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(54) **PORTABLE SOLAR POWER GENERATOR AND WATER HEATING SYSTEM**

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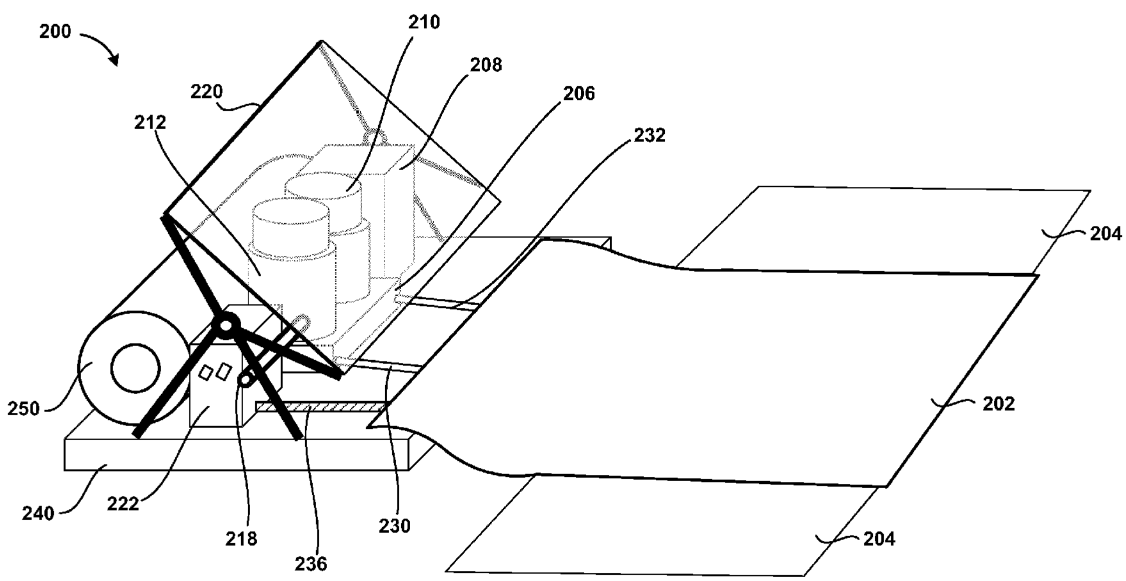
(57) **ABSTRACT**

Methods and systems provide for the creation of power and heated water utilizing a solar powered portable structure. According to embodiments described herein, solar radiation is used to heat a power generating bladder containing a heat transfer fluid. The heat transfer fluid within the power generating bladder is circulated through a heat exchanger to transfer heat from the heat transfer fluid to water stored in one or more water storage tanks, thereby heating the water. Solar radiation is also used to generate power by converting the solar radiation received by the power generating bladder to power using a photovoltaic material. The power may be provided for use and used to operate various components of the system. The power may also be stored in a battery.



