US009865903B1

(12) **United States Patent**
Petrella

(10) **Patent No.: US 9,865,903 B1**
(45) **Date of Patent: Jan. 9, 2018**

(54) **PORTABLE RENEWABLE ENERGY POWER SYSTEM**

(71) Applicant: **Unlimited Power LTD**, Spindale, NC (US)

(72) Inventor: **Christopher J. Petrella**, Spindale, NC (US)

(73) Assignee: **Unlimited Power, LTD.**, Greenville, SC (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 128 days.

(21) Appl. No.: **14/630,341**

(22) Filed: **Feb. 24, 2015**

Related U.S. Application Data

(60) Provisional application No. 61/966,378, filed on Feb. 24, 2014.

(51) **Int. Cl.**

H02J 7/00	(2006.01)
H01M 10/46	(2006.01)
H01M 10/44	(2006.01)
H02S 40/32	(2014.01)
H02J 7/35	(2006.01)
H02M 7/44	(2006.01)

(52) **U.S. Cl.**
CPC ***H01M 10/465*** (2013.01); ***H02J 7/0047*** (2013.01); ***H02J 7/35*** (2013.01); ***H02M 7/44*** (2013.01); ***H02S 40/32*** (2014.12)

(58) **Field of Classification Search**
USPC 320/101
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,522,943 A *	6/1996	Spencer	H01L 31/042	136/245
5,969,501 A *	10/1999	Glidden	F24J 2/523	320/101
8,203,237 B1 *	6/2012	Cowles	H02J 7/355	307/150
2005/0093514 A1 *	5/2005	Shimizu	H02J 7/0019	320/116
2008/0029153 A1 *	2/2008	Margalit	H02J 7/355	136/252
2009/0127933 A1 *	5/2009	Simonazzi	H02J 9/062	307/66
2011/0176256 A1 *	7/2011	Van Straten	F03D 9/007	361/601
2012/0187761 A1 *	7/2012	Yanagi	H01M 10/44	307/29

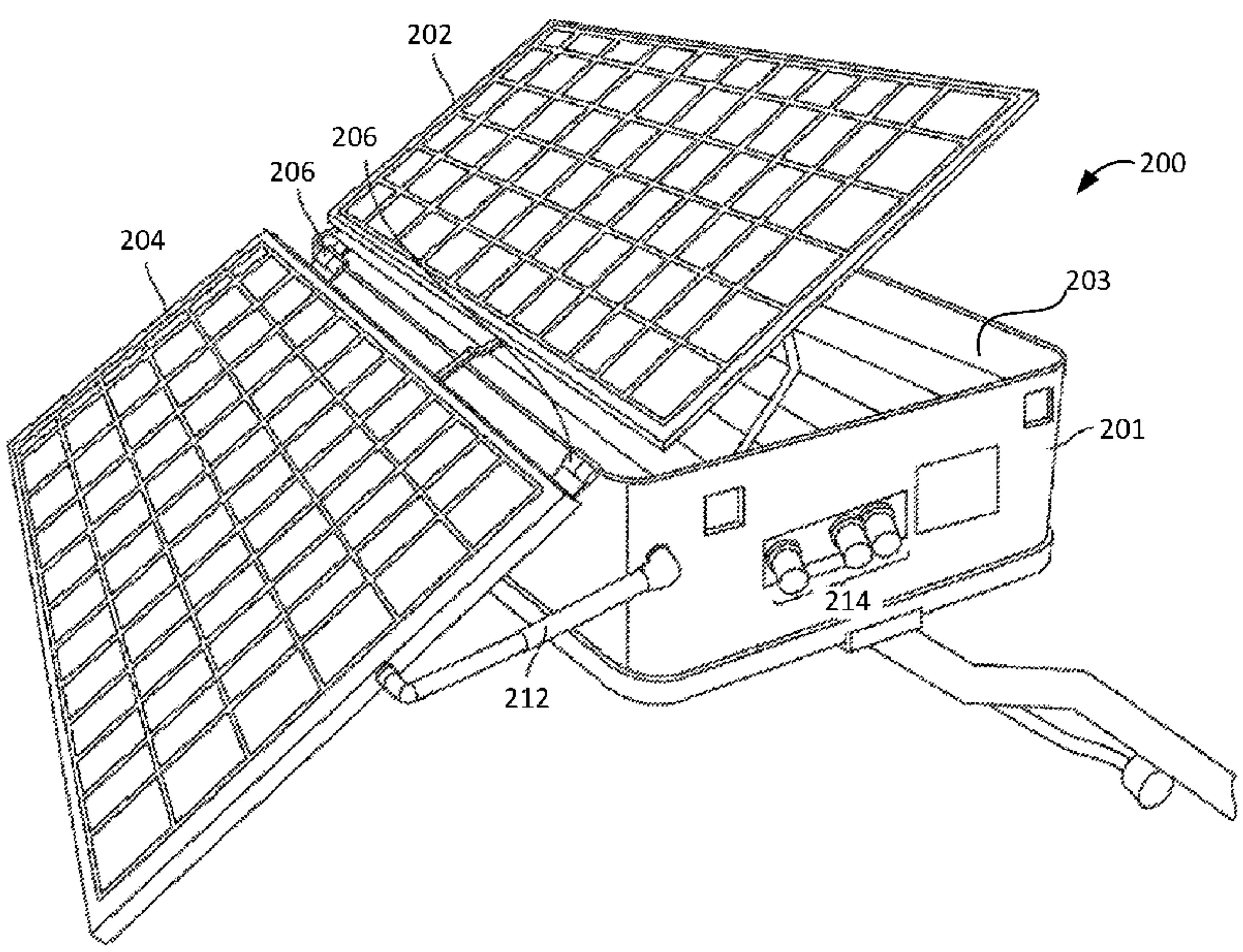
(Continued)

Primary Examiner — Samuel Berhanu
(74) *Attorney, Agent, or Firm* — McNair Law Firm, P.A.; Douglas W. Kim

(57) **ABSTRACT**

A portable renewable energy power system, the system having a first solar panel attached to an enclosure; a second solar panel hingeably attached to the enclosure; in an open position wherein the second solar panel is exposed and extends out from the enclosure; in a closed position; a battery module; a user interface comprising at least one input device and at least one display; an alternating current/direct current (AC/DC) converter; a direct current/alternating current (DC/AC) converter; and, a control module configure to provide: a solar charge configuration; a battery only configuration; a solar only configuration; and a solar and battery configuration, and a handle attached to the enclosure for carrying the system.

