BATTERY POWER GENERATOR

TECHNICAL FIELD

[0001] The present disclosure relates to fuel batteries, and more particularly relates to battery power generator that is provided with a plurality of battery power units.

BACKGROUND

[0002] Vanadium Redox Flow Batteries (VFRBs) or simply Flow batteries are rechargeable batteries that can resolve the constraint of secondary batteries in large-scale applications. In contrast to other secondary batteries, where energy is stored in electrode materials, VFRBs converts chemical energy of two redox couples stored in external tanks to electrical energy. The energy conversion occurs when redox couples interact with electrodes after being pumped from container to the cells.

[0003] Electrolytes when flowing in the conventional flow batteries might get leaked in a long run. This affects the overall performance of the flow battery. Also, conventional flow batteries come with a fixed size (dimensions) for generating power. When there is an increase in power requirement, there is a need for another flow battery of adequate dimensions to fulfil the additional power requirement. Moreover, servicing of the conventional flow batteries is difficult. Hence, there remains a need for an efficient battery power generator that solves the aforementioned problems.

SUMMARY

[0004] The present invention provides a battery power generator for producing electricity. The battery power generator includes a first and second battery power units such that an electrolyte flows into the first and second battery power units for producing electricity. The battery power generator further includes first and second pumps that are adapted to pump the electrolyte in the first and second battery power units.

[0005] The first and second battery power units include a skid frame, a leak tray,

a plurality of fuel cells, first and second inlet pipes, first and second outlet pipes, and plurality of tubes. The skid frame is adapted to support the plurality of fuel cells, the leak tray, the first and second inlet pipes, and the first and second outlet pipes. Specifically, the leak tray supports the first and second inlet pipes. The skid frame is provided with a plurality of castor wheels that are disposed at the bottom of the skid frame. The plurality of castor wheels facilitates movement of the skid frame to insert the first and second battery power units in a container or to remove the first and second battery power units from the container.

BRIEF DESCRIPTION OF DRAWINGS

[0006] The drawing/s mentioned herein disclose exemplary aspects of the claimed disclosure. To facilitate understanding, like reference numerals have been used, where possible to designate like elements common to the figures. Other objects, features, and advantages of the present disclosure will be apparent from the following description when read with reference to the accompanying drawings:

[0007] **FIG. 1** illustrates a perspective view of a battery power generator, in accordance with an embodiment of the present invention;

[0008] **FIG. 2** illustrates a top view of the battery power generator of **FIG. 1**, in accordance with an embodiment of the present disclosure;

[0009] **FIG. 3A** illustrates a perspective exploded view of a battery power unit, in accordance with an embodiment of the present invention; and

[0010] **FIG. 3B** illustrates a perspective collapsed view of the battery power unit of **FIG. 3A**, in accordance with an embodiment of the present disclosure.

DETAILED DESCRIPTION

[0011] This section is intended to provide explanation and description of various possible aspects of the present invention. The aspects used herein, and the various features and advantageous details thereof are explained more fully with reference to non-limiting aspects illustrated in the accompanying drawing/s and detailed in the following description. The examples used herein are intended only to facilitate understanding of ways in which the aspects may be practiced and to

enable the person skilled in the art to practise the aspects used herein. Also, the examples/aspects described herein should not be construed as limiting the scope of the aspects herein.

[0012] As mentioned, there is a need for a modular battery power unit that is provided with a plurality of battery power units. By virtue of the structure of the battery power unit of the present disclosure, the battery power unit is easily serviceable and thereby easy to maintain.

[0013] **FIG. 1** illustrates a perspective view of a battery power generator **100**, in accordance with an embodiment of the present invention. The battery power generator **100** may include a plurality of rechargeable battery power units to produce electricity or electric power. The battery power units may be flow batteries or the like. The battery power generator **100** may produce 250 Kilo-watt per hour (kWh) power. The battery power generator **100** may include a plurality of battery power units of which a first and second battery power units **102A** and **102B** are shown in **FIG. 1**.

[0014] The battery power generator **100** may further include a container **104** and a chiller **106**. The first and second battery power units **102A** and **102B** may be configured to produce electricity or electric power. The first and second battery power units **102A** and the **102B** may be rechargeable battery power units. To produce electricity or electric current, an electrolyte containing one or more dissolved electroactive elements, is circulated inside the first and second battery power units **102A** and **102B**. To recharge the battery power generator **100**, the electrolyte may be circulated inside the first and second battery power units **102A** and **102B** in a fashion opposite to the flow of the electrolyte as being flown while producing electricity.