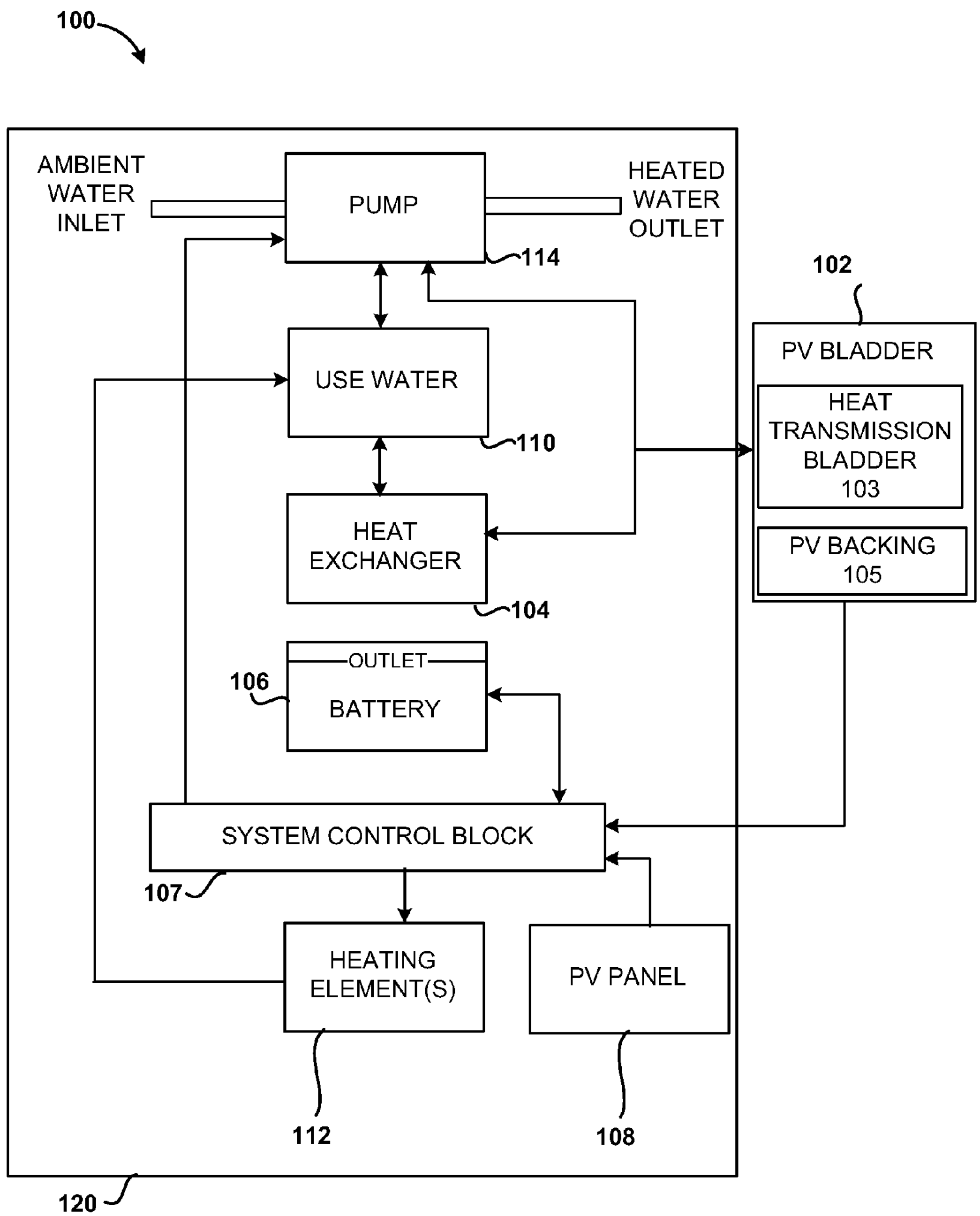

100
AMBIENT WATER INLET
PUMP
HEATED WATER OUTLET
114
102
PV BLADDER
HEAT TRANSMISSION BLADDER 103
PV BACKING 105
USE WATER
110
HEAT EXCHANGER
104
OUTLET
BATTERY
106
SYSTEM CONTROL BLOCK
107
HEATING ELEMENT(S)
PV PANEL
112
108
120