8 Claims, 5 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

2012/0202094	A1*	8/2012	Sada	H02J 7/355 429/9
2012/0205975	A1*	8/2012	Takehara	G06F 1/189 307/23

* cited by examiner

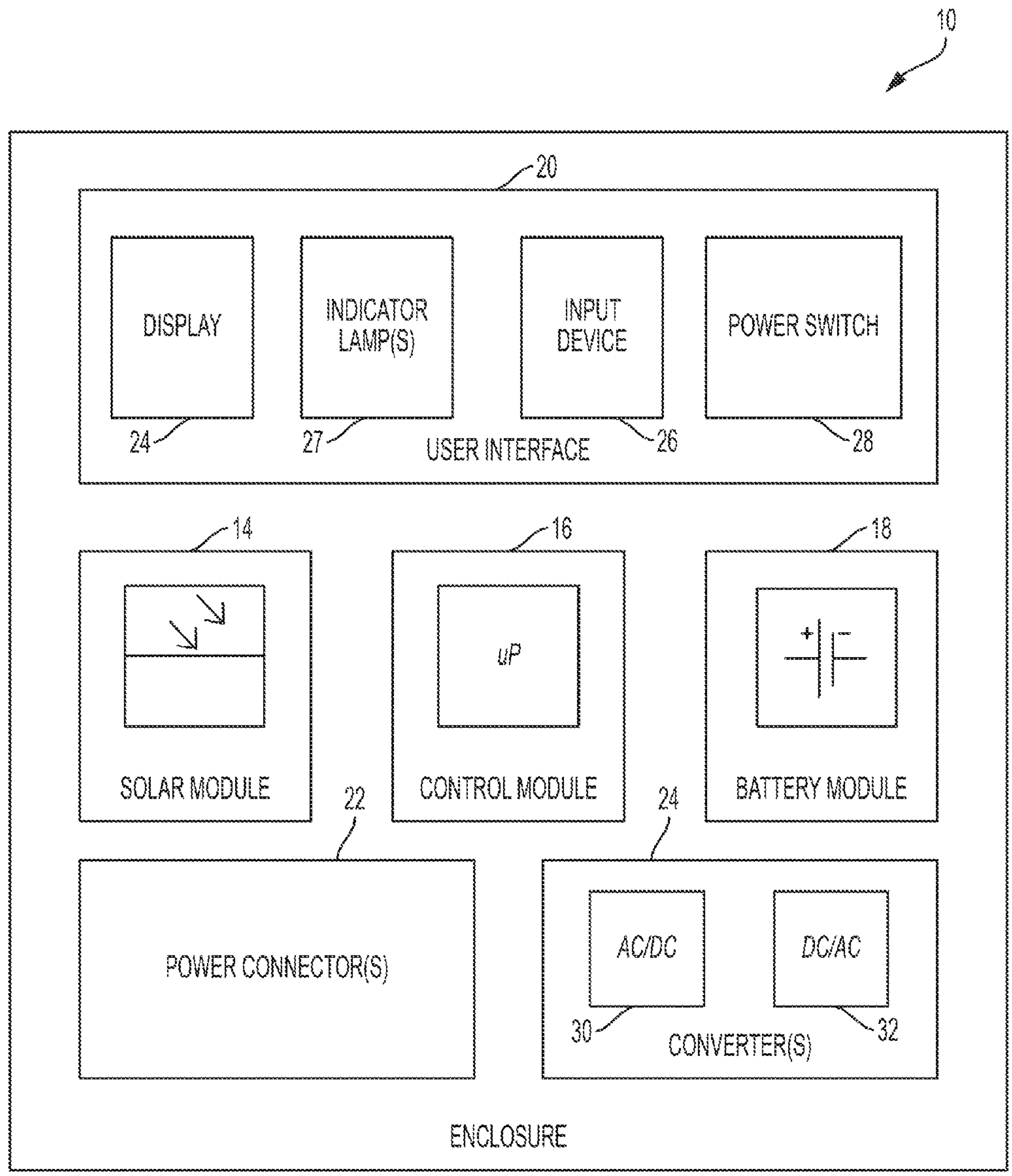

10
20
DISPLAY
INDICATOR LAMP(S)
INPUT DEVICE
POWER SWITCH
24
27
USER INTERFACE
26
28
14
16
18
uP
SOLAR MODULE
CONTROL MODULE
BATTERY MODULE
22
24
POWER CONNECTOR(S)
AC/DC
DC/AC
30
CONVERTER(S)
32
ENCLOSURE

