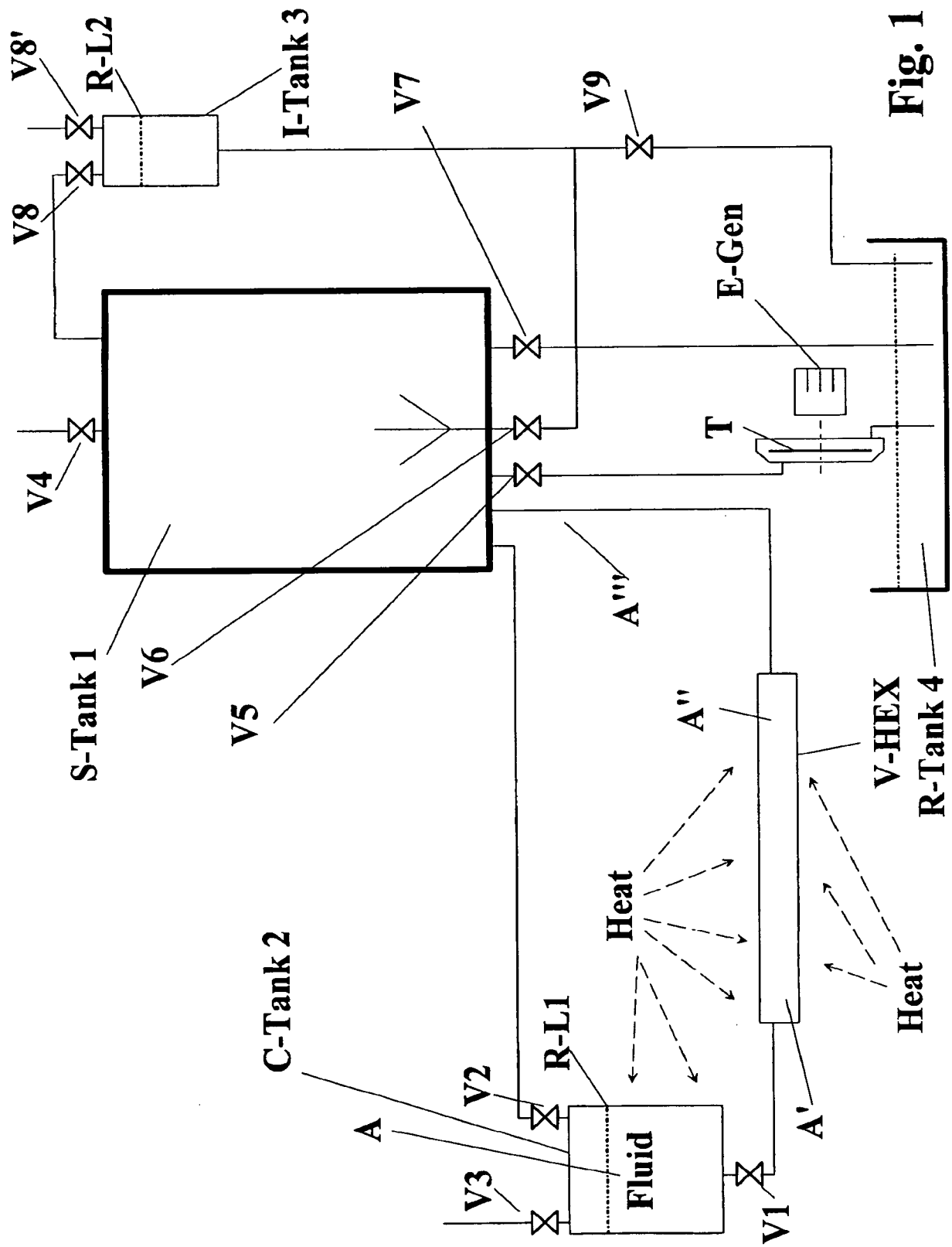