[0015] In some embodiments, the first and second battery power units **102A** and **102B** may be one of, redox type, hybrid type, and membrane-less flow type battery power unit. In some embodiments, the electrolyte inside the first and second battery power units **102A** and **102B** may be vanadium.

[0016] The container **104** may be adapted to house the plurality of first and second battery power units **102A** and **102B**. In some embodiments, the container **104**

may have length of about 20 inches. In some embodiments, the container **104** may include a plurality of access doors (not shown).

[0017] The plurality of access doors may facilitate easy entry and exit of the first and second battery power units **102A** and **102B** from the container **104**. In some embodiments, the container **104** may be made up of steel. In some embodiments, the container **104** may include corrugated walls.

[0018] In some embodiments, the container **104** may include an access hole / man-hole. The man-hole allows an operator to get into the container to repair the battery power generator **100**, in case of any fault in the battery power generator **100**.

[0019] In some embodiments, a temperature sensor (not shown) may be disposed on the container **104**. The temperature sensor may be configured to sense the temperature of the container **104**, while the battery power generator **100** produces the electricity. In some embodiments, a float switch (not shown) may be provided on the container **104**. The float switch may be adapted to indicate the level of electrolyte within the first and second battery power units **102A** and **102B**.

[0020] The chiller **106** may be coupled to the container **104**. Specifically, the chiller **106** may be fluidically coupled to the container **104**. The chiller **106** may include a chilling agent. The chilling agent may be any fluid that is capable of carrying away heat from a particular region.

[0021] The chilling agent may be pumped to the container **104** in order to provide cooling to the electrolyte that is flowing inside the first and second battery power units **102A** and **102B**, while producing electricity or while recharging the battery power generator **100**.

[0022] **FIG.2** illustrates a top view of the battery power generator **100** of **FIG. 1**, in accordance with an embodiment of the present disclosure. The battery power generator **100** may further include a plurality of pumps of which first through fourth pumps **202-208** are shown.

[0023] The first and second pumps **202** and **204** may be coupled to the first battery power unit **102A**. The first and second pumps **202** and **204** may be adapted to

pump the electrolyte in the first battery power unit **102A**. Specifically, while producing electricity and while charging the first battery power unit **102A**, the first and second pumps **202** and **204** may be adapted to maintain circulation of the electrolyte in the first battery power unit **102A**.

[0024] The third and fourth pumps **206** and **208** may be coupled to the second battery power unit **102B**. The third and fourth pumps **206** and **208** may be adapted to pump the electrolyte in the second battery power unit **102B**. Specifically, while producing electricity and while charging the second battery power unit **102B**, the third and fourth pumps **206** and **208** may be adapted to maintain circulation of the electrolyte in the second battery power unit **102B**.

[0025] In some embodiments, the container **104** may include a plurality of partitions to form a plurality of chambers for separately housing the first and second battery power units **102A** and **102B** and first through fourth pumps **202-208**. Specifically, one chamber may be adapted to house first battery power unit **102A** along-with first and second pumps **202** and **204** and another chamber may be adapted to house the second battery power unit **102B** along-with third and fourth pumps **206** and **208**.

[0026] In some embodiments, the first through fourth pumps **202-208** may be vertically arranged within the container **104**. The first through fourth pumps **202-208** may be an immersible pump.

[0027] **FIG. 3A** illustrates a perspective exploded view of a battery power unit, in accordance with an embodiment of the present disclosure. Specifically, **FIG. 3A** illustrates a perspective exploded view of the first battery power unit **102A** of the battery power generator **100**, in accordance with an embodiment of the present disclosure. **FIG. 3B** illustrates a perspective collapsed view of the battery power unit of **FIG. 3A**, in accordance with an embodiment of the present disclosure. Specifically, **FIG. 3B** illustrates a perspective collapsed view of the first battery power unit **102A** of the battery power generator **100**, in accordance with an embodiment of the present disclosure.

[0028] The first battery power unit **102A** may include a skid frame **302**, a plurality of fuel cells **303** of which first through third fuel cells **303A-303C** are

shown, first and second inlet pipes **304** and **306**, first and second outlet pipes **308** and **310**, a plurality of tubes **312**, a leak tray **314**, a plurality of castor wheels **316**, and a drag train **318**.