Fig. 1

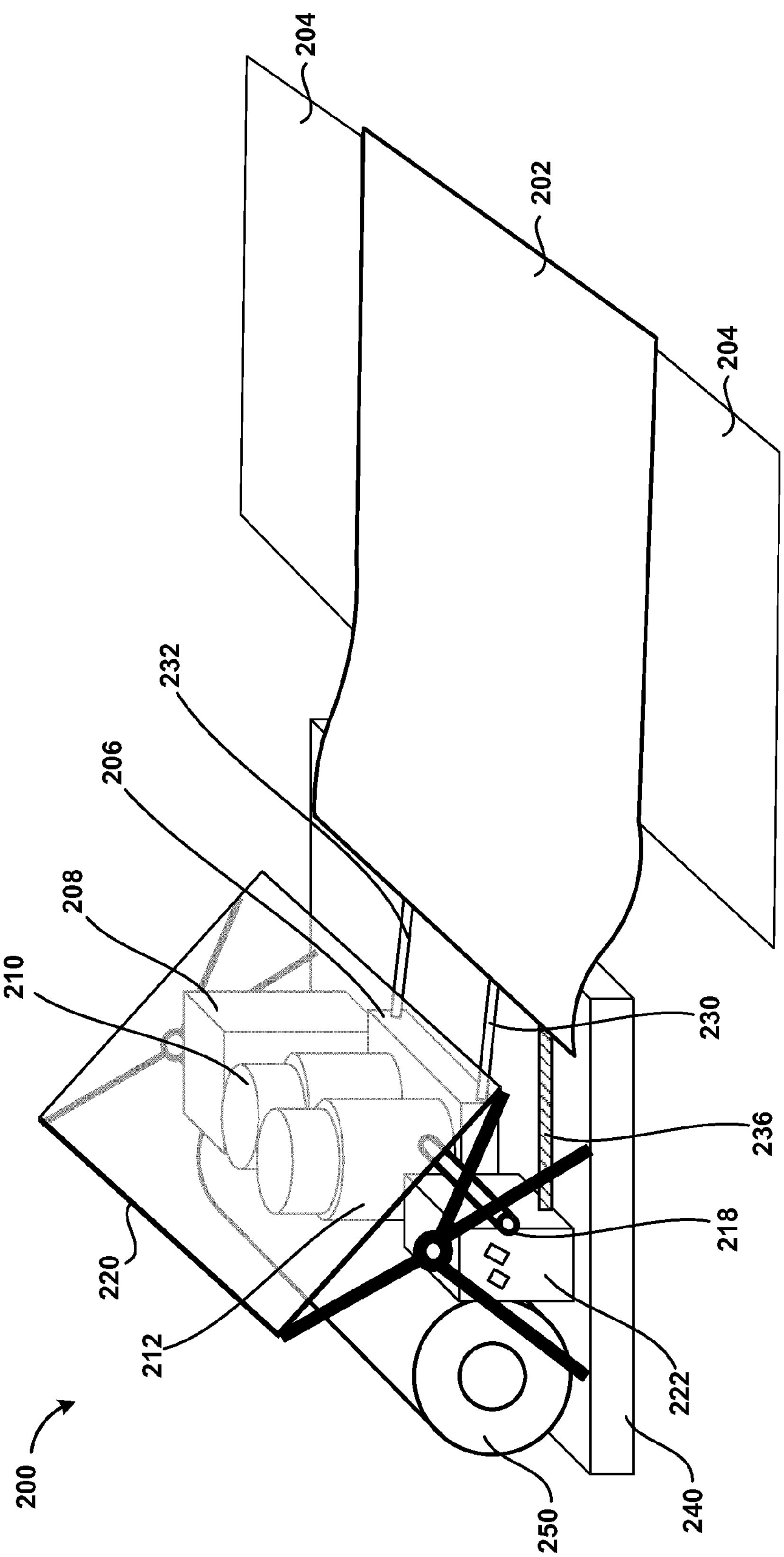


Fig. 2

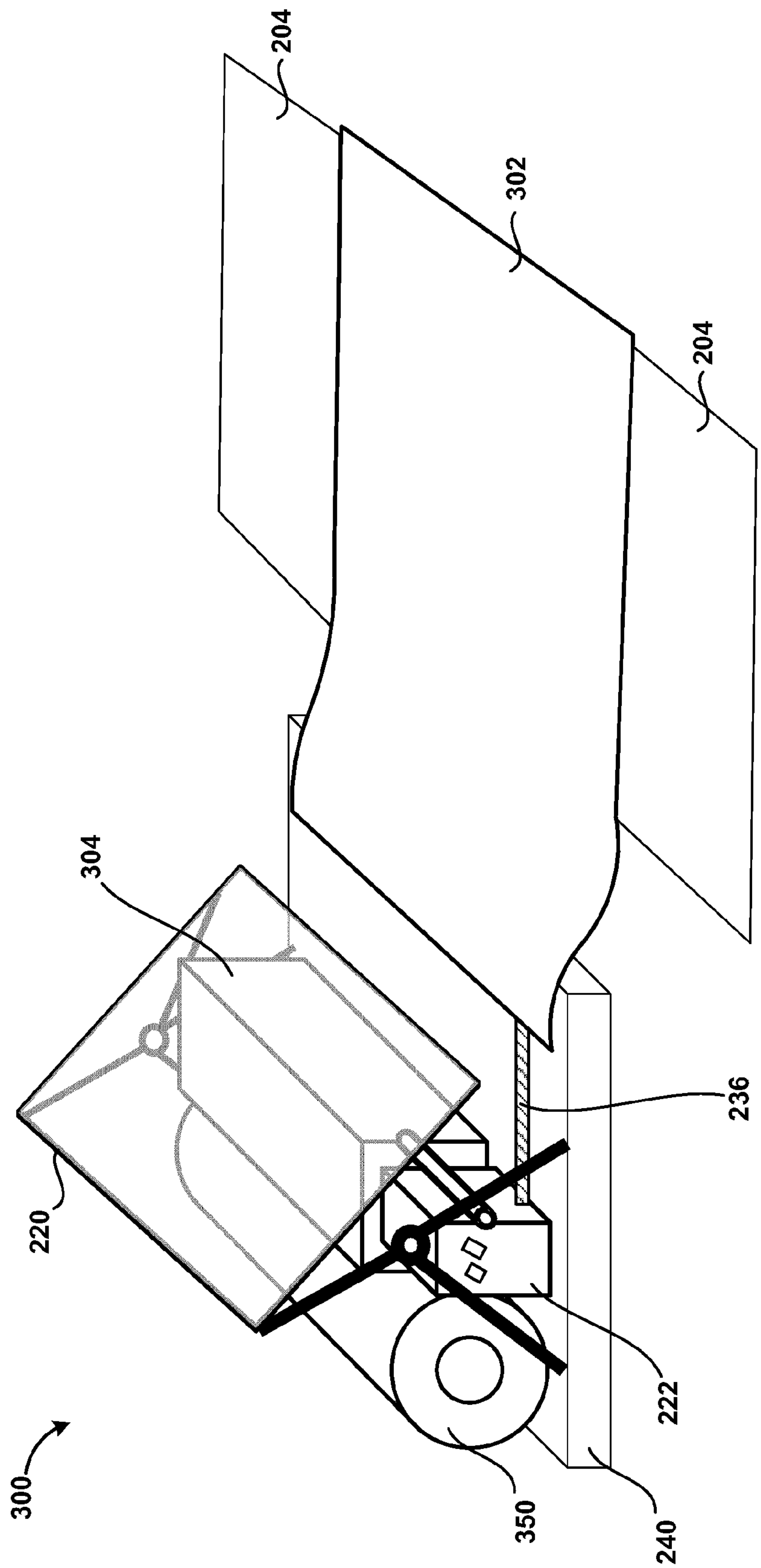


Fig. 3

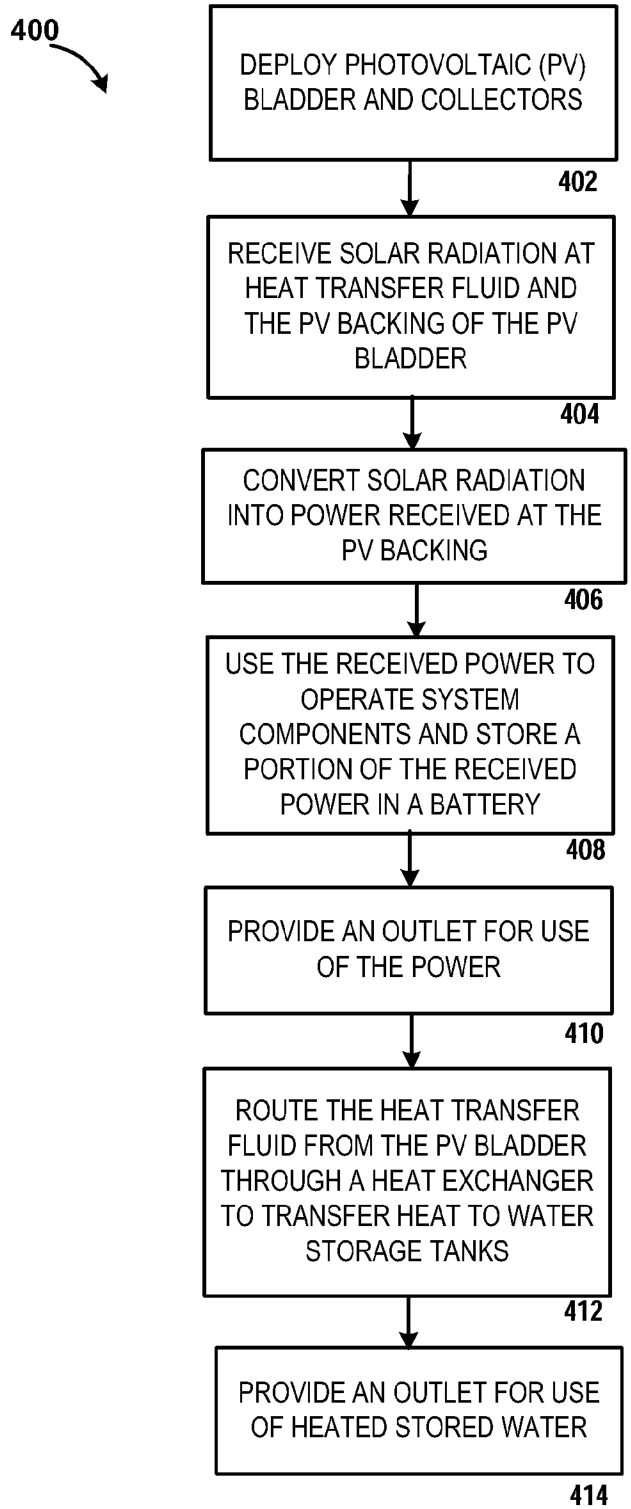

400
DEPLOY PHOTOVOLTAIC (PV) BLADDER AND COLLECTORS
402
RECEIVE SOLAR RADIATION AT HEAT TRANSFER FLUID AND THE PV BACKING OF THE PV BLADDER
404
CONVERT SOLAR RADIATION INTO POWER RECEIVED AT THE PV BACKING
406
USE THE RECEIVED POWER TO OPERATE SYSTEM COMPONENTS AND STORE A PORTION OF THE RECEIVED POWER IN A BATTERY
408
PROVIDE AN OUTLET FOR USE OF THE POWER
410
ROUTE THE HEAT TRANSFER FLUID FROM THE PV BLADDER THROUGH A HEAT EXCHANGER TO TRANSFER HEAT TO WATER STORAGE TANKS
412
PROVIDE AN OUTLET FOR USE OF HEATED STORED WATER
414

Fig. 4

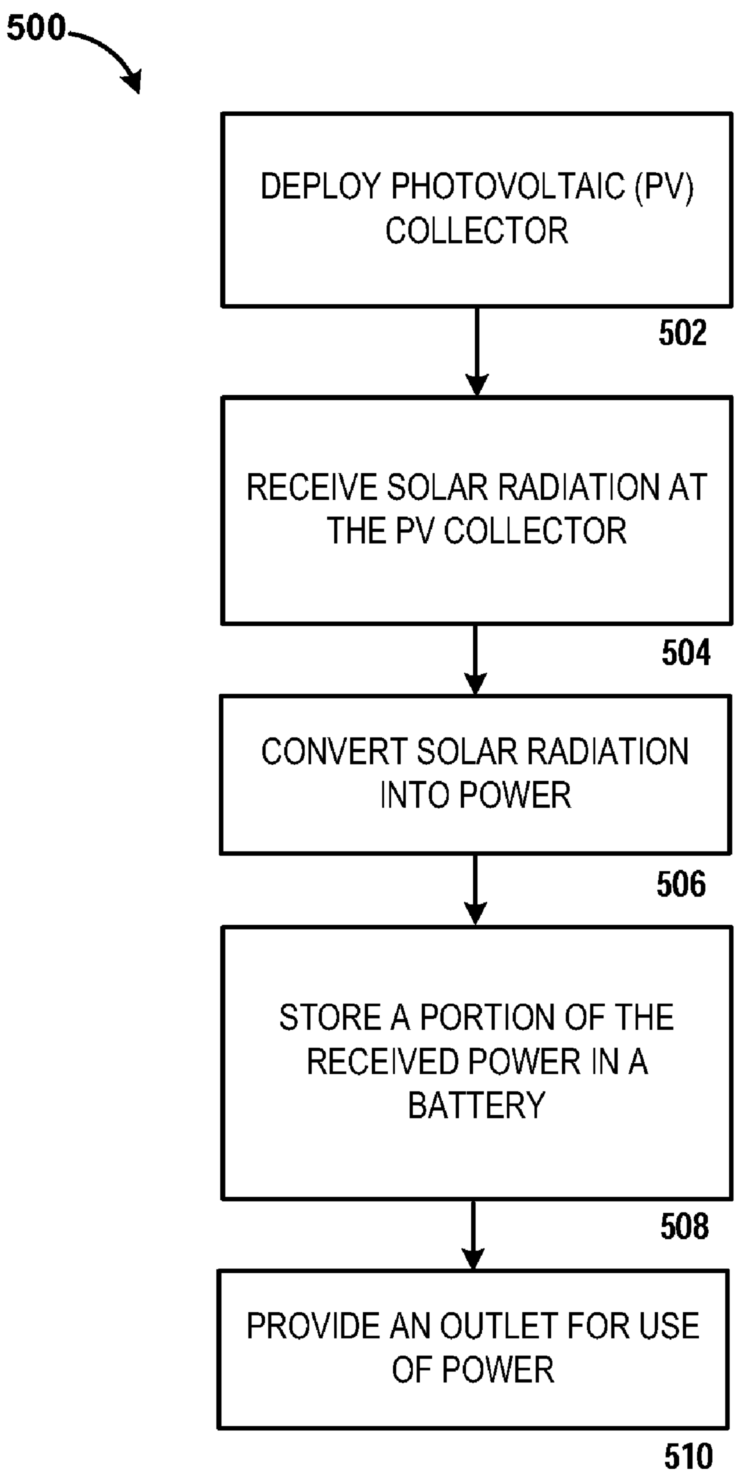

500
DEPLOY PHOTOVOLTAIC (PV) COLLECTOR
502
RECEIVE SOLAR RADIATION AT THE PV COLLECTOR
504
CONVERT SOLAR RADIATION INTO POWER
506
STORE A PORTION OF THE RECEIVED POWER IN A BATTERY
508
PROVIDE AN OUTLET FOR USE OF POWER
510

Fig. 5

PORTABLE SOLAR POWER GENERATOR AND WATER HEATING SYSTEM

BACKGROUND

[0001] Many remote bases or other facilities utilize fuel cells for the generation of power. For example, in military applications, forward operating bases are often set up at remote locations not serviced by a fixed power grid. Fuel cells provide one means for supplying the necessary power to sustain the base operations. Similarly, in civilian applications such as disaster response scenarios, power generation is a critical consideration for response teams since permanent power grids and heated water are commonly unavailable. Like power, heated water is another integral component for sustaining operations at many remote locations. Many remote locations do not have the functional infrastructure to provide electricity or heated water.