FIG. 1

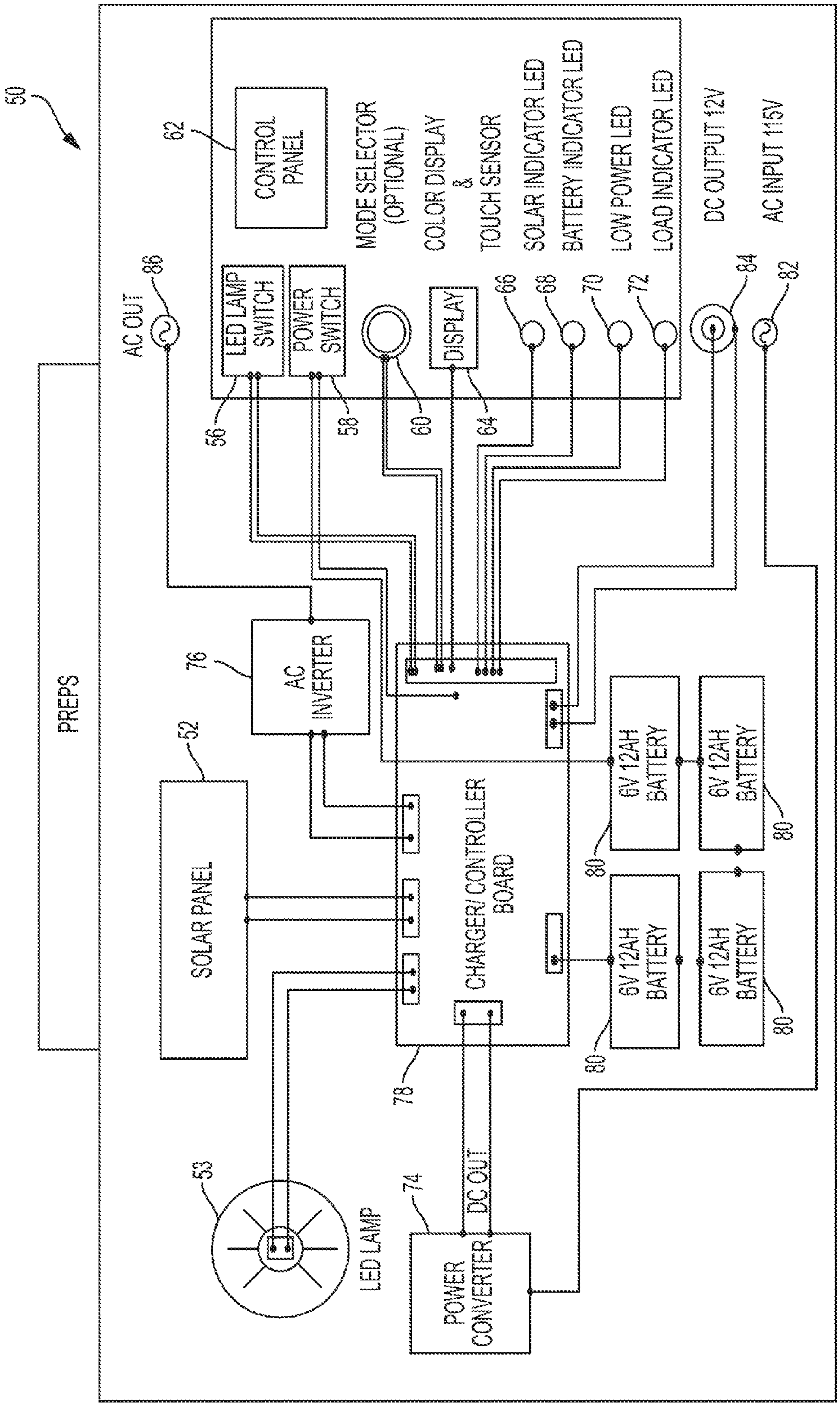

50
PREPS
CONTROL PANEL
62
MODE SELECTOR (OPTIONAL)
COLOR DISPLAY & TOUCH SENSOR
SOLAR INDICATOR LED
BATTERY INDICATOR LED
LOW POWER LED
LOAD INDICATOR LED
DC OUTPUT 12V
AC INPUT 115V
AC OUT
86
LED LAMP SWITCH
POWER SWITCH
DISPLAY
66
68
70
72
84
82
56
58
60
64
AC INVERTER
76
SOLAR PANEL
52
CHARGER/CONTROLLER BOARD
78
6V 12AH BATTERY
6V 12AH BATTERY
6V 12AH BATTERY
6V 12AH BATTERY
80
80
80
80
LED LAMP
53
POWER CONVERTER
74
DC OUT

