US 20180294534A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2018/0294534 A1**

Sala (43) **Pub. Date: Oct. 11, 2018**

(54) **SOLAR USB CHARGER**

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(21) Appl. No.: **15/936,067**

(22) Filed: **Mar. 26, 2018**

Related U.S. Application Data

(63) Continuation of application No. 13/103,972, filed on May 9, 2011, now Pat. No. 9,929,443.

(60) Provisional application No. 61/395,141, filed on May 8, 2010.

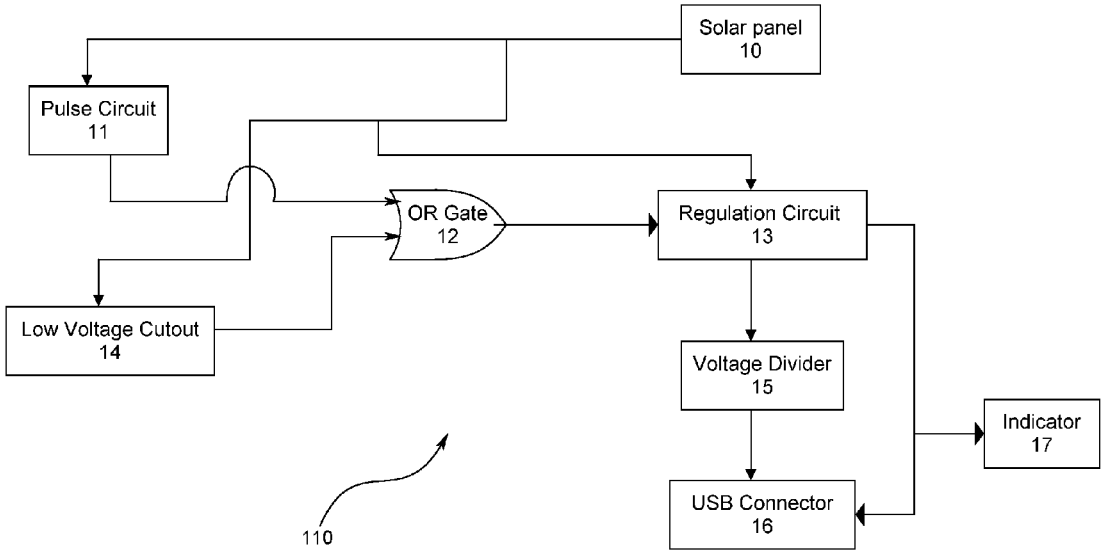
Publication Classification

(51) **Int. Cl.**
H01M 10/46 (2006.01)

(52) **U.S. Cl.**
CPC ***H01M 10/465*** (2013.01)

(57) **ABSTRACT**

A solar USB charger for providing power to electrical devices from solar energy without the use of an internal battery is described. The charger includes one or more solar cells, an electronic circuit and a means to connect the solar USB charger to the electrical devices that needs to be charged. An auto reset feature within the charger helps to correct for passing clouds or other factors that reduce the charger's output. The charger has a durable and simple low profile folding design that protects the solar cells from impact or scratching when the device is not in use.



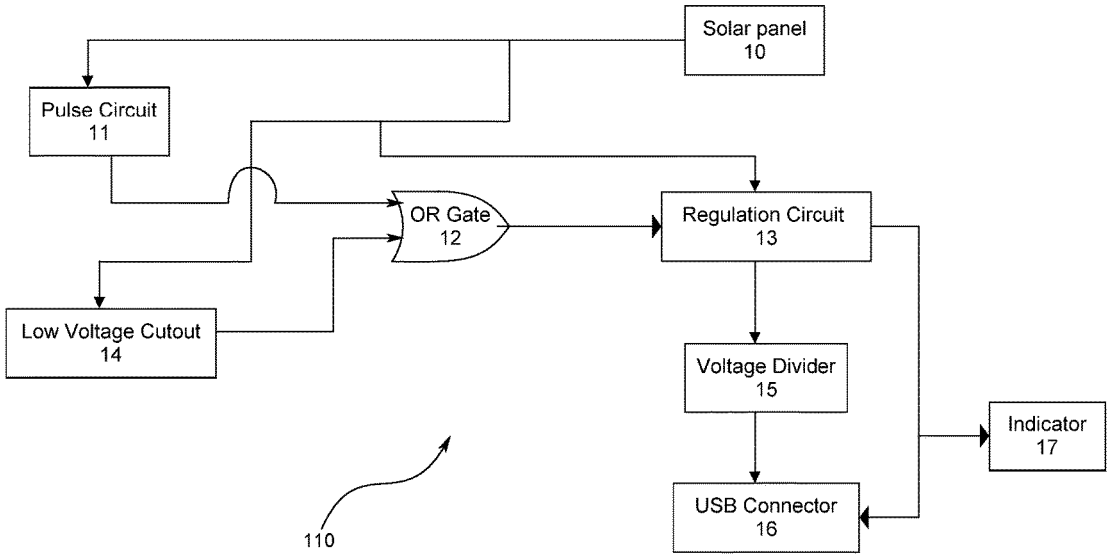

Solar panel
10
Pulse Circuit
11
OR Gate
12
Regulation Circuit
13
Low Voltage Cutout
14
Voltage Divider
15
Indicator
17
USB Connector
16
110