[0002] Due to the lack of suitable infrastructure at many of these locations, fuel must be transported to the forward operating bases or emergency response locations, often over great distances. Transporting fuel via aircraft, trains, ships, trucks and/or other vehicles is a costly and often dangerous operation. In the military context, for example, fuel makes up a significant portion of the cargo that is transported to remote bases. The convoys associated with these shipments not only operate at a significant expense, but also expose personnel to hazards associated with operating in hostile environments.

[0003] It is with respect to these considerations and others that the disclosure made herein is presented.

SUMMARY

[0004] It should be appreciated that this Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to be used to limit the scope of the claimed subject matter.

[0005] Methods and systems described herein provide for the creation of power and heated water utilizing a portable solar power generator and water heating system. According to one aspect of the disclosure provided herein, solar radiation is used to heat a liquid filled bladder. The heated liquid is used to heat stored water via a heat exchanger. The heated water is provided for use within these and other systems, or for general consumption.

[0006] According to another aspect, a portable solar power generator and water heating system includes one or more photovoltaic collectors and one or more batteries. Sunlight (solar radiation) is collected by the one or more photovoltaic collectors. The collected solar radiation is converted to power for storage in a battery. The power is provided for use within these and other systems, heating water, or for general consumption.

[0007] According to yet another aspect, both the liquid filled bladder and one or more photovoltaic collectors and batteries are utilized. Accordingly, heated water and power are provided for use within these and other systems, or for general consumption.

[0008] The features, functions, and advantages that have been discussed can be achieved independently in various embodiments of the present invention or may be combined in yet other embodiments, further details of which can be seen with reference to the following description and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. **1** is a block diagram showing a portable solar power generator and water heating system in accordance with some embodiments;

[0010] FIG. **2** is a diagram showing a portable solar power generator and water heating system in accordance with some embodiments;

[0011] FIG. **3** is a diagram showing a portable solar power generation system in accordance with some embodiments;

[0012] FIG. **4** is a flow diagram showing aspects of one illustrative process disclosed herein for generating power and providing heated water from solar radiation, according to one embodiment presented herein; and

[0013] FIG. **5** is a flow diagram showing aspects of one illustrative process disclosed herein for generating power from solar radiation, according to one embodiment presented herein.

DETAILED DESCRIPTION

[0014] The following detailed description is directed to methods and systems for generating power and heated water from solar radiation in a portable manner. As discussed briefly above, transporting fuel to forward operating bases and other remote locations is a costly, inefficient, and often dangerous process. Utilizing the concepts and technologies described herein, solar radiation is used to generate power and create heated water for consumption.

[0015] Throughout this disclosure, the various embodiments will be described with respect to use with a military forward operating base, such as would be used by military forces on a temporary or semi-permanent basis at a remote location that does not have permanent infrastructure capable of providing power and heated water. However, it should be understood that the disclosure provided herein is equally applicable to any type of application in which it is desirable to generate power and heated water in a portable and efficient manner that decreases the quantity of fuel that is required to be transported to the use location from a source location. Similarly, the various embodiments are also suitable for any implementations in which the transportation of resources is not an issue, but in which it is desirable to operate at a lower cost or weight, as will be described in detail below.

[0016] In the following detailed description, references are made to the accompanying drawings that form a part hereof, and which are shown by way of illustration, specific embodiments, or examples. Referring now to the drawings, in which like numerals represent like elements through the several figures, the portable generation of power and heated water via solar radiation, will be described. FIG. **1** illustrates a portable solar power generator and water heating system **100**.

[0017] The portable solar power generator and water heating system **100** is a portable system that may provide power and heated water for consumption. The concepts described herein allow for the rapid deployment of a portable solar power generator and water heating system **100** at a remote location. The solar power generator and water heating system **100** may be of a size and weight that is capable of being transported by several individuals. The entire system fits easily on a conventional pallet that can be carried to the optimal location and deployed. Deployment of the system may include unrolling a photovoltaic (PV) bladder **102**, which will be described in detail below, and connecting inlet and outlet water connections, as well as any supplemental power that may be used if the power generated by the system is not used to entirely power the system. Throughout this disclosure, embodiments will be described in which the PV bladder **102** is "rolled" or "unrolled." It should be appreciated that the terms "rolled" or "unrolled" may be interchanged with the terms "folded" or "un-folded" or any other terms related to stowing or deploying an item.

[0018] The solar power generator and water heating system **100** may include the PV bladder **102**. As will be described in detail below, the PV bladder **102** absorbs solar radiation, for example, infrared and visible light, and uses the absorbed radiation to heat a fluid within the bladder as well as to generate electrical power. The heated fluid within the bladder, or heat transfer fluid as it is referred to herein, is then used to heat stored water for consumption at the remote location or location of use. The PV bladder **102** may include two primary components, a heat transmission bladder **103** and a PV collector backing **105**. The heat transmission bladder **103** is a flexible container through which heat transfer fluid may be routed to collect heat from the absorbed solar radiation. The heat transmission bladder may be created from any suitable material that can be rolled or folded and that is transparent or translucent to allow for the transmission of visible light.

[0019] The heat transmission bladder **103** may include one or more channels for routing a heat transfer fluid into and through the heat transmission bladder **103**. The heat transmission bladder **103** may be made of a fluoride polymer, for example, ethylene tetrafluroethylene (ETFE). The fluoride polymer used to create the heat transmission bladder **103** may be a fluoride polymer that tends to transmit greater than 50% of the visible spectrum of light through the fluoride polymer. Since the heat transmission bladder **103** resides on top of the PV backing **105** of the PV bladder **102** and is transparent or translucent, the PV bladder **102** can utilize infrared radiation for heating the heat transfer fluid and visible light for power generation. The heat transmission bladder **103** and the PV backing **105** of the PV bladder **102** may be attached or integrated in any suitable manner that allows sunlight to be received by both the heat transmission bladder **103** and the PV backing **105**.