FIG. 2

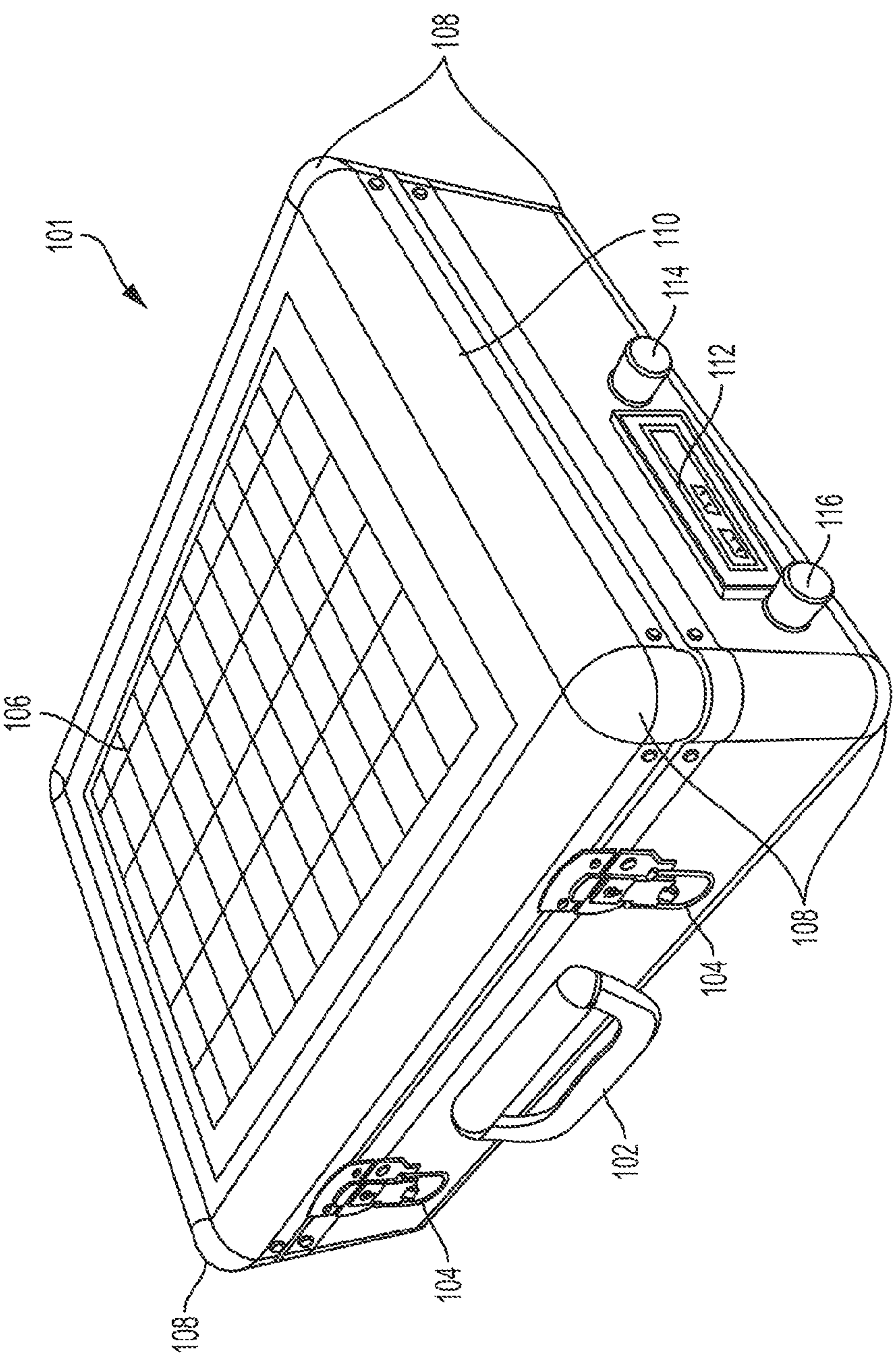


FIG. 3

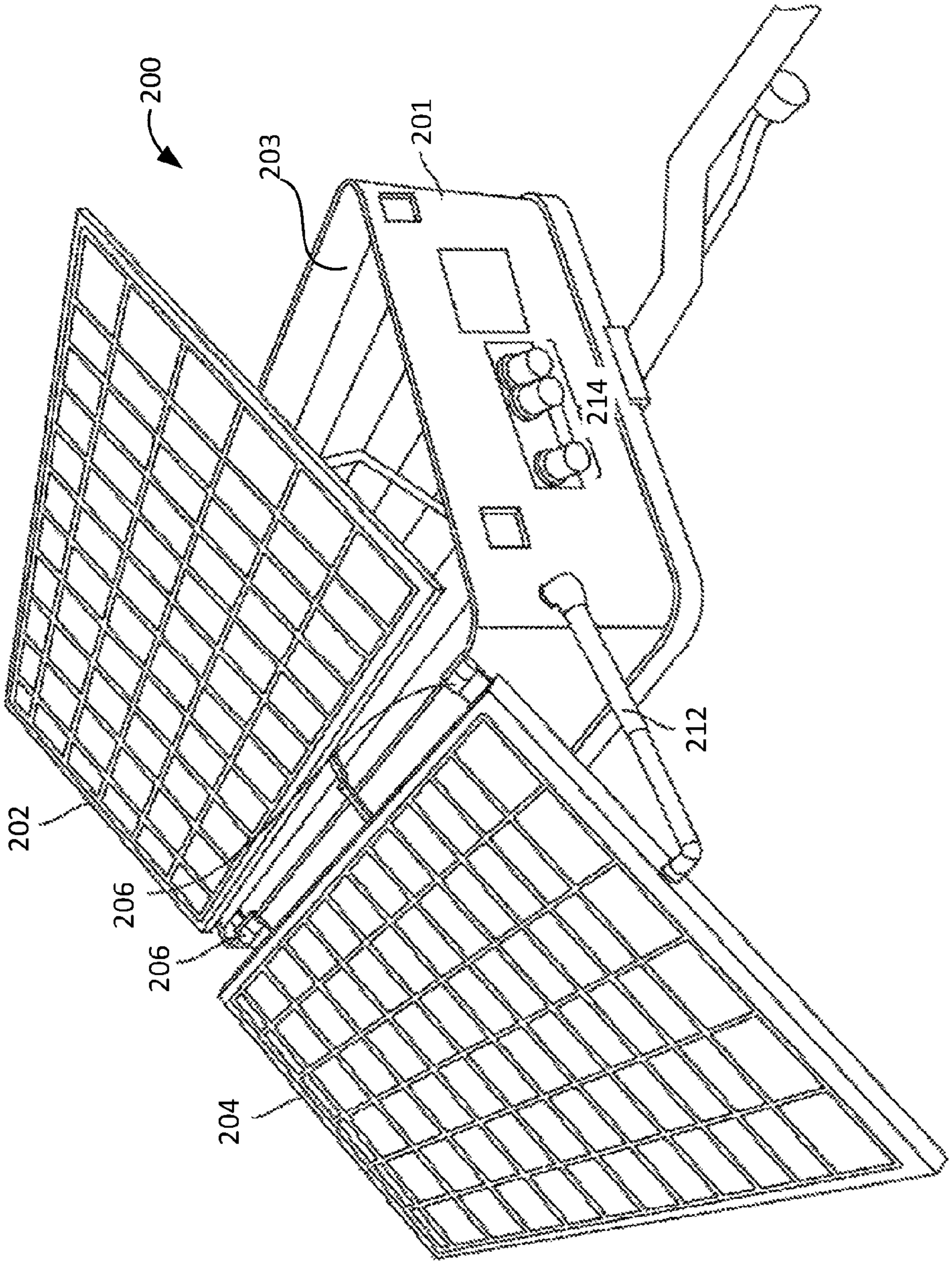


FIG. 4

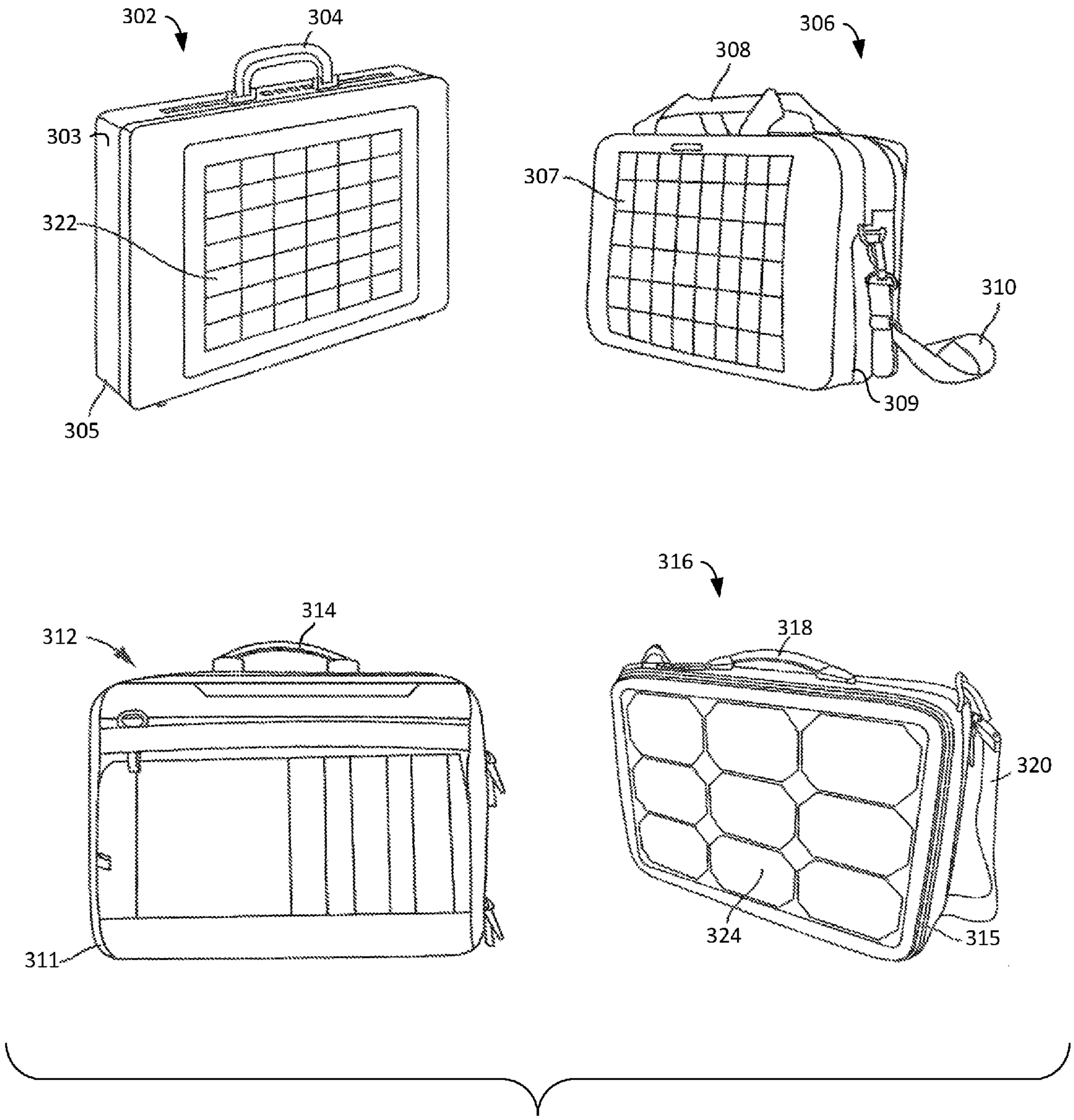

302
304
303
322
305
306
308
307
310
309
312
314
311
316
318
320
324
315

FIG. 5

PORTABLE RENEWABLE ENERGY POWER SYSTEM

PRIORITY

This application claims the benefit of U.S. Provisional Patent Application Ser. No. 61/966,378 filed on Feb. 24, 2014, which is incorporated herein by reference in its entirety.

BACKGROUND

Various examples described herein are directed to portable renewable energy power systems and methods of operating the same.

FIGURES

Various examples are described herein in conjunction with the following figures, wherein:

FIG. **1** is a block diagram showing one example of a portable power system.

FIG. **2** is a block diagram showing another example of a portable power system.

FIG. **3** is a diagram showing another example of a portable power system positioned in an example enclosure.

FIG. **4** is a diagram showing an example of an enclosure comprising deployable solar panels.

FIG. **5** shows diagrams of various examples of enclosures that may be utilized with portable renewable energy power systems.

DESCRIPTION

Various examples described herein are directed to portable renewable energy power systems (portable power systems) and methods of operating the same. Various portable power systems described herein may comprise a solar array-based battery charging system and a power inverter to generate outputs such as, for example, alternating current (AC). Portable power systems, as described herein, may be housed in a briefcase-type enclosure having dimensions similar to that of a briefcase. Various examples of portable power systems described herein may serve as power sources in remote locations or in back-up situations where the power supply must be portable, and/or if other power sources are not available.

FIG. **1** is a block diagram showing one example of a portable power system **10**. The portable power system may comprise various components including, for example, a solar module **14**, a battery module **18**, a control module **16**, a user interface module **20**, one or more power connectors **22** and one or more converters **24**. The modules **14**, **16**, **18**, **20**, **22**, **24** may positioned in an enclosure **12**. In various examples, the various components of the portable power system **10** may be sized to enhance portability. For example, the enclosure **12** may have a size comparable to that of a briefcase or suitcase. The various components positioned in the enclosure **12** may be sized to fit within the enclosure, allowing the system **10** to be moved from place-to-place.

The solar module **14** may comprise any suitable type of photovoltaic cell or other device for converting solar energy into electricity. For example, the solar module **14** may comprise an array of photovoltaic cells. When the solar module **14** comprises photovoltaic cells, any suitable type of cell may be used including, for example, monocrystalline silicon solar cells, polycrystalline silicon solar cells, string ribbon solar cells, thin-film solar cells, amorphous silicon solar cells, cadmium telluride (CdTe) solar cells, copper indium gallium selenide (CIS/CIGS) solar cells, etc. In some examples, the solar module may comprise an array of photovoltaic cells configured to provide fifteen (15) Watts (W) of power at a maximum voltage of twenty-four (24) Volts. In some examples, the solar module may comprise an array of photovoltaic cells configured to provide about one hundred and fifty (150) W.