FIG.1

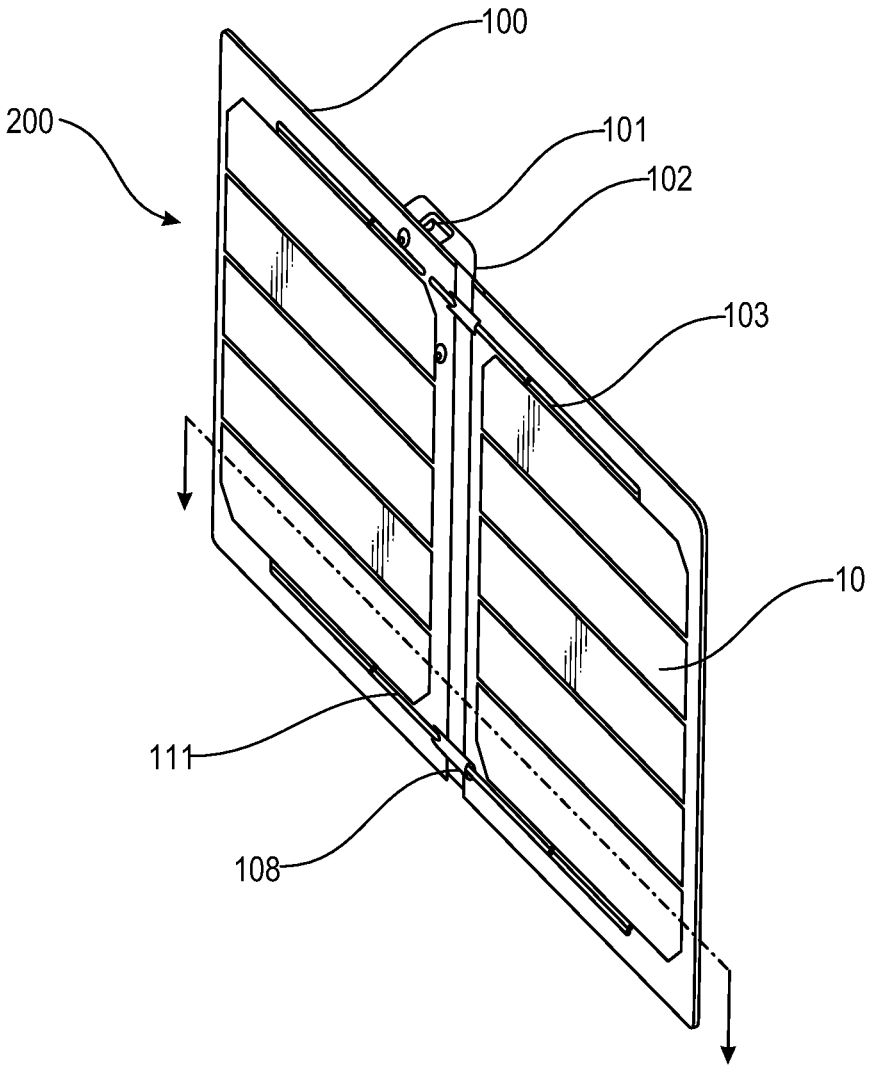


FIG. 2

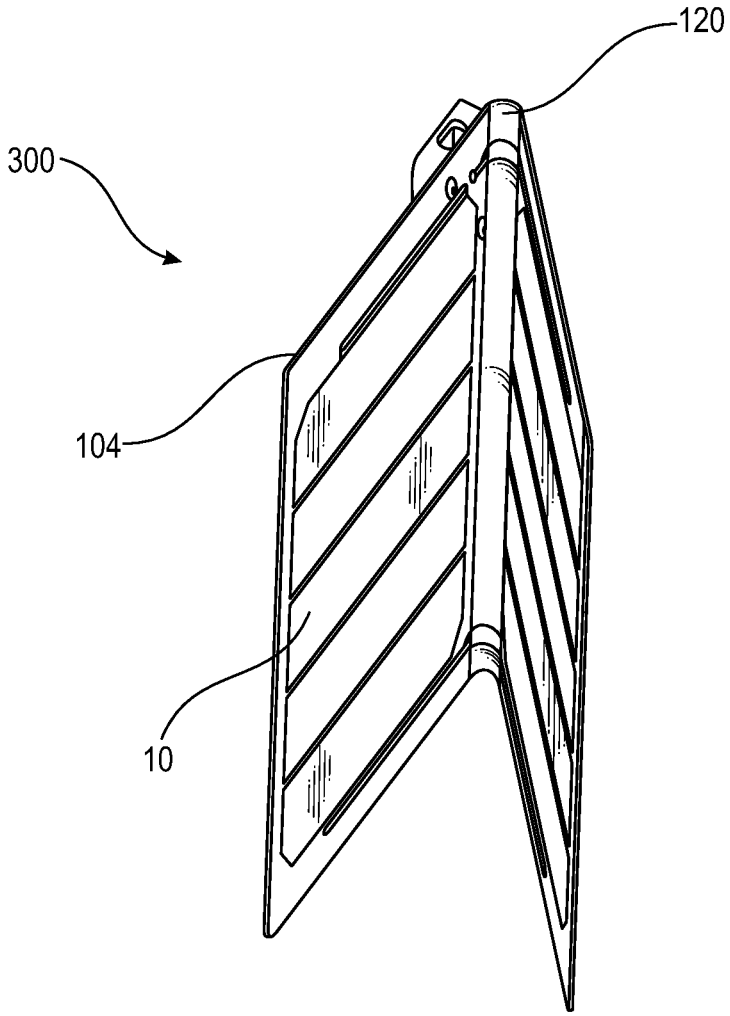


FIG. 3

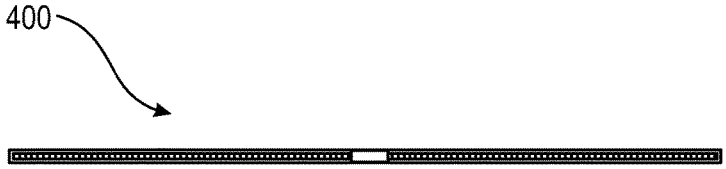


FIG. 4

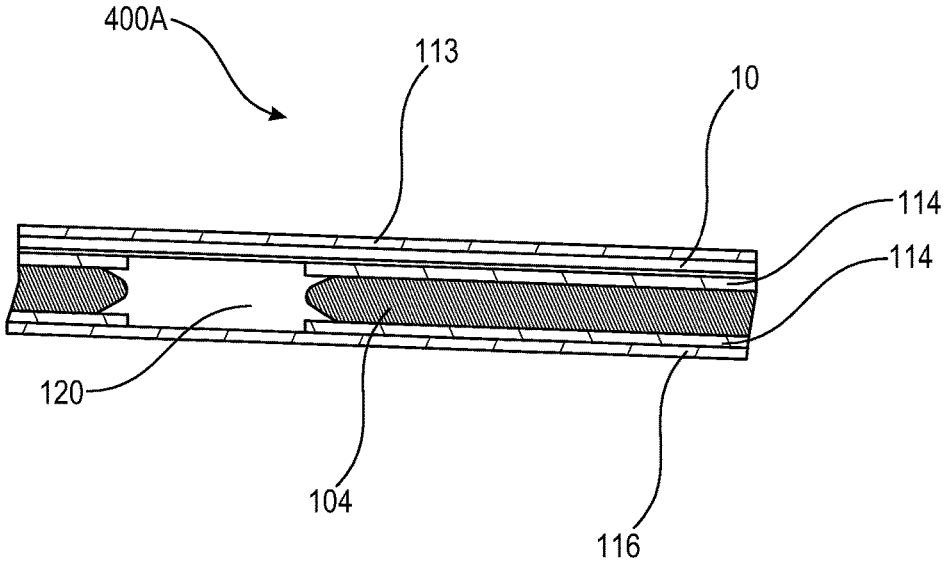