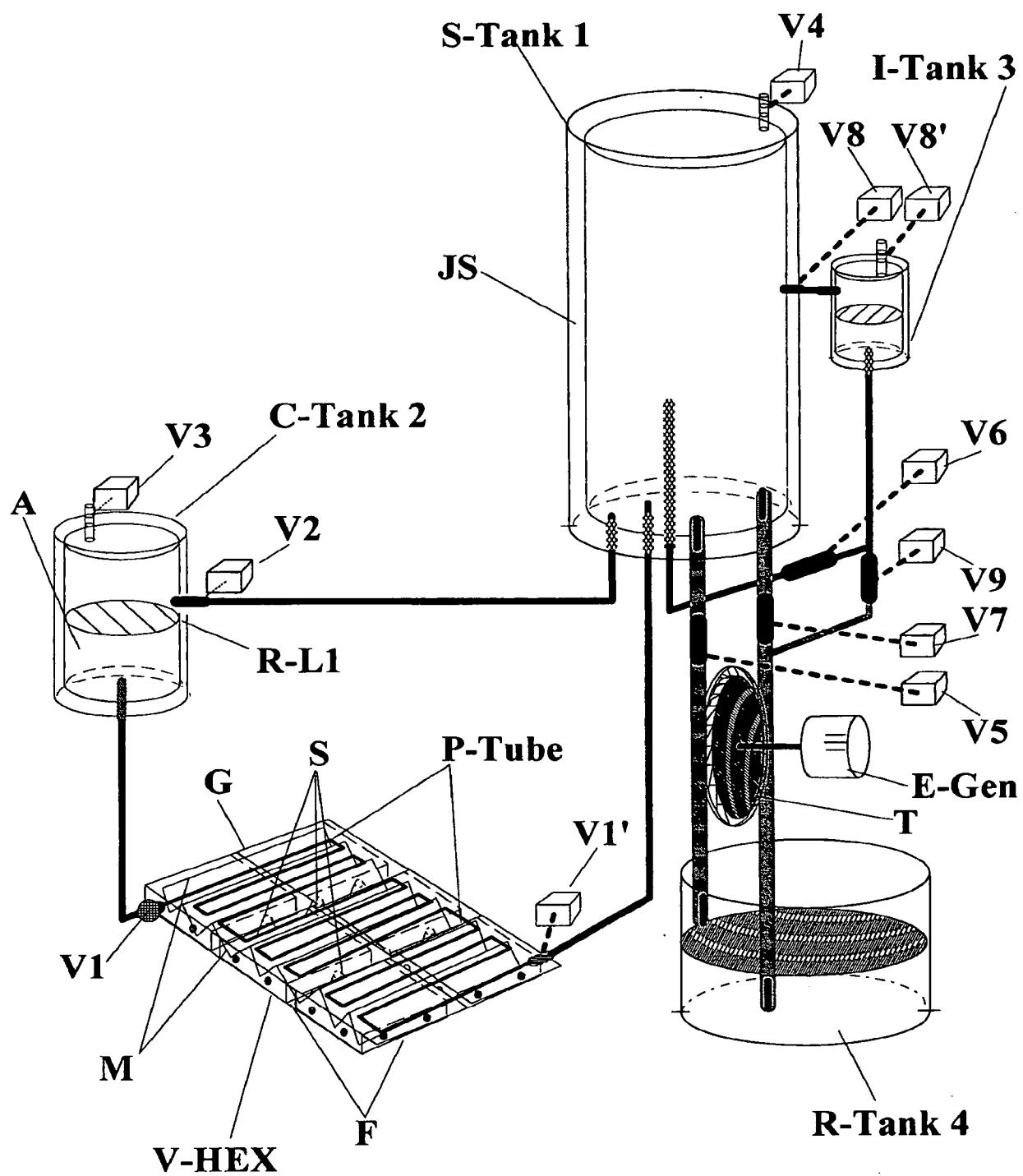