[0029] The skid frame **302** may be designed such that the skid frame **302** supports the first through third fuel cells **303A-303C**, the first and second inlet pipes **304** and **306**, the first and second outlet pipes **308** and **310**, and the leak tray **314**.

[0030] The plurality of castor wheels **316** may be disposed at the bottom of the skid frame **302**. The first and second inlet pipes **304** and **306** may be supported on the leak tray **314**. The leak tray **314** may be supported at a lower side of the skid frame **302**. The first and second inlet pipes **304** and **306** may be adapted to allow entrance of the electrolyte inside the first through third fuel cells **303A-303C**. Specifically, the first inlet pipe **304** may be adapted to allow entrance of positive electrolyte inside the first through third fuel cells **303A-303C** and the second inlet pipe **306** may be adapted to allow entrance of negative electrolyte inside the first through third fuel cells **303A-303C**. In some embodiments, a plurality of leak sensors (not shown) may be disposed at various locations on the leak tray **314**.

[0031] The plurality of leak sensors is configured to sense leakage of the electrolyte from the first and second inlet pipes **304** and **306**. Specifically, the plurality of leak sensors is configured to sense leakage of the positive electrolyte and the negative electrolyte from the first and second inlet pipes **304** and **306**. In some examples, the leak sensors may be configured to generate an alert signal to trigger an alarm when there is a detection in leakage of the electrolyte.

[0032] The first and second outlet pipes **308** and **310** may be supported at an upper side of the kid frame **302**. The first and second outlet pipes **308** and **310** may be adapted to allow egress of the electrolyte from the first through third fuel cells **303A-303C**. Specifically, the first outlet pipe **308** may be adapted to allow egress of the positive electrolyte from the first through third fuel cells **303A-303C** and the second outlet pipe **310** may be adapted to allow egress of the negative electrolyte from the first through third fuel cells **303A-303C**.

[0033] The first through third fuel cells **303A-303C** may be supported at a middle

side of the skid frame **302**. The plurality of tubes **312** may be coupled to different locations of the first and second inlet pipes **304** and **306** and first and second outlet pipes **308** and **310**. The plurality of tubes **312** may be coupled to the first inlet pipe **304** and the first outlet pipe **308** from one side and to the first through third fuel cells **303A-303C** from other side.

[0034] The plurality of tubes **312** may facilitate circulation of the positive electrolyte from the first inlet pipe **304** to the first through third fuel cells **303A-303C** and from the first through third fuel cells **303A-303C** to the first outlet pipe **308**. The plurality of tubes **312** may be coupled to the second inlet pipe **306** and the second outlet pipe **310** from one side and to the first through third fuel cells **303A-303C** from other side.

[0035] The plurality of tubes **312** may further facilitate circulation of the negative electrolyte from the second inlet pipe **306** to the first through third fuel cells **303A-303C** and from the first through third fuel cells **303A-303C** to the second outlet pipe **310**.

[0036] The first and second pumps **202** and 204 may be adapted to pump the positive and negative electrolytes in the first through third fuel cells **303A-303C**. In some embodiments, the plurality of tubes **312** may be coupled to the first and second inlet pipes **304** and **306** and the first and second outlet pipes **308** and **310** by a quick connect-disconnect camlock coupling.

[0037] In some embodiments, the first battery power unit **102A** may include a control unit (not shown) and a plurality of pressure sensors (not shown). The control unit may be coupled to the first and second pumps **202** and **204** and the plurality of pressure sensors may be deployed within the first and second inlet pipes **304** and **306**, the first and second outlet pipes **308** and **310**, and the plurality of tubes **312** and are coupled to the control unit.

[0038] The plurality of pressure sensors may be configured to determine pressure of flow of electrolyte that is flowing within the first and second inlet pipes **304** and **306**, the first and second outlet pipes **308** and **310**, and the plurality of tubes **312**. In a scenario when the pressure of flow of electrolyte is not appropriate, the plurality of pressure sensors may transmit a control signal to the control unit.

[0039] The control unit, upon receipt of the control signal, may be configured to control one or more operations of the first and second pumps **202** and **204** to maintain the flow rate of the electrolyte. In some embodiments, the first and second inlet pipes **304** and **306**, the first and second outlet pipes **308** and **310**, and the plurality of tubes **312** may be made up from polypropylene (PP). Embodiments of the present disclosure are intended to include and/or otherwise cover any kind of chemically compatible material without deviating from the scope of the present disclosure.