[0020] The heat transmission bladder **103** absorbs infrared radiation through the heat transfer fluid contained in the heat transmission bladder **103**. The heat transfer fluid in the heat transmission bladder **103** may be any fluid capable of being heated by solar radiation, for example, water. The heat transmission bladder **103** may circulate the heat transfer fluid through a heat exchanger **104** using a pump **114** that may be controlled by a system control block **107**. The heat exchanger **104** transfers heat received from the heat transfer fluid to use water **110** in order to heat the use water **110** for subsequent consumption. Pump **114** may be used to provide water pressure to heated use water **110** for extraction and use. The pump **114** may also be used to transfer ambient water to the use water **110** for subsequent heating and be used to transfer heated water for use via a heated water outlet.

[0021] The PV backing **105** of the PV bladder **102** may be made from a variety of durable and flexible materials configured with photovoltaic cells for the creation of electrical power from the collected solar radiation. Example materials include but are not limited to, copper indium gallium selenide (CIGS), copper indium selenide (CIS), tandum junction amorphous silicon (a-Si), cadmium telluride (CdTe), organic photovoltaics or any other suitable thin film photovoltaic. The PV collector backing **105** is dark for optimal absorption of solar radiation through the transparent or translucent heat transmission bladder **103** to which it is attached. The PV backing **105** is capable of collecting visible light due to the transparent or translucent nature of the heat transmission bladder **103**. The PV backing **105** transfers created power to a battery **106** for storage via the system control block **107** that controls power exchanged between components within the solar power generator and water heating system **100**. The battery **106** may be a 24-volt direct current (DC) battery and may include an outlet for consuming the stored power.

[0022] The solar power generator and water heating system **100** may also include a PV panel **108**. The PV panel **108** may be made from materials similar to that of the PV backing **105**. The PV panel **108** may also convert visible light to power for consumption by the solar power generator and water heating system **100** or general use. Power generated from the PV backing **105** and/or the PV panel **108** may be used to power one or more heating elements **112**. The heating elements **112** may be used to generate heat in order to heat the use water **110**. In one embodiment, the heating elements **112** may be direct current (DC) heating elements.

[0023] As shown in FIG. **1**, the system control block **107** may control the power exchanged between various components of the solar power generator and water heating system **100**. For example, the system control block **107** may control the power extracted from the PV backing **105** of the PV bladder **102** and stored in the battery **106**. In another example, the system control block **107** may control the power extracted from the PV panel **108** and transferred to the battery **106**. In a further example, the system control block **107** may control the transfer of power from the battery **106** to the heating elements **112** and/or to the pump **114**. In addition to controlling the exchange and/or transfer of power within the solar power generator and water heating system **100**, the system control block **107** may also be used to regulate and/or monitor such power transfers/exchanges. The control system block **107** may include a central processing unit and a memory along with other components to control power transfer/exchanges.

[0024] The solar power generator and water heating system **100** may use a container **120** to house the pump **114**, use water **110**, heat exchanger **104**, battery **106**, heating elements **112**, system control block **107**, and PV panel **108**. During transport or non-use, the container **120** may also be used to stow the PV bladder **102**. According to one embodiment, the container **120** may be a conventional pallet of any size commonly used for the transport and storage of equipment and goods. The container **120** may also be specifically configured or customized for hand carrying, pushing, or pulling by multiple individuals, including handles and/or wheels or skids.

[0025] FIG. **2** illustrates an embodiment of a solar power generator and water heating system **200**. As discussed above, the portable solar power generator and water heating system **200** includes a PV bladder **202**. The PV bladder **202** may be used to absorb infrared radiation to generate heat via a heat transmission bladder (not shown) and absorb visible light to generate power via a PV backing (not shown). The dimension of the PV bladder **202** may vary depending on the amount of heat transfer fluid desired to be circulated through the PV bladder **202**. For example, the PV bladder **202** may have a dimension of 16 feet by 7.58 feet. The PV bladder **202** may absorb solar radiation once the PV bladder **202** is un-rolled in a sunny location.

[0026] Any heat collected through the absorption of solar radiation by the PV bladder **202** may be transferred to water storage tanks **210** and **212** by circulating the heat transfer fluid in the PV bladder **202** through a heat exchanger **206** that may be in thermal contact with the water storage tanks **210** and **212**. The portable solar power generator and water heating system **200** may use one or more water pumps **208** to circulate the heat transfer fluid through the heat exchanger **206** via heated fluid transfer conduit **230**. The portable solar power generator and water heating system **200** may also use the one or more water pumps **208** to circulate exchanged heat transfer fluid from the heat exchanger **206** back to the PV bladder **202** via ambient fluid transfer conduit **232**. The heat exchanger **206** may be a flat plate heat exchanger or any other suitable instrument for exchanging heat.

[0027] The water storage tanks **210** and **212** may be filled with water via an ambient water inlet (not shown). The water storage tanks **210** and **212** may be interconnected and water may be exchanged between the water storage tanks **210** and **212**. The water storage tanks **210** and **212** may be the same size or, alternatively, may vary in size. For example, water storage tank **210** may be smaller in comparison to water storage tank **212**. The water storage tank **210** may be used to provide heated water for use more rapidly than the water storage tank **212** due to the volume of water being heated in both tanks Accordingly, the water storage tank **210** may provide some amount of heated water, for example, six gallons, for consumption in a shorter period, for example, five hours, while the larger water storage tank **212** is being heated. One or more heating elements (not shown) may be used with the water storage tank **210** to further reduce the water heating time. The one or more water pumps **208** may also be used to provide water pressure to extract the heated water from the water storage tank **210** and/or water storage tank **212** at a heated water outlet **218** that is connected to water storage tank **210** (not shown) and/or water storage tank **212**.

[0028] Any power generated through the absorption of visible light by the PV bladder **202** may be transferred to a direct current (DC) power unit **222** via a power control block (not shown) and a power conduit **236**. The DC power unit **222** may include power control logic and one or more power outlets. The power generated through the absorption of visible light by the PV bladder **202** may also be used for general consumption by and/or operating the solar power generator and water heating system **200** via the power control block.