FIG. 4A

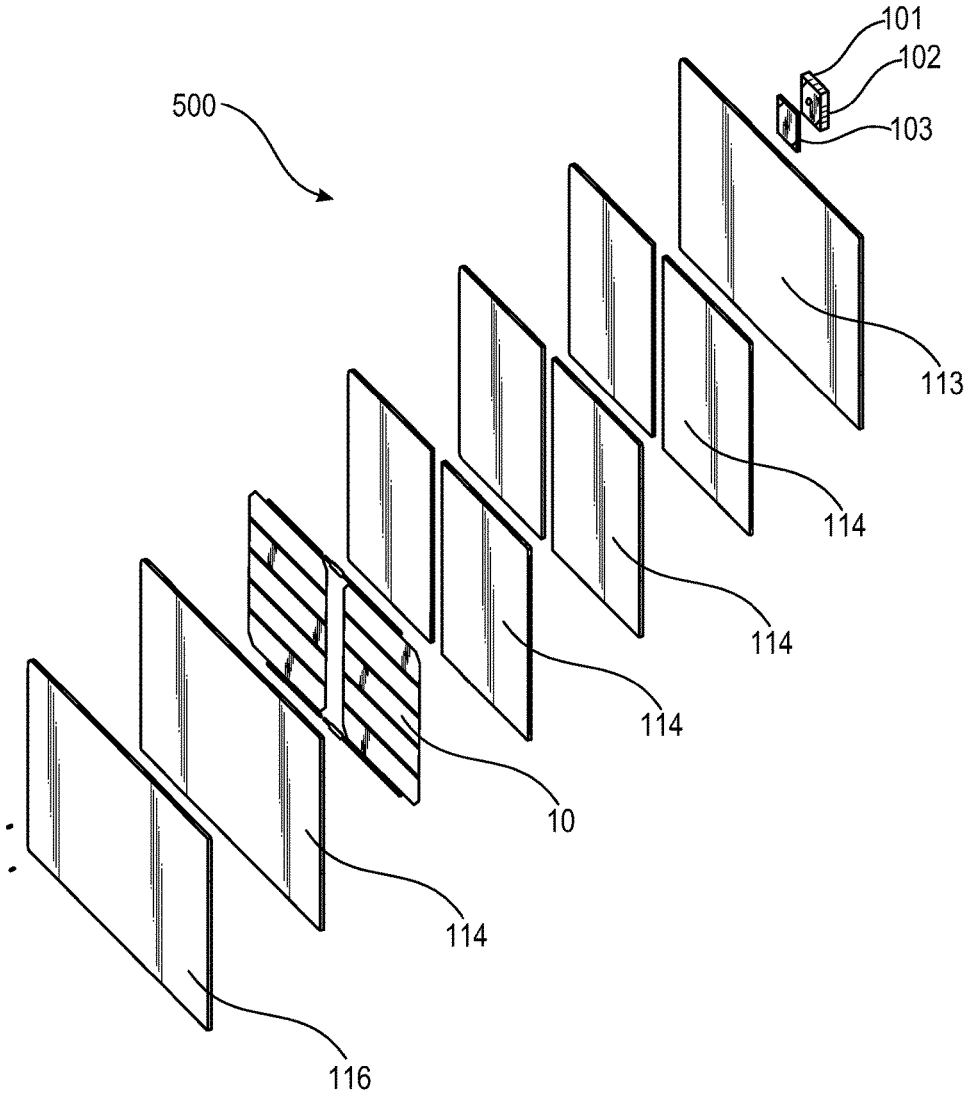


FIG. 5

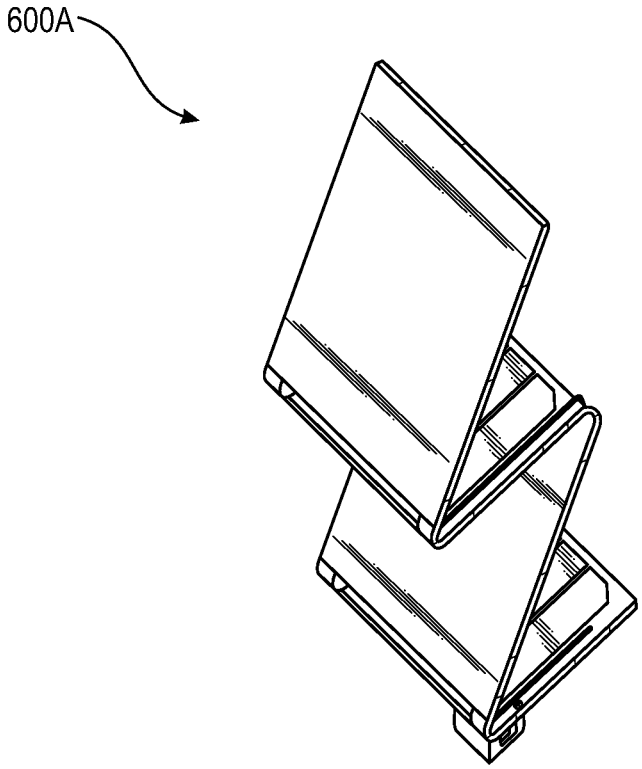


FIG. 6A

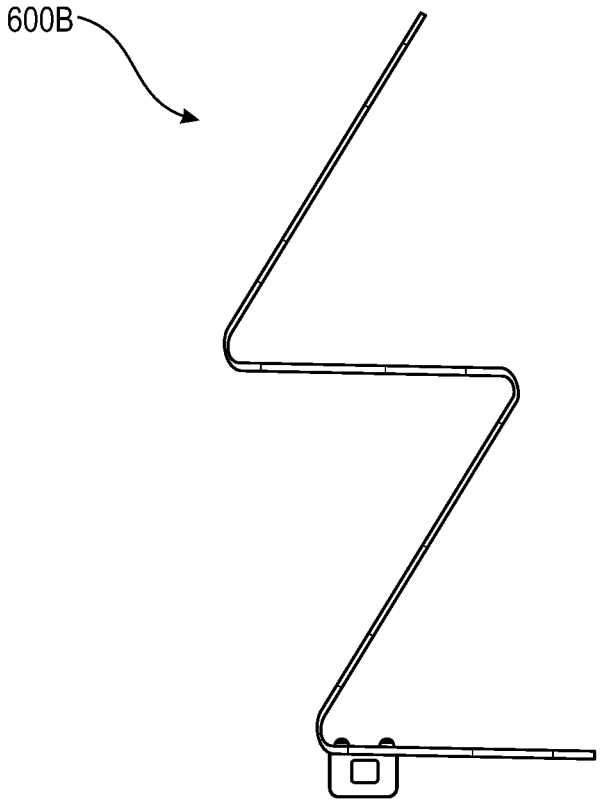


FIG. 6B

