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**Hunter et al.**

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(54) **POWER SUPPLY UNIT**

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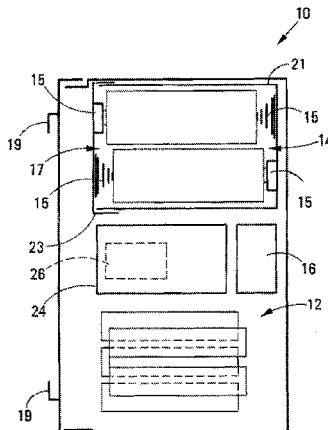
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**ABSTRACT**

A power supply unit for supplying power to a device has a rechargeable, main battery; a charging arrangement for charging the main battery; a non-rechargeable back-up battery; load terminals for connection to a load; and a control unit for controlling supply of power to the load primarily from the main battery and secondarily from the back-up battery. The device is, in particular, a single bay, stand alone parking meter. In the event that the main battery runs low, the control unit is configured to supply power to the load from both the main battery and the back-up battery or only from the back-up battery. The back-up battery is easily replaceable, and the power supply unit has a bay, with connectors for receiving the back-up battery. The main battery is charged from solar panels. A communication device is provided to communicate status messages wirelessly to a control system.

**24 Claims, 4 Drawing Sheets**



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FIG. 1

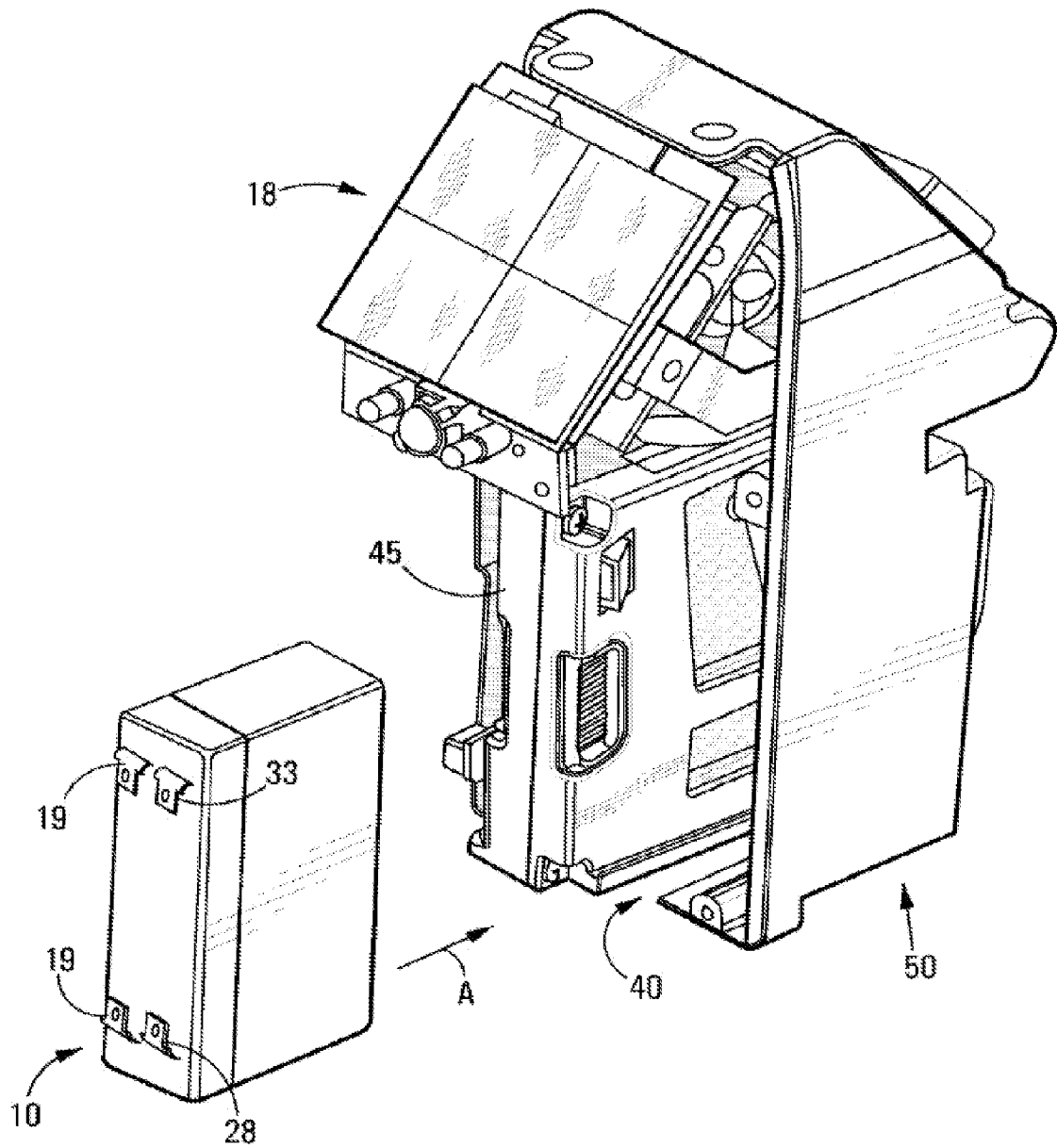


FIG. 2

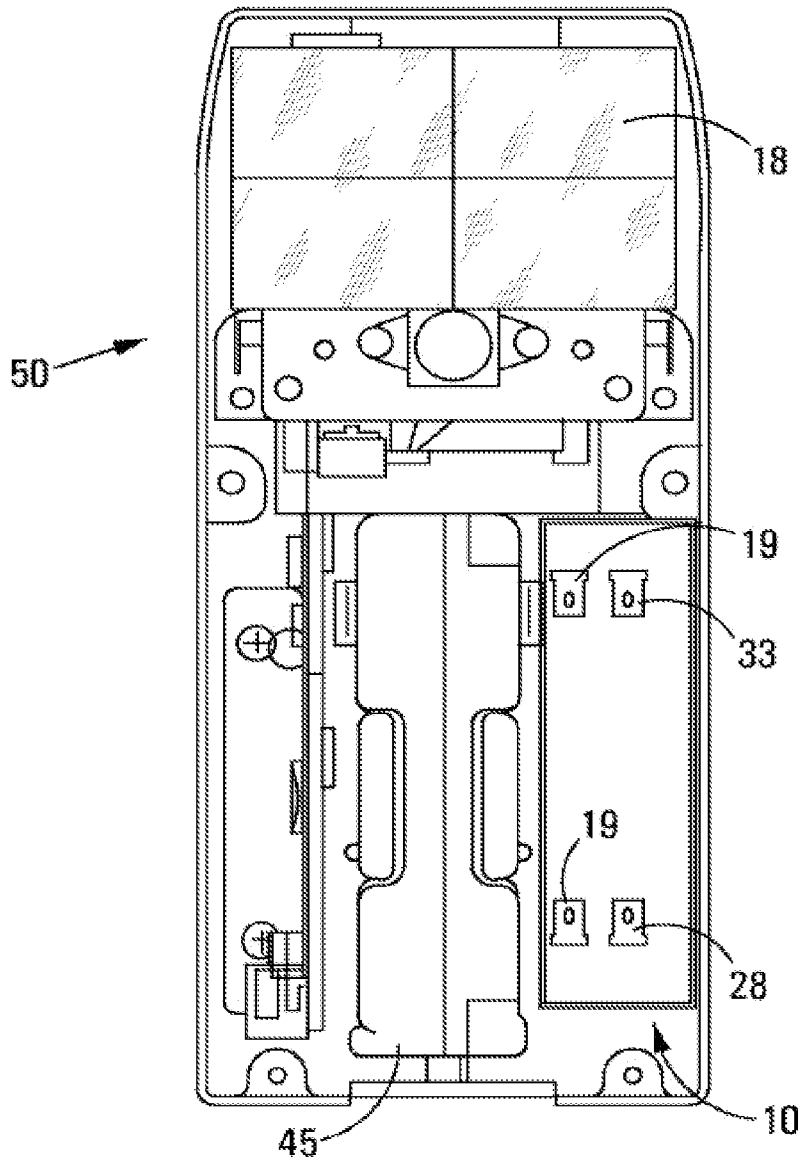


FIG. 3

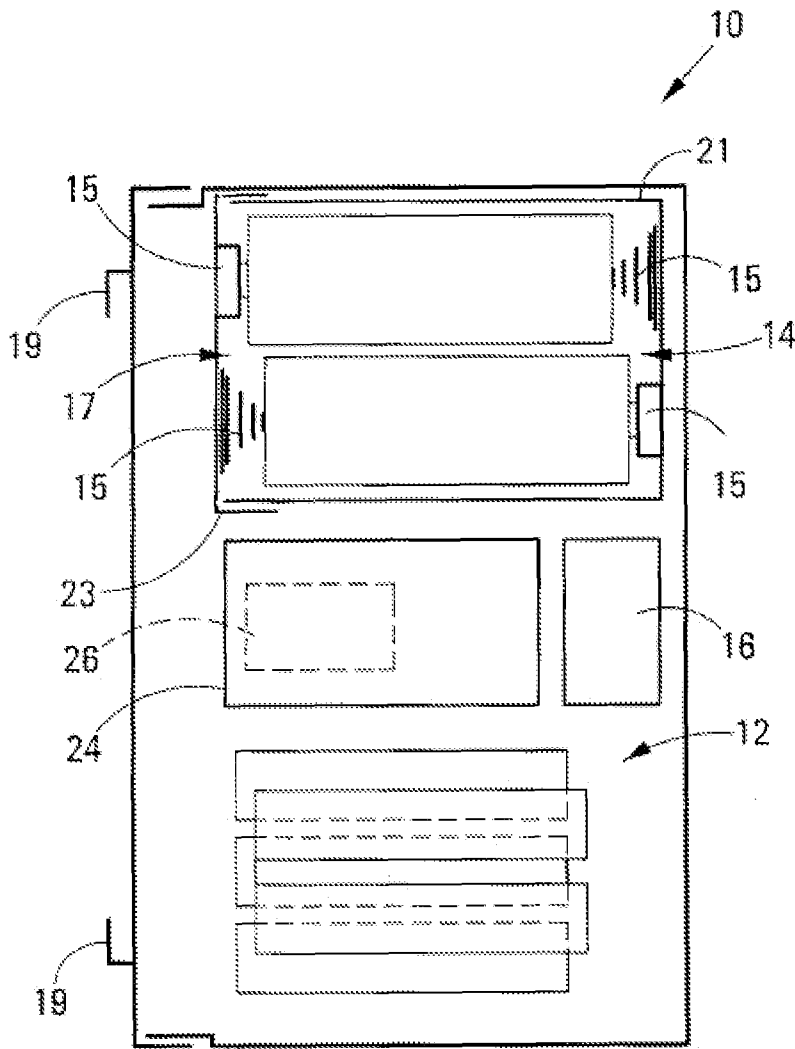
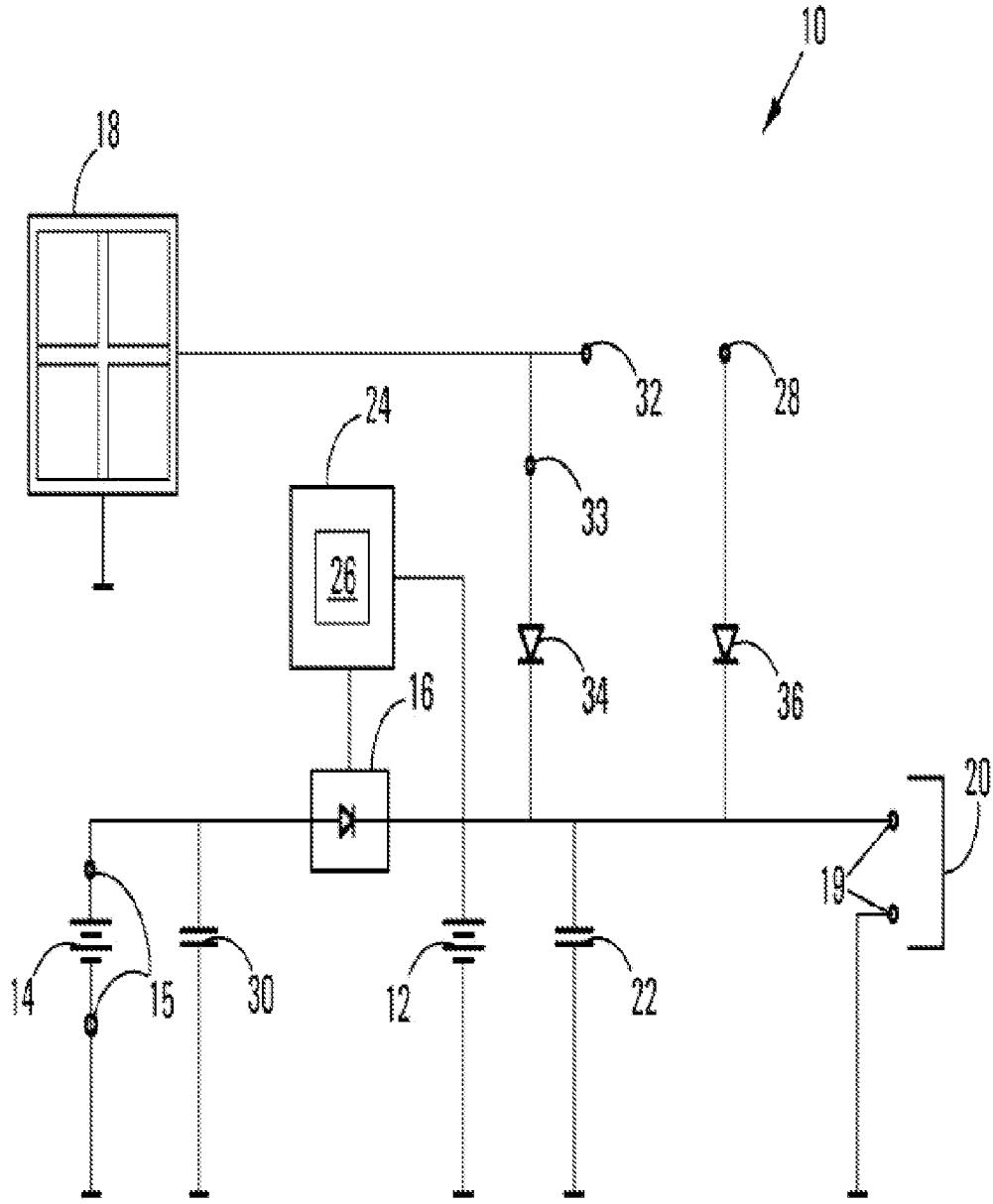