The battery module **18** may comprise one or more battery cells. The battery cells may be charged either from an external power source and/or by the solar module **14**. Battery cells included in the battery module **18** may be of any suitable type including, for example, Lithium-ion cells, nickel-cadmium cells, lead-acid cells, etc. In some example, the battery module **18** may comprise four sealed lead acid battery cells connected in series. Each of the sealed lead acid battery cells may have a capacity of twelve (12) amp-hours and a voltage of sic (6) Volts (V).

Converter module **24** may comprise one or more power converters **30**, **32** for converting power between alternating current (AC) and direct current (DC). An AC/DC converter **30** may convert alternating current to direct current. The AC/DC converter **30** may be configured to receive power from an external source (e.g., an electric outlet powered by the electric grid) and convert the received power to direct current for charging battery cells comprising the battery module **18**. In this way, a user may plug-in the system **10** to charge the battery module **18**. Any suitable AC/DC converter architecture may be used. In some examples, the AC/DC converter **30** may receive an input of between one hundred (100) and two-hundred and forty (240) V at between fifty (50) Hertz (Hz) and sixty (60) Hz. The AC/DC converter **30** may provide a direct current output of between twelve (12) V and twenty-four (24) V, with a maximum output current of ten (10) A at two-hundred and forty (240) W. In some embodiments, the AC/DC converter **30** may be solid state, for example, the AC/DC converter **30** may not have any moving parts. The AC/DC converter **30** may be configured to maximize battery life and minimize heat generation. In some examples, the converter may comprise a processor configured to execute battery management software. The battery management software may be configured to enhance battery life by sampling and adjusting the power in and out. Any suitable sampling and/or adjusting rate may be used. In this way, heat and strain on the circuits of the system may be reduced.

The converter module **24** may also comprise a DC/AC converter **32**. The DC/AC converter **32** may be configured to receive power from a DC source, such as the solar module **14** and/or the battery module **18**, and convert the received power into an AC current that may be used by traditional devices designed for use on an AC power grid. The DC/AC converter **32** may receive an input of about twelve (12) V and provide an AC output of between one-hundred fifteen (115) V and two-hundred and forty (240) V at between fifty (50) Hertz (Hz) and sixty (60) Hz. In some examples, the maximum output power is one-hundred fifty (150) W.