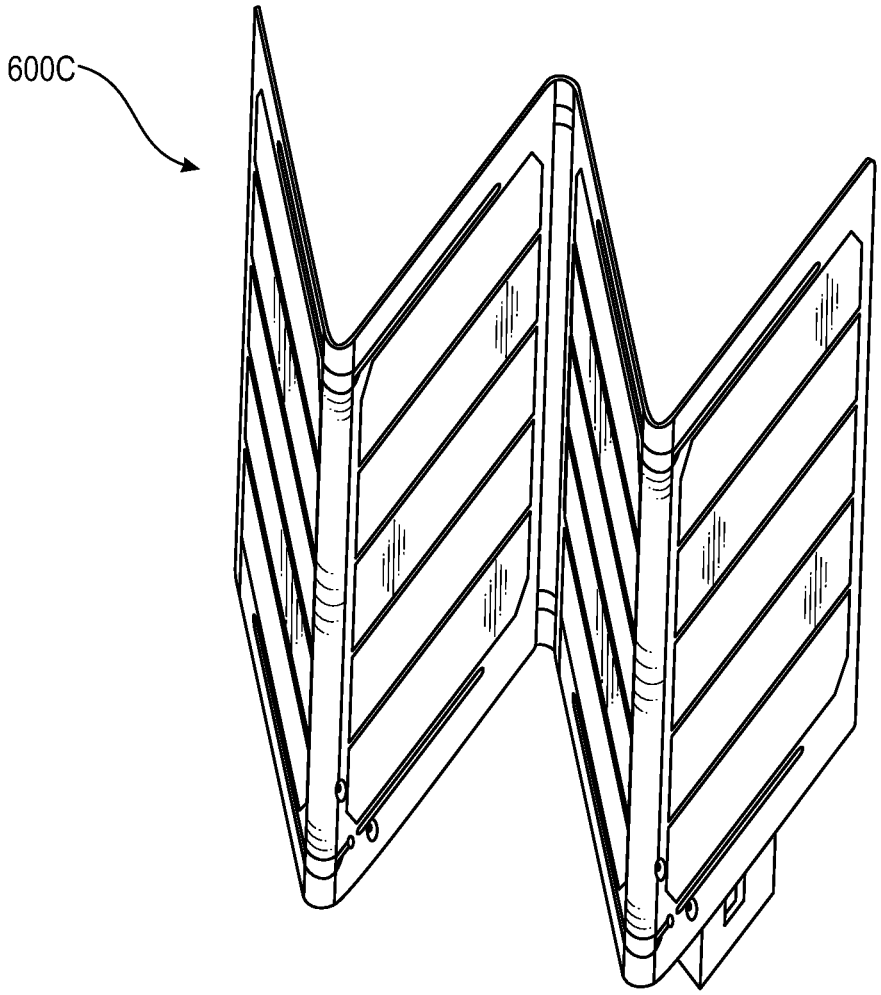


FIG. 6C

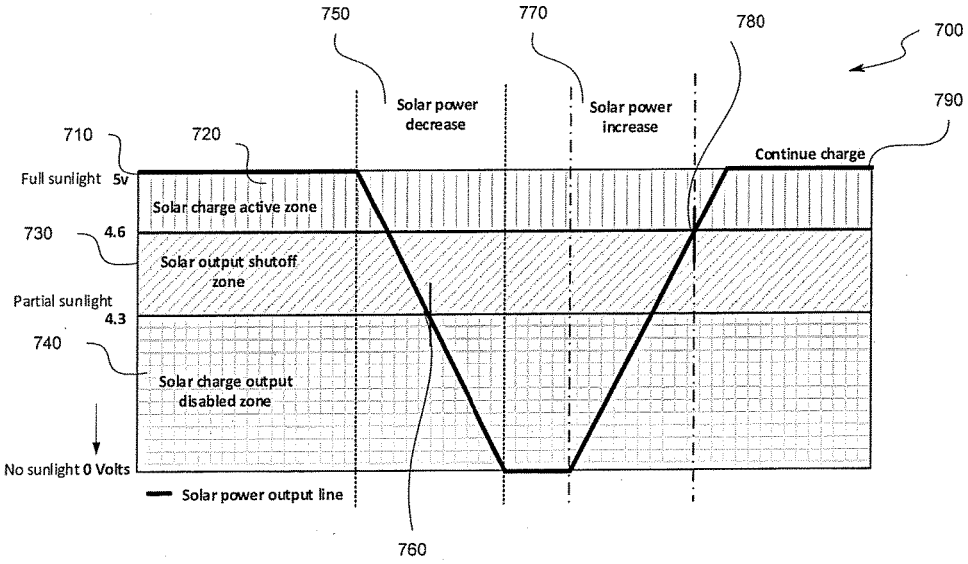

750
770
780
700
790
Solar power decrease
Solar power increase
710
720
Continue charge
Full sunlight 5v
Solar charge active zone
730
4.6
Solar output shutoff zone
Partial sunlight
4.3
740
Solar charge output disabled zone
No sunlight 0 Volts
Solar power output line
760