FIG. 4



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**POWER SUPPLY UNIT**CROSS-REFERENCE TO RELATED  
APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 12/059,909 filed Mar. 31, 2008 and issued as U.S. Pat. No. 8,513,832 on Aug. 20, 2013, which claims the benefit of U.S. Provisional Application No. 60/909,209, filed Mar. 30, 2007, each of which is incorporated in its entirety herein by reference.

## FIELD OF THE INVENTION

THIS INVENTION relates to a power supply unit and to a device, in particular a single bay parking meter, having the power supply unit.

## SUMMARY OF THE INVENTION

According to the invention, there is provided a power supply unit for supplying power to a device, the power supply unit including

- a rechargeable, main battery;
- a charging arrangement for charging the main battery;
- a set of connectors for connection to a back-up battery;
- a set of load terminals for connection to a load; and
- a control unit for controlling supply of power to the load primarily from the main battery and secondarily from the back-up battery.

In an embodiment of the invention the power supply unit has the main battery and the back-up battery. The back-up battery is preferably non-rechargeable.

It will be appreciated that power is taken, in use, from the backup battery in the event that the main battery is inadequate.

Further according to the invention there is provided a device, in particular a parking meter, which has a power supply unit in accordance with the invention.

In the event that the main battery runs low, the control unit is configured to supply power to the load from both the main battery and the back-up battery or only from the back-up battery.

In a preferred embodiment, the back-up battery is easily replaceable. In this embodiment, the power supply unit has a bay for receiving the back-up battery and the connectors are spaced and are such as to permit easy removal and replacement of the back-up battery.

In another embodiment of the invention, the power supply unit further includes a communication device, for communicating messages to a control system. Such messages are selected from the group consisting of: notification that the main battery has been insufficiently recharged, and a notification that power is being supplied from the backup battery.

In a further embodiment of the invention, the communication device may be operable in a wireless manner, and utilizes a cellular telephone network. Thus, with this embodiment, the communication device may have a cellular telephone module.

In an embodiment of the invention, the charging arrangement includes charging terminals for connecting the unit to a solar panel. The device then incorporates the solar panel.

It will be appreciated that in normal operation power is supplied only from the main battery. However, if the main battery is insufficiently recharged, or it is unable to supply the power required by the load, then supplementary power is

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supplied, partially or totally, from the backup battery, as determined by the control unit.

Preferably, the nominal supply voltage of the backup battery is slightly greater than that of the main battery.

## BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention is now described, by way of example only and without limiting the scope of the invention, with reference to the accompanying figures, wherein:

FIG. 1 is an isometric view of a power supply unit in accordance with the invention, shown in alignment with part of a parking meter body;

FIG. 2 is a rear view of the part of the parking meter body, depicting the power supply unit when inserted fully therein;

FIG. 3 is a schematic sectioned view of the power supply unit; and

FIG. 4 is a circuit diagram of the power supply unit.

## DETAILED DESCRIPTION

In the accompanying figures, the power supply unit is generally designated by reference numeral 10 and comprises a rechargeable, main battery 12, a charging arrangement in the form of a diode 34 for charging the main battery 12, a replaceable back-up battery 14, load terminals 19 and a control unit 16 for controlling supply of power to a load 20 connected via the load terminals 19 primarily from the main battery 12 and secondarily from the back-up battery 14 in the event that the main battery 12 is inadequate. The power supply unit 10 further has a solar panel terminal 33 and an auxiliary charging terminal 28.

The power supply unit 10 further includes a bay 17 which contains the replaceable backup battery 14. The bay 17 is illustrated in FIG. 3, where it is seen to be defined by a compartment 21 with a lid 23 within the power supply unit 10. The bay 17 has spaced connectors 15 for the backup battery 14. Also shown in FIG. 3 is a communication device 24 with a cellular telephone module 26.

More specifically, in a preferred embodiment of the invention, the main battery 12 comprises an arrangement of five "AA" size nickel cadmium rechargeable cells, which cells are coupled to each other and recharged by solar panels 18 via the solar panel terminal 33. The backup battery 14 comprises a coupled arrangement of two non-rechargeable, disposable "C" size lithium-thionyl chloride cells, and the control unit 16 is a conventional linear, low dropout control unit, known in the trade as the Linear Technology™ model LT1529-5. The control unit 16 controls the supply of power to the load 20 from the main battery 12 and the backup battery 14, in the manner described below.