[0040] The plurality of castor wheels **316** may be disposed at a bottom side of the skid frame **302**. The plurality of castor wheels **316** may facilitate movement of the skid frame **302** on the drag train **318**. Specifically, the plurality of castor wheels **316** may be adapted to move the first battery power unit **102A** in order to insert the first battery power unit **102A** into the container **104** and to remove the first battery power unit **102A** out from the container **104**.

[0041] In some embodiments, the skid frame **302** and the leak tray **314** may be made from mild steel. In some examples, the skid frame **302** and the leak tray **314** may be coated with a paint.

[0042] Although, **FIG. 3A** and **FIG. 3B** illustrate perspective exploded and collapsed view of the first battery power unit **102A**, respectively, however, it will be apparent to a person skilled in the art that the second battery power unit **102B** may have similar or substantially similar elements with similar or substantially similar functionalities as being described hereinabove for the first battery power unit **102A**.

[0043] Certain advantages of the battery power generator **100** and the battery power unit of the present disclosure are provided as: Easy maintainability and serviceability of the battery power generator **100** and the battery power unit by making the battery power generator **100** and the battery power unit more modular and compact. The battery power generator **100** and the battery power unit consumes less space by making the elements of the battery power generator **100** and the battery power unit more intact when deployed for power generation or recharging. The battery power generator **100** is modular i.e., there is an ease

of access for various elements of the battery power generator **100**. Various elements of the battery power generator **100** are easily attachable and detachable and thereby making the battery power generator **100** modular. The battery power generator **100** is scalable i.e., various ranges of power can be produced without substantially altering the dimensions of the battery power generator **100**. For example, same battery power generator can be used for producing.

[0044] The foregoing discussion of the present disclosure has been presented for purposes of illustration and description. It is not intended to limit the present invention to the form or forms disclosed herein. In the foregoing description, for example, various features of the present invention are grouped together in one or more embodiments, configurations, or aspects for the purpose of streamlining the disclosure.

[0045] Moreover, though the description of the present disclosure has included description of one or more embodiments, configurations, or aspects and certain variations and modifications, other variations, combinations, and modifications are within the scope of the present invention, *e.g.*, as may be within the skill and knowledge of those in the art, after understanding the present disclosure. It is intended to obtain rights which include alternative embodiments, configurations, or aspects to the extent permitted, including alternate, interchangeable and/or equivalent structures, functions, ranges or steps to those claimed, whether or not such alternate, interchangeable and/or equivalent structures, functions, ranges or steps are disclosed herein, and without intending to publicly dedicate any patentable subject matter.

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CLAIMS

We claim:

1. A battery power generator **100** comprising:

a plurality of rechargeable battery power units, wherein the battery power units are flow batteries;

a container **104** housing the plurality of battery power units, the container **104** having separate mounts for leakage sensor, temperature sensor and / or a float switch, wherein the container **104** includes a plurality of partitions that form separate chambers to house the first battery power units **102A** and second battery power units **102B**;

a chiller **106** coupled to the container **104**, the chiller **106** configured to cool an electrolyte circulating within the battery power units; and

a plurality of pumps **202–208**, each coupled to at least one of the battery power units, to circulate the electrolyte for electricity production or recharging of the battery power units,

wherein

the container **104** includes a plurality of access doors to facilitate easy entry and exit of a first **102A** battery power unit and a second battery power unit **102B** from the container **104**;

the plurality of pumps **202–208** being adapted to pump the electrolyte within the first **102A** battery power unit and second battery power unit **102B**, wherein first two pumps of the plurality of pumps **202–208** counted from the container **104** are coupled to the first battery power unit **102A** to maintain circulation of the electrolyte in the first battery

power unit **102A** and subsequent two pumps of the plurality of pumps **202–208** are coupled to the second battery power unit **102B to** maintain circulation of the electrolyte in the second battery power unit **102B;** and

the battery power unit **102A / 102B** further comprising:

a skid frame **302** that supports a first through third fuel cells **303A–303C**, a first inlet pipe **304** and second inlet pipe **306**, a first outlet pipe **308** and second outlet pipe **310**, and a leak tray **314**, wherein

the first inlet pipe **304** and second inlet pipe **306** are adapted to allow entrance of positive and negative electrolyte, respectively, into the first through third fuel cells **303A–303C**,

the first outlet pipe **308** and second outlet pipe **310** are adapted to allow egress of the positive and negative electrolyte, respectively, from the first through third fuel cells **303A–303C**,

a plurality of tubes **312** for circulation of the electrolytes within the first through third fuel cells **303A–303C**.