Fig. 1

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**Fig. 2**

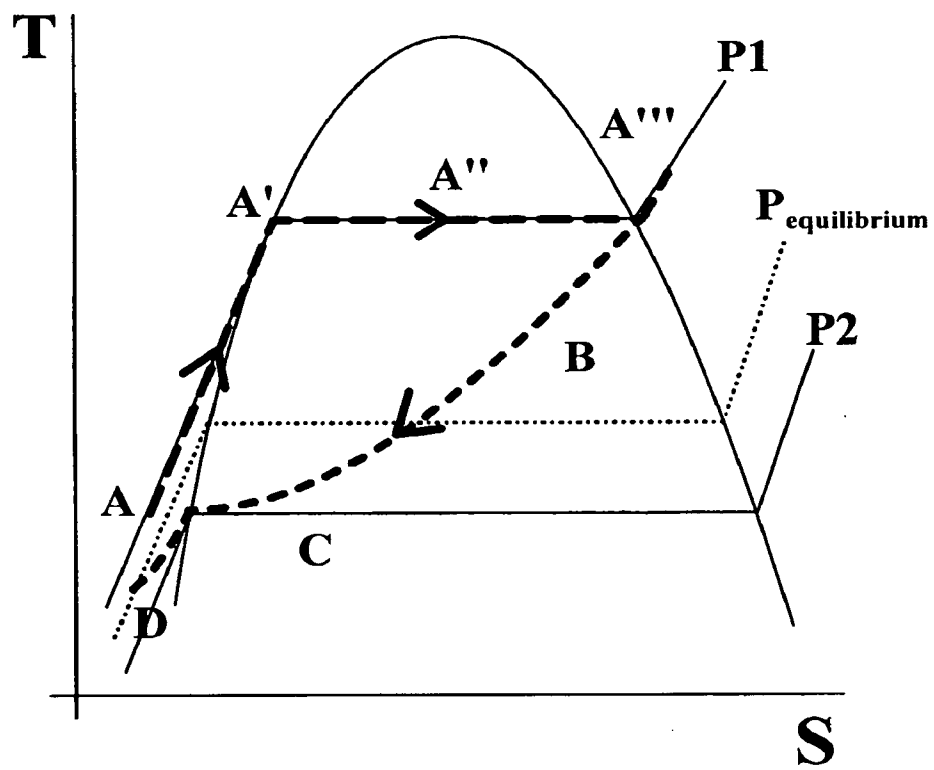
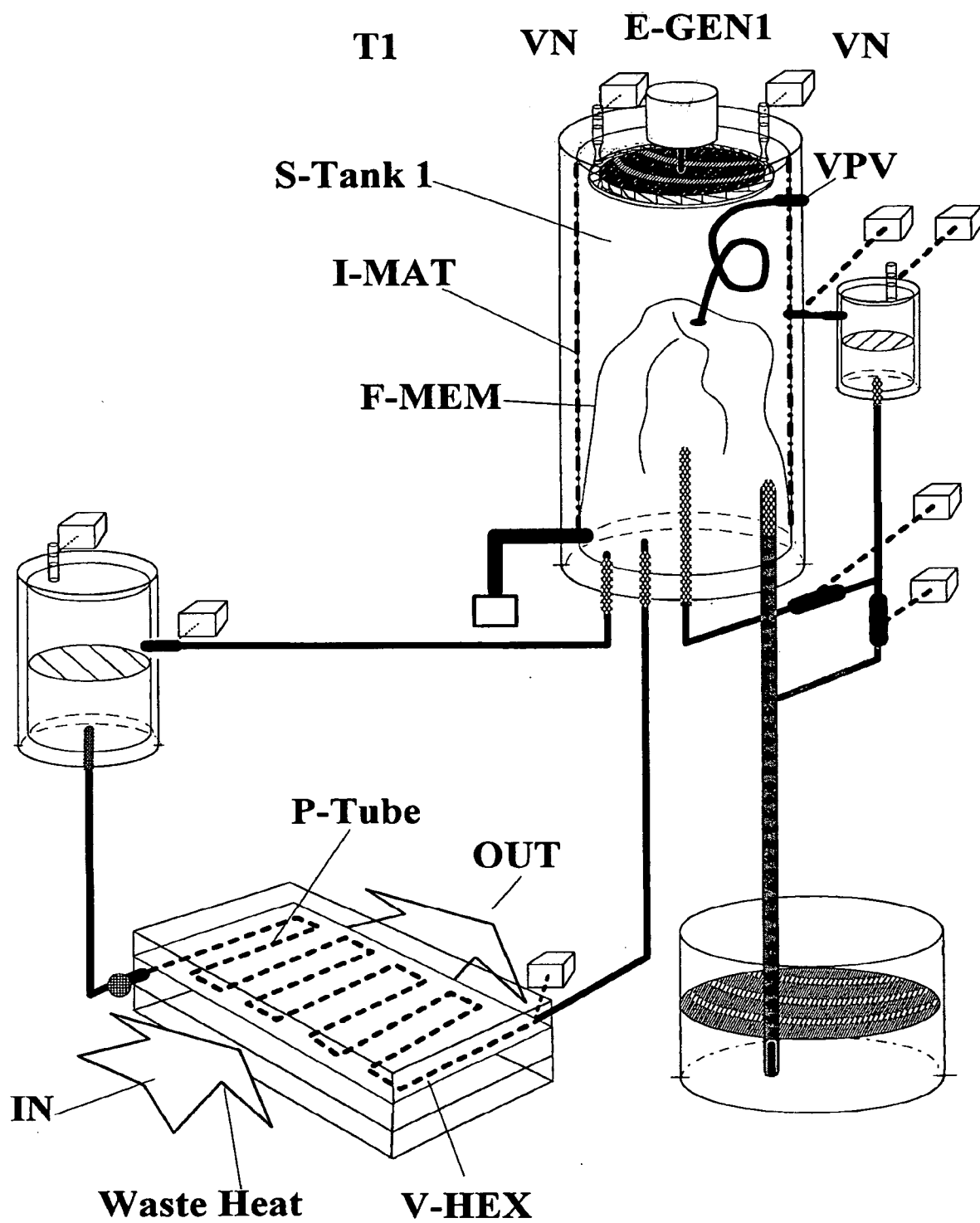


Fig. 3

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**Fig. 4**