Power connector module **22** may comprise various connectors for providing and receiving power. For example, the power connector module **22** may comprise a connector for connecting the system **10** to a standard power grid to receive power, for example, to charge battery cells of the battery module **18**. The power connector module **22** may also comprise one or more connectors for connecting the system **10** to one or more devices to be powered by the system (e.g., from the battery module **18** and/or the solar module **14**). In some examples, a single connector may be used to both provide power to the system **10** from a standard power grid and to provide power from the system **10** to one or more devices.

The user interface **20** may comprise various components allowing a user to interact with and configure the system **10**. The user interface **20** may comprise one or more displays **24**, one or more input devices **26**, one or more indicator lamps **27**, and one or more power switches **28**. The display **24** may comprise any suitable type of display including, for example, a display screen, a speaker, etc. The input device **26** may comprise any suitable device for providing input to the system including, for example, a keypad, a pointing device such as a mouse or touchpad, embedded membrane switches, etc. In some examples, the user interface **20** may comprise a touch screen that forms all or part of the display(s) **24** and all or part of the input device(s). In some examples, a touchpad may comprise a 1.7 inch diagonal liquid crystal display (LCD) integrated with an overlaid touch sensor and polyester overlay. Indicator lamps **27** may include lamps such as light emitting diodes (LEDs) or other suitable lamps. For example, indicator lamps **27** may indicate a mode or configuration of the system **10**. The power switch **28** may be actuatable to turn the system **10** on and/or off.

The control module **16** may comprise one or more microprocessors and/or other control components configured to control the operation of the system **10**. Any suitable microprocessor may be used. In some examples, the control module **16** may utilize a CORTEX M-3 microprocessor available from ARM. In some examples, the control module **16** may utilize an embedded microcontroller architecture. The control module **16** may be programmed to configure and monitor functional states of the system **10**, monitor the condition of the battery module **18**, and provide a graphical user interface (GUI) via the components of user interface **20**. In some examples, the control module **16** may utilize one or more relays, transistors, or other switching elements to change the configuration or functional state of the system, for example, by changing the connectivity between the various components of the system **10**. The system **10** may comprise various configurations or functional states that may be set by the control module **16**, for example, in response to input received via the user interface **20**.

According to an external charge configuration, the control module **16** may configure the system **10** to receive an AC signal via a power connector **22**, convert the AC signal to a DC signal utilizing the AC/DC converter **30**, and provide the DC signal to the battery module **18** to charge the battery cells. According to an internal charge configuration, the control module **16** may configure the system to route a DC signal generated by the solar module **14** to the battery module **18** to charge the battery cells. In some examples, the control system and/or the converter module **24** may comprise components for performing suitable DC/DC conversion to the DC signal generated by the solar module **14** so as to make it suitable for charging the battery module **18**. According to a hybrid power configuration, the control module **16** may configure the system **10** to provide power to an external load (e.g., via power connector **22**) from the solar module **14** and/or the battery module **18**. For example, in the hybrid power configuration, the external load may be driven by the solar module **14** if it is providing enough power to drive the load (e.g., if the solar cells are deployed and in sufficient sunlight). If the solar module **14** does not provide sufficient power to drive the load, it may be supplemented by the battery module **18**. According to a battery-only configuration, the control module **16** may configure the system **10** to provide power to the load from the battery only. According to a solar-only configuration, the control module **16** may configure the system **10** to provide power from the solar module **14** only. In some examples, the control module **16** may configure the system **10** to allow the solar module **14** to charge the battery module **18** while the system **10** is powering a load. For example, in the solar-only configuration and hybrid power configuration, the control module **16** may configure the system **10** such that solar power (if any) above what is needed to drive the load is provided to charge the battery module **18**. In the battery-only mode, any power generated by the solar module **14** may be provided to charge the battery module **18**.

The enclosure **12** may be made from any suitable material including, for example, plastic or plastic alloy components. For example, the enclosure **12** may comprise components made from injection-molded Acrylonitrile butadiene styrene (ABS) or a suitable alloy thereof. In some examples, tooling may be developed for each plastic component. In some examples, the enclosure **12** may be made from a material that is impervious to deteriorative elements that are expected to be encountered during normal use such as, for example, outer elements such as snow, wind, and rain, knocks and bumps as users carry the system **10** from place to place, etc. In some examples, the enclosure **12** may be designed to support operational integrity and ergonomic factors in multiple orientations, as described herein.

FIG. **2** is a block diagram showing another example of a portable power system **50**. In some examples, the portable power system **50** is an implementation of the system **10** described herein above. The system may comprise one or more solar panels **52**, for example, part of the solar module **14** described above. The system **50** may additionally comprise a charger/controller board **78**. For example, the charger/controller board **78** may comprise components for implementing the control module **16** including, for example, one or more microprocessors, microcontrollers, digital signal processors (DSPs), etc. The charger/controller board **78** may be in communication with batteries **80**, which may make up all or part of the battery module **18**. The charger controller board **78** may additionally be in communication with an AC/DC power converter **74** and a DC/AC converter or AC inverter **76**. The power converter **74** may be connected to receive an AC input **82** and provide a DC output. The DC output may be connected by the charger/controller board **78** to charge the batteries **80** and/or may be connected to a DC output port **84**, for example, to power devices configured to operate on a DC rail, such as twelve (12) V. The AC inverter **76** may be connected to receive a DC signal (e.g., from the power converter **74** and/or the solar panel **52**). The DC signal may be provided to an AC out port **86**. For example, the AC out port **86**, the DC out port **84** and the AC input port **82** may be part of the power connector module **22** described herein.

In some examples, the system **50** further comprise an LED lamp **53**, which may provide light to users configuring the device. A control panel **62** may comprise components making up the user interface **20** described herein above. For example, the control panel may comprise an LED lamp switch **56**, which may be operative to light and extinguish the LED lamp **53**. A power switch **58** may turn power to the system **50** on and off. A mode selector **60** may comprise a rotary or other switch allowing a user to select a configuration for the system **50**. The display **64** may comprise an LCD touchscreen, as described above. A solar indicator LED or other lamp **66** may be programmed to light when the solar panel **52** is generating an electric signal. A battery indicator LED or other lamp may be programmed to light when the battery has reached a predetermined state (e.g., fully charged, nearly discharged, etc.). A low power LED **70** may be programmed to light when the system **50** is not capable of delivering its indicated power. A load indicator LED **72** may be configured to light when a load is present (e.g., across the AC output **86**).