FIG. 7

SOLAR USB CHARGER

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] The present application is a continuation of U.S. Utility patent application Ser. No. 13/103,972, filed on Sep. 5, 2011 and entitled "Solar USB Charger" which is herein incorporated by reference in its entirety, which further claims priority of U.S. Provisional Patent Application No. 61/395,141, filed on May 8, 2010 and entitled "Solar USB Charger", which is herein incorporated by reference in its entirety.

BACKGROUND OF THE INVENTION

[0002] The invention relates generally to the field of providing energy to electronic devices utilizing solar energy and more particularly to a portable lightweight section of solar panels suitable for use with small devices such as smart phones, personal music devices, PDA (personal data assistants) and cellular telephones.

[0003] The majority of today's electronic devices are compatible with the USB (universal serial bus) specification for the transferring of data as well as for receiving power in the form of D.C. (direct current) voltage of approximately 5 volts. This specification has become ubiquitous with roughly 6 billion of these connectors sold to date.

[0004] Most portable devices utilize rechargeable batteries encased within the unit and are equipped with a remote charger, typically a transformer in conjunction with a rectifier, which converts household alternating current into a suitable direct current. This is a good solution unless the user is not located near a suitable energy source. The use of a remote power source is then required in this situation; therefore, one option is to use the sun's solar energy via a photo-voltaic cells.

BRIEF SUMMARY

[0005] The current inventive material provides for, according to one general embodiment, a solar USB charger that provides at least 5 watts of power in a compact form that can both charge and simultaneously run a variety of popular electronic devices such as iPod®, iPhone®, HTC/Droid®, Blackberry®, Palm®, iPad® eReaders, game devices or virtually any other portable device that can be charged through a USB port.

[0006] The device is water resistant and can be used at outdoor events, such as camping, backpacking, and anytime where there is no power available. It also is very lightweight in comparison to its power output and provides for a rather quick charge in relation to traditional trickle chargers.

[0007] It is also very durable and simple because of the low profile folding design that protects the solar cells from impact or scratching when the device is not in use. Another factor that increases the durability of the charging device is that it does not incorporate an internal battery, that is, this device directly charges the battery in the portable device, rather than contain a battery in its circuit. This is an important feature because batteries can be degraded and fail when exposed to high temperatures, such as those experienced by placing the solar cell in direct sunlight. This affects the longevity and usefulness of the charger as well as creates a greener product.

[0008] Furthermore, the charger can be used to charge a variety of rechargeable batteries.

[0009] Other aspects and advantages of the present invention will become apparent from the following detailed description which when taken in conjunction with the drawings, illustrates by way of example the principles and structure of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Taking the following specifications in conjunction with the accompanying drawings will cause the invention to be better understood regarding these and other features and advantages. The specifications reference the annexed drawings wherein:

[0011] FIG. **1** is a generalized block diagram of a solar USB charger.

[0012] FIG. **2** is a frontal perspective view of a solar USB charger.

[0013] FIG. **3** is analogous to FIG. **2** with a solar USB Charger partially folded.

[0014] FIG. **4** is cross-sectional top view along section A-A of FIG. **2** of a USB charger.

[0015] FIG. **4**A is magnified view of FIG. **4**.

[0016] FIG. **5** is an exploded view of a solar USB charger.

[0017] FIG. **6**A is a side perspective view of an embodiment of a solar USB Charger.

[0018] FIG. **6**B is a top view of an embodiment of a solar USB Charger.

[0019] FIG. **6**C is a front perspective view of an embodiment of a solar USB Charger.

[0020] FIG. **7** is a solar power output profile for a solar USB charger.

DETAILED DESCRIPTION

[0021] While describing the invention and its embodiments, various terms will be used for the sake of clarity. These terms are intended to not only include the recited embodiments, but also all equivalents that perform substantially the same function, in substantially the same manner to achieve the same result.

[0022] Referring to FIG. **1**, FIG. **2** and FIG. **3**, FIG. **1** describes a generalized block diagram **110** for a solar USB charger **100**. The solar USB charger **100** is also referred to as a portable solar powered power supply for the use of charging portable electronic devices that includes at least one solar panel **10** which converts solar energy into electrical energy preferably in a range of up to 7 volts to deliver approximately 5 watts of power. The photovoltaic cell or cells **10** are electronically connected to a pulse circuit **11**, a regulation circuit **13**, and a low voltage cutout **14**. The amount of energy generated by a photovoltaic cell is directly proportional to the amount of sunlight received, so the more sun the panel **10** receives the higher the voltage and conversely the less sun received, such as in the instance of shade, cloud cover, overcast or darkness the lower the voltage generated. The low voltage cutout **14** is a switch that disconnects current flow to the device if the voltage falls below a certain threshold, to be USB compliant this voltage is 5 volts direct current, however in varying embodiments this amount could vary, but the purpose is to prevent battery drainage from the device.