It is not only the power supply unit 10 itself that is the subject of this invention. This invention extends to include a device, in particular a single bay stand alone parking meter 50, having the power supply unit 10 as described above. This is illustrated in FIGS. 1 and 2, in which FIG. 1 depicts the power supply unit 10 aligned for insertion into a complementary dimensioned and configured recess 40 within parking meter 50. The power supply unit 10 is moved into position, in the direction of arrow "A," to fit snugly within the recess 40, as is depicted in FIG. 2. A coin validation unit 45 of the parking meter 50 is not a part of the present invention, but is mentioned for completeness, since the validation unit 45, and other components, such as a timer and a display (not shown) are powered by the power supply unit 10, being connected



thereto via the load terminals 19. The parking meter 50 has the solar panels 18 which are connected to the solar panel terminal 33.

The power supply unit 10 is operated as follows. Under favorable conditions, with the main battery 12 being sufficiently charged and with the voltage across the main battery 12 being greater than a predetermined threshold value, the control unit 16 is configured to permit only the main battery 12 to supply power to the load 20. Conversely, under unfavorable conditions, when the main battery is not sufficiently charged, the supply voltage of the main battery 12 is lower than the threshold value, and in such conditions, the control unit 16 is configured to permit power to be supplied also, or only, from the backup battery 14 to the load. It will be appreciated that, in this way, use of the backup battery 14 occurs only when strictly necessary, namely when the voltage across the main battery 12 falls below a predetermined level.

In the particular instance where the power supply unit 10 is for a stand alone parking meter, the nominal supply voltage of the main battery 12 is 6.0V and of the back-up battery 14 7.2V. The control unit 16 is configured to permit power to be supplied from the backup battery 14 when the voltage across the main battery 12 measures 5.5 V or less.

Capacitor 30 is provided to assist during peak power demand and capacitor 22 assists with stability of the regulator 16 and with peak power demand. In alternative embodiments of the invention, a further, external recharging source, such as a portable charger, may be connected via terminal 28. It will be appreciated that the extent of reliance on the backup battery 14 to supply current to circuit 20, is minimized. This, in turn, extends the lifespan of the backup battery 14.

The power supply unit 10 further includes diodes 34 and 36, which serve to prevent reverse current from flowing into the solar panels 18 and an external auxiliary recharging source via terminal 28 respectively.

The communication device 24 communicates notifications to a control system (not shown). Typically, such notifications relate to the state of the main battery 12 and of the backup battery 14. Notifications that are communicated are that the voltage across the main battery 12 has fallen below the predetermined minimum level, and that power is being supplied from the backup battery 14. The communication device 24 communicates these notifications in a wireless manner across a telecommunications network via the cellular telephone module 26.

It will be appreciated by the person skilled in the art that application of this invention is not limited to parking meters only, but that this invention also has application to a multitude of power supply units used to supply current to electrical circuits.

What is claimed is:

1. A method for controlling the supply of power to a parking meter comprising:

- a) monitoring, by a control unit, a status of a main battery which is rechargeable and a back-up battery which is non-rechargeable;
- b) charging at least partially, by the control unit, the main battery via one or more charging sources;
- c) supplying power, by the control unit, to the parking meter primarily from the main battery;
- d) switching the supply of power, by the control unit, to come from the back-up battery when the voltage across the main battery falls below a predetermined level;
- e) supplementing the supply of power during a peak power demand, by the control unit, to the main battery by utilizing at least one capacitor; and

f) signaling, by the control unit, a wireless communication device to communicate a status message to a control system external to the parking meter regarding the status of the main battery and the back-up battery;

wherein the main battery, the back-up battery, the at least one capacitor, the wireless communication device, and the control unit are received within the parking meter.

2. The method of claim 1, wherein the parking meter further comprises a solar cell, and wherein the status message comprises one or more of: battery charge rate, remaining battery charge, remaining battery life, real-time current supplied by the solar cell, average current supplied by the solar cell, resistance at various sections within the power supply, error messages indicating battery failure, error messages indicating solar cell failure, real-time power consumption, and average power consumption.