FIG. **3** is a diagram showing one example of a portable power system **100** positioned in an example enclosure **101**. The enclosure **101** may be made of any suitable material, for example, as described herein. In various examples, the enclosure **101** may comprise a handle **102** allowing the system **100** to be lifted and transported, for example, by a single human user. The example enclosure **101** may open along a seam **110**. In some examples, components making up the user interface **20** are positioned inside the enclosure **101**, for example, to provide protection from the elements. Latches **104** may secure the enclosure **101** in the closed position that is shown. In some examples, the enclosure **101** may be made from a plastic, as described, with corner guards **108** made from a metal, such as steel. The enclosure **101** shown in FIG. **3** comprises an externally positioned solar panel **106**. Input knobs **116**, **114** and a touch screen **112** may provide input and output capabilities for controlling the system **100**.

FIG. **4** is a diagram showing an example of an enclosure **201** comprising deployable solar panels **202**, **204**. The enclosure **201** is shown in an open position with the solar panels **202**, **204**, deployed. An extendable strut **212** may support the panel **204** as shown. The panels may be un-deployed by folding panel **204** onto panel **202** along hinges **206**. The two panels may be folded over a remainder of the enclosure **201** to transition to a closed state with the panels **202**, **204** positioned inside the enclosure **201**. The strut **212** may be retracted as the panels **204**, **206** are un-deployed. Display lamps **214** are also positioned on an exterior of the enclosure **201**.

FIG. **5** shows diagrams of various examples of enclosures that may be utilized with portable renewable energy power systems. An enclosure **302** may comprise a hard shell material (e.g., plastic, metal or other suitable material) and may be hinged to open along hinge **305**. The enclosure **302** also comprises a handle **304** for carrying. A solar panel **322** comprising an array of solar cells may be positioned on an exterior portion of the enclosure. An enclosure **306** may be made from a soft nylon material. The enclosure **306** may comprise an external solar panel **307** and may hinge about hinge **309**. In some examples, the enclosure **306** may be secured in the closed position by a zipper or other suitable fastener. The enclosure **306** may be usable in multiple orientations. For example, a user may transport the enclosure **306** by grasping handles **308**. In some examples, the user may also transport the enclosure **306** utilizing the handle strap **310**. The enclosure **312** may hinge about hinge **311** and may comprise a handle **314** for carrying. The enclosure **316** may also hinge about a hinge **315** and may comprise a handle **318** and carrying strap **320**. The enclosure **316** may additionally comprise an exterior solar panel **324**.

In some examples, multiple portable power systems may be connected in parallel and/or series to act as a single power system. For example, power systems may be connected in series to increase the available voltage output. Power systems may be connected in parallel, for example, to increase the available current and power output. Each power system may be configurable by its control module **16** for multi-unit connection.

In various examples, components of portable power systems described herein may be selected such that the portable power systems meet certain operating parameters. Some examples of portable power systems may be configured to operate between −30° and 70° C. and to tolerate storage at temperatures between −40° and 85° C. Some examples of portable power systems may be configured to operate and be stored at humidity levels between 10% and 95%. Some examples of portable power systems may be configured to operate between 0 and 10,000 feet and be stored between 0 and 40,000 feet. Some examples of portable power systems may be configured to operate through vibrations of 20 Hz to 50 Hz, 10 meters/second^2, 0.5 oct/min, along 3 axes. Some examples of portable power systems may be configured to have a shock resistance of at least 294 meters/second^2. Some examples of portable power systems may be configured to meet International Protection Specification IP65. Some examples of portable power systems may be configured to meet EN 55022/FCC Class A (Class B targeted) standards for radio disturbance characteristics for information technology equipment. Some examples of portable power systems may be configured to meet EN 55024 immunity characteristics and limits for information technology equipment. Some examples of portable power systems may be configured to be compliant with RoHS environmental regulations.

Reference in the specification to, "examples," "various examples," "some examples," etc. means that a particular feature, structure, or characteristic described in connection with the examples is included in at least one example of the invention. The appearances of the above-referenced phrases in various places in the specification are not necessarily all referring to the same example. Reference to examples is intended to disclose examples, rather than limit the claimed invention. While the invention has been particularly shown and described with reference to several examples, it will be understood by persons skilled in the relevant art that various changes in form and details can be made therein without departing from the spirit and scope of the invention.

It should be noted that the language used in the specification has been principally selected for readability and instructional purposes, and may not have been selected to delineate or circumscribe the inventive subject matter. Accordingly, the present disclosure is intended to be illustrative, but not limiting, of the scope of the invention.

It is to be understood that the figures and descriptions of example embodiments of the present disclosure have been simplified to illustrate elements that are relevant for a clear understanding of the present disclosure, while eliminating, for purposes of clarity, other elements, such as, for example, details of system architecture. Those of ordinary skill in the art will recognize that these and other elements may be desirable for practice of various aspects of the present examples. However, because such elements are well known in the art, and because they do not facilitate a better understanding of the present disclosure, a discussion of such elements is not provided herein.

It is to be understood that the figures and descriptions of example embodiments of the present disclosure have been simplified to illustrate elements that are relevant for a clear understanding of the present disclosure, while eliminating, for purposes of clarity, other elements, such as, for example, details of system architecture. Those of ordinary skill in the art will recognize that these and other elements may be desirable for practice of various aspects of the present examples. However, because such elements are well known in the art, and because they do not facilitate a better

understanding of the present disclosure, a discussion of such elements is not provided herein.

It can be appreciated that, in some examples of the present methods and systems disclosed herein, a single component can be replaced by multiple components, and multiple components replaced by a single component, to perform a given command or commands. Except where such substitution would not be operative to practice the present methods and systems, such substitution is within the scope of the present disclosure. Examples presented herein, including operational examples, are intended to illustrate potential implementations of the present method and system examples. It can be appreciated that such examples are intended primarily for purposes of illustration. No particular aspect or aspects of the example method, product, computer-readable media, and/or system examples described herein are intended to limit the scope of the present disclosure.

It will be appreciated that the various components of the environment 100 may be and/or be executed by any suitable type of computing device including, for example, desktop computers, laptop computers, mobile phones, palm top computers, personal digital assistants (PDA's), etc. As used herein, a "computer," "computer system," "computer device," or "computing device," may be, for example and without limitation, either alone or in combination, a personal computer (PC), server-based computer, main frame, server, microcomputer, minicomputer, laptop, personal data assistant (PDA), cellular phone, pager, processor, including wireless and/or wireline varieties thereof, and/or any other computerized device capable of configuration for processing data for standalone application and/or over a networked medium or media. Computers and computer systems disclosed herein may include operatively associated memory for storing certain software applications used in obtaining, processing, storing and/or communicating data. It can be appreciated that such memory can be internal, external, remote or local with respect to its operatively associated computer or computer system. Memory may also include any means for storing software or other instructions including, for example and without limitation, a hard disk, an optical disk, floppy disk, ROM (read only memory), RAM (random access memory), PROM (programmable ROM), EEPROM (extended erasable PROM), and/or other like computer-readable media.