[0023] The pulse circuit **11** provides a voltage pulse to the device from the charger at a predetermined frequency, in one

embodiment a frequency of every two minutes is desired. This essentially resets the charging circuitry within the device to correct for passing clouds or other factors that reduce the charger's output. Some devices have different charging modes or amperages, pulsing ensures that the optimal and thus fastest setting is used at all times. Another benefit of this pulsing is to trigger the device's chirping signal which occurs when most devices are attached to a charger, this audible alert reminds you that your device is charging and also serves to help locate it without increased hardware in the charging circuit.

[0024] The regulation circuit **13** ensures that a consistent voltage is received by the device; in one embodiment the USB voltage of 5 vdc is contemplated. The indicator **17** is a visible indicator or light allowing the user to verify that the charger is working. Controlling voltage fluctuations is important to protect the circuitry of the portable device from being overloaded. The OR gate **12** determines whether or not to continue charging the device. The voltage divider **15** is required by some devices to allow charging, it simply applies varying voltage to select pins of the device, so that it will receive and regulate a charge. In one embodiment a USB connector **16**, type "A" style is the interface between the charger and the device, but other similar plug and socket configurations are also contemplated.

[0025] Now referring to FIG. **2** and FIG. **3** which discloses a preferred embodiment of the present invention, a solar USB charger **100** with the charger fully open configuration **200** and partially opened configuration **300** respectively. At least two solar cells **10** are mounted to at least two rigid backing boards **104**. The backing boards **104** are relatively narrow and substantially rectangular and are configured so that one side of each board is parallel to that of the opposing board and configured so that there is a small gap between the two forming a hinge point **120**, similar to the configuration of a typical bi-fold wallet, so that the two halves are pivotally connected. The panels and photovoltaic cells are laminated together to form a continuous structure wherein the solar panels **10** are electronically connected to each other by an electrical flex circuit **108** that completes the circuit from the solar cells through negative and positive buses **111**,**103** to the charging circuitry which is in an enclosure **102** mounted on the external face of the backing board **104**, that is the face opposite of the photovoltaic cells. The enclosure also contains a means of electrically connecting the charging circuit to the electronic device **101** in one embodiment this is a USB connector.

[0026] The photovoltaic or solar cells **10** are electronically connected together by a low-profile ribbon connector that traverses the interstitial gap. The gap acts as a hinge point for the charger, in one embodiment the gap is approximately one half of an inch wide with a thickness of around 12 mil (0.012"), with each panel being approximately six inches by five and a half inches with a thickness of approximately ⅛ of an inch or less. Because the charger **100** is constructed of rigid materials it can be laid flat on a surface or can be stood on edge as in FIG. **3** if so desired.

[0027] Now referring to FIG. **4** and FIG. **4**A, FIG. **4** depicts cross-sectional view **400** and FIG. **4**A depicts a close-up view **400**A of a USB solar charger **100** at the hinge point **120**, prior to finally assembly, comprising of at least two hard backer substrates **104**. In one embodiment the use of a material consistent with the FR-4 specification is preferred. This material is a rigid material and is relatively thin of compressed epoxy fiberglass or equivalent with two opposing faces that are parallel to each other at the hinge point with the leading end of these parallel surfaces of the backing board tapered to form a knife-like edge or a beveled edge, this structure allows for a smooth and even transition of the front sheet **113** and the back sheet **116** over the backing boards to minimize the thickness of the hinge point. The backing board has a front (internal) and a back (external) side and affixed to the front side is a photovoltaic cell **10** and respective bus bars with the entire structure sandwiched between two sections of ultra violet resistant clear sheets **113** adhered to the board and the solar cell with the proper adhesive. In one embodiment the sheet has a thickness of approximately 6 mil and contemplates the use of ETFE (ethylene tetrafluoroethylene) with an adhesive polymer such as EVA (Ethyl Vinyl Acetate or equivalent), but other varieties of plastic have also been contemplated. The combination of the thin coversheet, the tapered backing and the gap produces a hinge that is very thin and durable allowing the charger to be folded upon itself and to retain a very thin profile.

[0028] Referring to FIG. **5**, an exploded view **500** of a solar USB charger provides a clearer representation of the various components of the charger **100**, detailing the circuit enclosure **102** or case to protect the circuit board **103**, an opening **101** to allow the USB cable to connect to the charger **100** that is mechanically fastened in close proximity to the external face of the backing board. The charger utilizes an adhesive **114** throughout wherein the clear front sheet **113** is adhered to the external face of the backing board **104** which is intern adhered to at least one solar panel **10** and bus bars which intern is adhered to a back sheet **116**. Although it is desirable to have the front and back sheets **113**,**116** clear of transparent, it has further been contemplated utilizing an opaque material, colored sheet, or even a design or pattern in various embodiments.