3. The method of claim 1, wherein the status message is communicated over a telecommunications network.

4. The method of claim 1, further comprising switching the supply of power, by the control unit, back to the main battery when the main battery is sufficiently recharged.

5. The method of claim 4, further comprising minimizing the supply of power from the back-up battery after switching the supply of power to come from the main battery.

6. The method of claim 1, wherein the rechargeable main battery consists of one to five cells.

7. The method of claim 1, wherein the replaceable back-up battery consists of one to five cells.

8. The method of claim 1, wherein the at least one capacitor consists of two to five capacitors.

9. The method of claim 1, wherein the at least one capacitor comprises an ultra-capacitor.

10. The method of claim 1, wherein the at least one capacitor is in parallel with the main battery.

11. The method of claim 1, wherein a first capacitor is connected in parallel with the main battery to assist the main battery during the peak power demand, and a second capacitor is connected in parallel with the back-up battery to assist the back-up battery during the peak power demand.

12. The method of claim 1, wherein the peak power demand is during start up of the parking meter.

13. The method of claim 1, wherein the peak power demand is during start up of the wireless communications device.

14. The method of claim 1, wherein the parking meter further comprises a solar panel connected to the main battery.

15. The method of claim 14, wherein the main battery is recharged by the solar panel.

16. The method of claim 14, wherein the parking meter further comprises a diode coupled to the solar panel to prevent reverse current from flowing into the solar panel.

17. The method of claim 1, wherein the predetermined level is 5.5V.

18. A power supply for supplying power to a parking meter comprising:

- a) a main battery which is rechargeable;
- b) a charging arrangement comprising one or more terminals for connecting the main battery to one or more charging sources;
- c) a back-up battery which is replaceable and non-rechargeable;
- d) at least one capacitor;
- e) a connection to a wireless communication device for communicating a status message regarding the state of the main battery and the state of the back-up battery to a control system external to the parking meter; and

f) a connection to a control unit for controlling supply of power to the parking meter primarily from the main battery and secondarily from the back-up battery, wherein the at least one capacitor assists during a peak power demand;

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wherein the main battery, the back-up battery, the at least one capacitor, the wireless communication device, and the control unit are received within the parking meter.

19. The power supply of claim 18 further comprises a solar cell, wherein the wireless communication device communicates status messages to the control system, the status messages comprising one or more of: battery charge rate, remaining battery charge, remaining battery life, real-time current supplied by the solar cell, average current supplied by the solar cell, resistance at various sections within the power supply, error messages indicating battery failure, error messages indicating solar cell failure, real-time power consumption, and average power consumption.

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20. The power supply of claim 18, further comprising a solar panel connected to the main battery.

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21. The power supply of claim 20, wherein the main battery is recharged by the solar panel.

22. The power supply of claim 18, wherein the peak power demand is during start up of the parking meter.

23. The power supply of claim 18, wherein the peak power demand is during start up of the wireless communications device.

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24. The power supply of claim 18, wherein the at least one capacitor comprises an ultra-capacitor.

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\* \* \* \* \*

UNITED STATES PATENT AND TRADEMARK OFFICE  
**CERTIFICATE OF CORRECTION**

PATENT NO. : 9,391,474 B2  
APPLICATION NO. : 13/928058  
DATED : July 12, 2016  
INVENTOR(S) : Hunter et al.

Page 1 of 1

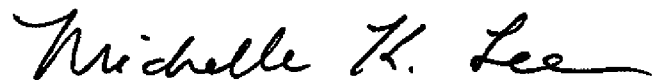
It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the claims:

Column 4, line 4, claim 1, please delete “batter” and replace with --battery--

Column 5, line 9, claim 19, please delete “The power supply of claim 18 further comprises” and replace with --The power supply of claim 18, further comprising--

Signed and Sealed this  
Eighth Day of November, 2016



Michelle K. Lee  
*Director of the United States Patent and Trademark Office*