2. The battery power generator **100** of claim 1, wherein the unit **102A / 102 B**, further comprising:

a plurality of castor wheels **316** disposed at the bottom of the skid frame **302** to facilitate movement of the battery power unit **102A / 102B**.

3. The battery power generator **100** of claim 1, wherein the unit **102A / 102 B**, further comprising:

a plurality of leak sensors disposed on the leak tray **314** to sense leakage of the electrolyte from the first inlet pipe **304** and second inlet pipe **306**.

4. The battery power generator **100** of claim 1, wherein the unit **102A / 102 B**, further comprising:

a control unit coupled to the first pump **202** and second pump **204** and a plurality of pressure sensors deployed within the first inlet pipe **304** and second inlet pipe **306**, the first outlet pipe **308** and second outlet pipe **310**, and the plurality of tubes **312**, wherein the control unit is configured to control one or more operations of the pumps **202–208** based on the pressure signals from the pressure sensors.

5. The battery power generator **100** of claim 1, wherein the unit **102A / 102 B**, further comprising:

wherein the first inlet pipe **304** and second inlet pipe **306**, the first outlet pipe **308** and second outlet pipe **310**, and the plurality of tubes **312** are made of a chemically compatible material such as polypropylene (PP).

6. The battery power generator **100** of claim 1, wherein the units **102A / 102 B**, are selected from redox type, hybrid type, or membrane-less flow battery power units.

7. The battery power generator **100** of claim 1, wherein the electrolyte in the first **102A** battery power unit and second battery power unit **102B** is vanadium.

8. The battery power generator **100** of claim 1, wherein the container **104** is made of steel and may include corrugated walls to provide structural integrity.

9. A battery power generator comprising:

a first battery power unit and a second battery power unit, each configured to generate electricity by circulating an electrolyte;

a first pump and a second pump configured to circulate the electrolyte within the first battery power unit;

a third pump and a fourth pump configured to circulate the electrolyte within the second battery power unit; and

a container configured to house the first battery power unit, the second battery power unit, the first pump, the second pump, the third pump, and the fourth pump.

10. The battery power generator of claim 9, wherein each of the first battery power unit and the second battery power unit comprises:

a skid frame;

a plurality of fuel cells supported by the skid frame;

a first inlet pipe and a second inlet pipe supported by the skid frame, configured to receive the electrolyte;

a first outlet pipe and a second outlet pipe supported by the skid frame, configured to discharge the electrolyte;

a plurality of tubes fluidly connecting the first inlet pipe, the second inlet pipe, the first outlet pipe, and the second outlet pipe to the plurality of fuel cells; and

a leak tray supported by the skid frame, configured to support the first inlet pipe and the second inlet pipe.

11. The battery power generator of claim 10, wherein the skid frame further comprises a plurality of castor wheels disposed at a bottom portion of the skid frame, facilitating movement of the battery power unit.

12. The battery power generator of claim 9, further comprising a plurality of leak sensors disposed on the leak tray, configured to detect electrolyte leakage.

13. The battery power generator of claim 9, wherein the first inlet pipe is configured to receive a positive electrolyte, and the second inlet pipe is configured to receive a negative electrolyte.

14. The battery power generator of claim 9, wherein the first outlet pipe is configured to discharge a positive electrolyte, and the second outlet pipe is configured to discharge a negative electrolyte.

15. The battery power generator of claim 9, further comprising a chiller fluidly coupled to the container, configured to cool the electrolyte.

16. The battery power generator of claim 9, wherein the first pump, the second pump, the third pump, and the fourth pump are vertically arranged within the container.

17. The battery power generator of claim 9, wherein the container includes a plurality of partitions forming chambers, wherein a first chamber houses the first battery power unit, the first pump, and the second pump, and a second chamber houses the second battery power unit, the third pump, and the fourth pump.

18. The battery power generator of claim 10, further comprising:

a control unit; and

a plurality of pressure sensors disposed within the first inlet pipe, the second inlet pipe, the first outlet pipe, the second outlet pipe, and the plurality of tubes, and coupled to the control unit;

wherein the control unit is configured to control the first pump and the second pump based on signals received from the plurality of pressure sensors.

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