[0029] FIGS. **6**A, **6**B, and **6**C refer to back perspective view **600**A, top view **600**B and front perspective view **600**C respectively of alternate embodiments of the solar USB charger **100** utilizing more than two panels with a clear depiction of a typical hinge point **120** fully assembled. Because power output is proportional to the surface area of the solar panels increasing the number of panels would also increase the power output and so larger devices could be powered with additional panels. Although we have described preferred embodiments with solar panels on only one face of the charger it has been contemplated to increase the surface area of the solar panels by incorporating them on not only the internal faces, but also the external faces of the device.

[0030] In an embodiment for the solar USB charger **100** described in the present inventive subject matter, FIG. **7** describes a solar output profile **700** to auto reset the solar USB charger **100**. A voltage of 5V is output when a full sunlight **910** is available and the solar USB charger **100** is in a solar charger active zone **920**. As the voltage output reaches a range between 4.6 to 4.3 volts the solar USB charger **100** enters a solar output shutoff zone **930**. As the voltage output drops further below 4.3 volts the solar USB charger **100** enters a solar charge output disabled zone **940**. As the solar voltage output decreases in the region **950** from 5V to 0V a solar output disable point **960** is reached. As the solar voltage output increases in the region **970** form 0V to

5V a solar output enable point **980** is reached and the solar USB charger is all set to continuously charge **990** after an output of 5V is maintained.

[0031] The invention has been described in terms of the preferred embodiment. One skilled in the art will recognize that it would be possible to construct the elements of the present invention from a variety of means and to modify the placement of the components in a variety of ways. While the embodiments of the invention have been described in detail and shown in the accompanying drawings, it will be evident that various further modifications are possible without departing from the scope of the invention as set forth in the following claims.

1. A portable foldable solar powered power supply comprising:

one or more backing boards pivotally connected through a hinged connection;

one or more photovoltaic panels on an internal surface of the backing boards and one or more photovoltaic panels on an external surface of the backing boards, the photovoltaic panels including one or more photovoltaic cell encased in an ultraviolet radiation resistant sheet and electronically connected through a ribbon connector traversing the hinged connection between the backing boards;

the first photovoltaic panel and the second photovoltaic panel connected via an electrical flex circuit to a charging circuit mounted on an external surface of the first backing board, the charging circuit having an auto reset capability to restore an original output of the portable solar powered power supply upon interruptions in solar power; and

a plug and socket configuration connecting the charging circuit to an external device.

2. The portable solar powered power supply of claim **1**, wherein the ultraviolet radiation resistant sheet is a form of clear plastic.

3. The portable solar powered power supply of claim **1** wherein the plug and socket configuration electronically connecting the charging circuit to an external device is a USB connector.

4. The portable solar powered power supply of claim **1** wherein the charging circuit further comprises: a pulse circuit; a regulation circuit; a low voltage cutout switch; a regulation circuit; a visible indicator; an OR gate, and; a voltage divider.

5. The portable solar powered power supply of claim **4** wherein the pulse circuit provides a voltage pulse to a device from the charger at a predetermined frequency to maximize the devices charging circuit and to provide an audible alert.

6. The portable solar powered power supply of claim **4** wherein pulse circuit frequency is approximately two minutes.

7. The portable solar powered power supply of claim **1** further comprising: a visible indicator, the visible indicator electrically connected to the charging circuit.

8. The portable solar powered power supply of claim **1**, wherein the backing board is substantially rectangular with opposing faces tapered and spaced to form a hinge point.

9. The portable solar powered power supply of claim **1**, wherein the backing board is made of compressed epoxy fiberglass.

10. The portable solar powered power supply of claim **1**, wherein ethylene tetrafluoroethylene is used in combination with ethyl vinyl acetate for adhesive purposes.

11. A portable solar charger comprising:

at least two solar panels foldably connected along an interstitial gap and electrically interconnected to provide a solar electrical energy output that is dependent on a solar energy input;

a regulation circuit, the regulation circuit having the solar electrical energy input and a portable electronic power output, the solar electrical energy input electrically connected to the solar energy output;

the regulation circuit having an auto reset capability to restore an original output of the portable solar powered power supply upon interruptions in solar power; and

an output port, the output port mechanically adaptable to electrically connect to a portable electronic device and the output port mechanically and electrically connected to the solar panel.

12. The portable solar charger as described in claim **11**, wherein a voltage ranging between 4.9-5.1 volts is output in a charging active zone.

13. The portable solar charger as described in claim **11**, wherein a voltage ranging between 4.3-4.6 volts is output in a charging shutoff zone.

14. The portable solar charger as described in claim **11**, wherein a voltage ranging between 0.0-4.3 volts is output in a charging disabled zone.

* * * * *