[0029] The portable solar power generator and water heating system **200** may also include one or more foldout PV collectors **204**. The foldout PV collectors **204** may be made of a material similar to the material used to create the PV backing of the PV bladder **202**. In one embodiment, each of the PV collectors **204** may be 6.5 feet by 13 feet, thereby providing an additional collection area of about 170 square feet. The foldout PV collectors **204** may collect visible light that is converted, together with the visible light collected by the PV bladder **202**, to power which may be used to charge DC power unit **222** via the power control block and power conduit **236**.

[0030] In addition to the foldout PV collectors **204**, the portable solar power generator and water heating system **200** may also include a rigid PV panel **220**. The PV panel **220** may vary in size. For example, the PV panel **220** may have the dimensions of 6.4 feet by 5.4 feet, thereby providing an additional collection area of about 35 square feet. The PV panel **220** may be rotatable in order to tilt the PV panel **220** in a direction of incoming sunlight. The PV panel **220** may be positioned to shade the various components of the portable solar power generator and water heating system **200** during daylight hours and provide insulation for the water storage tanks **210** and **212** during the night. Converted power created by the PV panel **220** may also charge the DC power unit **222** via the power control block. The power generated by the PV backing of the PV bladder **202**, the one or more foldout PV collectors **204**, and the PV panel **220** may also be used to operate the one or more pumps **208**, transfer water between water storage tanks **210** and **212**, and operate one or more heating elements **112** (not shown).

[0031] For example, the PV backing of the PV bladder **202**, the foldout PV collectors **204**, and PV panel **220** may convert approximately nine kilowatt-hours of energy within a 24-hour period in a given location. This energy could be used to operate the one or more water pumps **208**, which may use four or more kilowatt-hours of energy to operate within a 24-hour period in a given location. A portion of the nine kilowatt-hours of collected energy may also be used to operate heating elements that may be attached to the water storage tanks **210** and **212**, which may use three or more kilowatt-hours of energy to operate. A portion of the nine kilowatt-hours of energy may be used to operate various valves and controls of the portable solar power generator and water heating system **200**. The remaining energy from the nine kilowatt-hours of collected energy may be stored in the DC power unit **222**. Using the heating elements **112** and heat exchanged from the heat transmission bladder of the PV bladder **202**, the portable solar power generator and water heating system **200** may heat water to a given temperature for consumption, for example, fifty gallons at 100 degrees Fahrenheit (F).

[0032] The portable solar power generator and water heating system **200** may utilize a second PV bladder **202** and a second set of foldout PV collectors **204**, illustrated in a stowed configuration **250**, to also provide heated water and power for use. When both sets of PV bladders **202** and foldout PV collectors **204** are in a stowed configuration **250**, the overall size of the portable solar power generator and water heating system **200** is reduced easing the logistics for transporting the portable solar power generator and water heating system **200**. Accordingly, when in the stowed configuration **250**, the portable solar power generator and water heating system **200** may be housed on a container **240** for transport.

[0033] In one embodiment, the portable solar power generator and water heating system **200** may be used without filling the PV bladder **202** with the heat transfer fluid. In this configuration, the portable solar power generator and water heating system **200** may provide heated water using the heating elements **112** (shown in FIG. **1**) as well as power. In another embodiment, the solar power generator and water heating system **200** does not supply heated water but, rather, solely provides power. As such, this design also does not require the heating elements **112** to be operational.

[0034] FIG. **3** illustrates a portable solar power generator system **300** for solely providing power. The portable solar power generator **300** may include one or more foldout PV collectors **204**. The foldout PV collectors **204** may be wide enough to create wings in relation to a PV collector **302**. The PV collector **302** may be made from the same material in which the foldout PV collectors **204** are made. The PV collector **302** may vary in size. For example, the PV collector **302**

may have dimensions of 66 feet by 7.58 feet. The foldout PV collectors **204** and PV collector **302** may collect visible light and convert the received visible light to power that may be used to charge DC power unit **222** and battery **304** using the power control block (not shown) and power conduit **236** and operate various components of the portable solar power generator system **300** using the power control block. The battery **304** may be a 24-volt direct current (DC) battery and include one or more batteries and inverters. In addition to the foldout PV collectors **204** and PV collector **302**, the portable solar power generator system **300** may also include the PV panel **220**. Converted power created by the PV panel **220** may also charge DC power unit **222** and the battery **304** using the power control block. The power generated by the foldout PV collectors **204**, the PV collector **302** and the PV panel **220** may be used for general consumption and to power various components of the portable solar power generator system **300** using the power control block. For example, the foldout PV collector **204**, the PV collector **302** and the PV panel **220** may convert approximately fifty kilowatt-hours of energy within a 24-hour period for storage in the battery **304**.

[0035] The portable solar power generator system **300** may utilize a second PV collector **302** and a second set of foldout PV collectors **204**, illustrated in a stowed configuration **350**, to provide power for use. When both sets of PV collectors **302** and foldout PV collectors **204** are in a stowed configuration **350**, the overall size of the portable solar power generator system **300** is reduced easing the logistics for transporting the portable solar power generator system **300**. Accordingly, when in the stowed configuration **350**, the portable solar power generator system **300** may be housed on a container **240** for transport.

[0036] FIG. **4** is a flow diagram showing a routine **400** of one illustrative process disclosed herein for generating power and providing heated water from solar radiation. The process references the solar power generator and water heating system **100**, **200** of FIGS. **1** and **2**, respectively. It should also be appreciated that more or fewer operations may be performed than shown in the figures and described herein. These operations may also be performed in a different order than those described herein.