Some portions of the above disclosure are presented in terms of methods and symbolic representations of operations on data bits within a computer memory. These descriptions and representations are the means used by those skilled in the art to most effectively convey the substance of their work to others skilled in the art. A method is here, and generally, conceived to be a sequence of actions (instructions) leading to a desired result. The actions are those requiring physical manipulations of physical quantities. Usually, though not necessarily, these quantities take the form of electrical, magnetic or optical signals capable of being stored, transferred, combined, compared and otherwise manipulated. It is convenient at times, principally for reasons of common usage, to refer to these signals as bits, values, elements, symbols, characters, terms, numbers, or the like. Furthermore, it is also convenient at times, to refer to certain arrangements of actions requiring physical manipulations of physical quantities as modules or code devices, without loss of generality. It should be borne in mind, however, that all of these and similar terms are to be associated with the appropriate physical quantities and are merely convenient labels applied to these quantities. Unless specifically stated otherwise as apparent from the preceding discussion, it is appreciated that throughout the description, discussions utilizing terms such as "processing" or "computing" or "calculating" or "determining" or "displaying" or the like, refer to the action and processes of a computer system, or similar electronic computing device, that manipulates and transforms data represented as physical (electronic) quantities within the computer system memories or registers or other such information storage, transmission or display devices.

Certain aspects of the present disclosure include process steps and instructions described herein in the form of a method. It should be noted that the process steps and instructions of the present disclosure can be embodied in software, firmware or hardware, and when embodied in software, can be downloaded to reside on and be operated from different platforms used by a variety of operating systems.

The present disclosure also relates to an apparatus for performing the operations herein. This apparatus may be specially constructed for the required purposes, or it may comprise a general-purpose computer selectively activated or reconfigured by a computer program stored in the computer. Such a computer program may be stored in a computer readable storage medium, such as, but is not limited to, any type of disk including floppy disks, optical disks, CD-ROMs, magnetic-optical disks, read-only memories (ROMs), random access memories (RAMs), EPROMs, EEPROMs, magnetic or optical cards, application specific integrated circuits (ASICs), or any type of media suitable for storing electronic instructions, and each coupled to a computer system bus. Furthermore, the computers and computer systems referred to in the specification may include a single processor or may be architectures employing multiple processor designs for increased computing capability.

The methods and systems presented herein, unless indicated otherwise, are not inherently related to any particular computer or other apparatus. Various general-purpose systems may also be used with programs in accordance with the teachings herein, or it may prove convenient to construct more specialized apparatus to perform the disclosed method actions. The structure for a variety of these systems will appear from the above description. In addition, although some of the examples herein are presented in the context of a particular programming language, the present disclosure is not limited to any particular programming language. It will be appreciated that a variety of programming languages may be used to implement the teachings of the present disclosure as described herein, and any references above to specific languages are provided for disclosure of enablement and best mode of the present disclosure.

The term "computer-readable medium" as used herein may include, for example, magnetic and optical memory devices such as diskettes, compact discs of both read-only and writeable varieties, optical disk drives, and hard disk drives. A computer-readable medium may also include non-transitory memory storage that can be physical or virtual.

I claim:

1. A portable renewable energy power system, the system comprising:

a first solar panel attached to an enclosure;

a second solar panel hingeably attached to the enclosure and deployable away from a solar cavity defined in the enclosure;

an open position wherein the second solar panel is exposed and extends out from the enclosure;

a closed position wherein the second solar panel is stored and received within the enclosure and the solar panel cavity is covered by an exterior portion of the enclosure;

a battery module comprising a plurality of battery cells;

a user interface comprising at least one input device and at least one display;

an alternating current/direct current (AC/DC) converter;

a direct current/alternating current (DC/AC) converter; and,

a control module comprising at least one processor, wherein the control module is programmed to configure the system among a plurality of configurations including:

an external charge configuration wherein in the external charge configuration, the system is configured to receive an alternating current (AC), convert the AC to a direct current (DC) with the AC/DC converter, and provide the DC to charge the battery module;

a solar charge configuration wherein in the solar charge configuration, the system is configured to receive solar generated power generated by the first solar panel and the second solar panel, and charge the battery with the solar generated power;

a battery only configuration wherein in the battery only configuration, the system is configured to convert the DC from the battery to an output AC with the DC/AC converter and an output DC;

a solar only configuration wherein in the solar only configuration, the system is configured to convert the DC from the first solar panel and the second solar panel to an output AC with the DC/AC converter and an output DC; and,

a solar and battery configuration wherein in the solar and battery configuration, the system is configured to convert the DC from the first solar panel, second solar panel, and battery to an output AC with the DC/AC converter and an output DC;

a handle attached to the enclosure for carrying the system, wherein the battery module, the AC/DC converter, the DC/AC converter, and the control module are positioned within the enclosure.

2. The system of claim **1**, wherein the user interface comprises a plurality of indicator lamps indicating the configuration of the system.

3. The system of claim **1**, wherein the user interface comprises a touchscreen display.

4. The system of claim **1**, wherein the first solar panel includes a plurality of photovoltaic cells that comprise at least one photovoltaic cell selected from the group consisting of: a monocrystalline silicon solar cell, a polycrystalline silicon solar cell, a string ribbon solar cell, a thin-film solar cell, an amorphous silicon solar cell, a cadmium telluride (CdTe) solar cell, and a copper indium gallium selenide (CIS/CIGS) solar cell.

5. The system of claim **1**, wherein the plurality of battery cells comprises at least one battery cell selected from the group consisting of: a Lithium-ion cell, a nickel-cadmium cell, and a lead-acid cell.

6. The system of claim **1**, wherein the plurality of battery cells comprises four sealed lead acid battery cells connected in series.

7. The system of claim **1**, wherein the control module is further programmed to configure the system according to an internal charge configuration wherein in the internal charge configuration, the system is configured to and receive a solar generated power by the solar module; and provide the solar generated power to charge the battery module.

8. The system of claim **1**, wherein the control module is further programmed to configure the system according to a hybrid power configuration wherein in the hybrid power configuration, the system is configured to receive a solar generated power; convert the solar generated power to a solar AC with the DC/AC converter; provide the solar AC to a load; determine that the solar AC is insufficient to drive the load; convert a battery generated power to a battery AC with the DC/AC converter; and, provide the battery AC to the load.

* * * * *