[0037] The routine **400** begins at operation **402**, where the PV bladder **202** and the one or more foldout PV collectors **204** are deployed. At operation **404**, the PV bladder **202**, the one or more foldout PV collectors **204** and the PV panel **220** receive solar radiation, for example, infrared radiation and visible light, via the heat transfer fluid and the PV material used by the PV bladder **202**, the one or more foldout PV collectors **204** and the PV panel **220**. At operation **406**, solar radiation absorbed by the PV bladder **202**, the PV collectors **204**, and the PV panel **220** is converted to power. At operation **408**, the converted power is provided for use by the components of the portable solar power generator and water heating system **200**, for example, to operate the water pumps **208** and the heating elements **112**, and a portion of the converted power is stored in the DC power unit **222**. At operation **410**, the converted power is also provided for general consumption via a power outlet. At operation **412**, the heat transfer fluid is routed through the heat exchanger **206** to transfer heat from the heat transfer fluid to water stored in the water storage tanks **210** and **212**. At operation **414**, the heated water is provided for general consumption. The operation **400** subsequently ends.

[0038] FIG. **5** is a flow diagram showing a routine **500** that illustrates aspects of one illustrative process disclosed herein for generating power from solar radiation. The process references the solar power generator and water heating system **100**, **200** of FIGS. **1** and **2**, respectively, and the solar power generator system **300**. The routine **500** begins at operation **502**, where the one or more foldout PV collectors **204** and the PV collector **302** are deployed. At operation **504**, the foldout PV collectors **204**, the PV collector **302**, and the PV panel **220** receive solar radiation. At operation **506**, the solar radiation absorbed by the foldout PV collectors **204**, the PV collector **302** and the PV panel **220** is converted to power. At operation **508**, the converted power is stored in the DC power unit **222** and the battery **304**. At operation **510**, the converted power is also provided for use by components of the portable solar power generator system **300** and for general consumption. The operation **500** subsequently ends.

[0039] It should be clear from the above disclosure that the portable solar power generator and water heating system **100**, the portable solar power generator and water heating system **200**, and the portable solar power generator system **300** described herein and encompassed by the claims below provide an improvement in operating efficiency over conventional systems, effectively reducing operating costs, reducing logistical costs associated with transporting fuel, and decreasing the casualty risks corresponding with the hazardous transportation of fuel to forward operating bases. The portable solar power generator and water heating system **100**, the portable solar power generator and water heating system **200**, and the portable solar power generator system **300** utilizes solar radiation to provide heated water and/or provide power at a base, reducing fuel consumption rates of the base as compared to traditional generator sets. The portable solar power generator and water heating system **100**, the portable solar power generator and water heating system **200**, the portable solar power generator system **300** may be modular and components of each system may be exchanged or interchanged.

[0040] The subject matter described above is provided by way of illustration only and should not be construed as limiting. Various modifications and changes may be made to the subject matter described herein without following the example embodiments and applications illustrated and described, and without departing from the true spirit and scope of the present invention, which is set forth in the following claims.

What is claimed is:

1. A method for heating water and generating power, the method comprising:

deploying a photovoltaic (PV) bladder from a stowed configuration, the PV bladder comprising a heat transmission bladder and a PV backing;

routing a heat transfer fluid through the heat transmission bladder;

receiving solar radiation at the PV bladder;

routing the heat transfer fluid from the heat transmission bladder to a heat exchanger;

transferring heat from the heat transfer fluid via the heat exchanger to water stored within one or more water storage tanks;

creating heated water in the one or more water storage tanks; and

providing the heated water for use.

2. The method of claim **1**, further comprising:
converting the solar radiation received at the PV backing to power; and
providing the power for use.

3. The method of claim **2**, further comprising storing the converted power in a direct current (DC) power unit.

4. The method of claim **1**, wherein the heat transmission bladder is a translucent bladder.

5. The method of claim **2**, further comprising using the power to operate one or more heating elements for heating the water stored within the one or more water storage tanks.

6. The method of claim **2**, further comprising using the power to operate one or more pumps for circulating the heat transfer fluid between the heat transmission bladder and the heat exchanger.

7. The method of claim **6**, wherein the one or more pumps provide water pressure for extracting the heated water from the one or more water storage tanks.

8. A solar power and water generation system, comprising:
a PV bladder comprising:
a heat transmission bladder configured to absorb solar radiation through a heat transfer fluid filling the heat transmission bladder;
a PV back configured to convert solar radiation absorbed through the PV backing into power;
one or more foldout PV collectors to convert solar radiation into power;
a heat exchanger to transfer heat from the heat transfer fluid to water stored in one or more water storage tanks; and
a DC power unit for storing power converted by the PV bladder and the PV backing.

9. The power and water generation system of claim **8**, further comprising a PV panel to convert solar radiation into power.

10. The power and water generation system of claim **8**, further comprising one or more pumps to circulate the heat transfer fluid between the heat transmission bladder and the heat exchanger.

11. The power and water generation system of claim **10**, wherein the one or more pumps provide pressure for extracting heated water from the one or more water storage tanks.

12. The power and water generation system of claim **8**, wherein the heat transmission bladder is comprised of a fluoride polymer.

13. The power and water generation system of claim **12**, wherein the fluoride polymer is ethylene tetrafluoroethylene.

14. The power and water generation system of claim **12**, wherein the fluoride polymer transmits greater than 50% of the visible spectrum through the fluoride polymer.

15. The power and water generation system of claim **8**, wherein the PV backing is comprised of a thin film photovoltaic material.

16. The power and water generation system of claim **15**, wherein the thin film photovoltaic material is at least one of copper indium gallium selenide material, tandum junction amorphous silicon material, or cadmium telluride material.

17. The power and water generation system of claim **8**, wherein the power and water generation system is portable.

18. The power and water generation system of claim **8**, further comprising one or more heating elements to heat the water stored in the one or more water storage tanks.

19. The power and water generation system of claim **8**, wherein the heat exchanger is a flat plate heat exchanger.

20. A power generation system, comprising:
a PV collector to convert solar radiation into power;
one or more foldout PV collectors to convert solar radiation into power;
a PV panel to convert solar radiation into power;
one or more batteries for storing power converted by the PV collector, the one or more foldout PV collectors and the PV panel; and
a power outlet to provide power for use.

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