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Hunter et al.

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(54) **POWER SUPPLY UNIT**

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(58) **Field of Classification Search**
None
See application file for complete search history.

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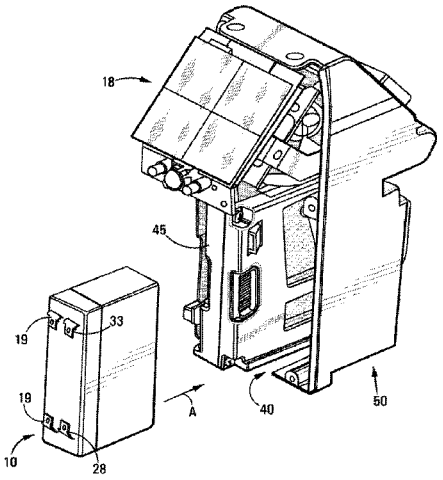
(57) **ABSTRACT**

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.

32 Claims, 4 Drawing Sheets



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continuation of application No. 15/599,827, filed on May 19, 2017, now Pat. No. 10,574,085, which is a continuation of application No. 15/160,646, filed on May 20, 2016, now Pat. No. 9,692,256, which is a continuation of application No. 13/928,058, filed on Jun. 26, 2013, now Pat. No. 9,391,474, which is a continuation of application No. 12/059,909, filed on Mar. 31, 2008, now Pat. No. 8,513,832.

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FIG. 1

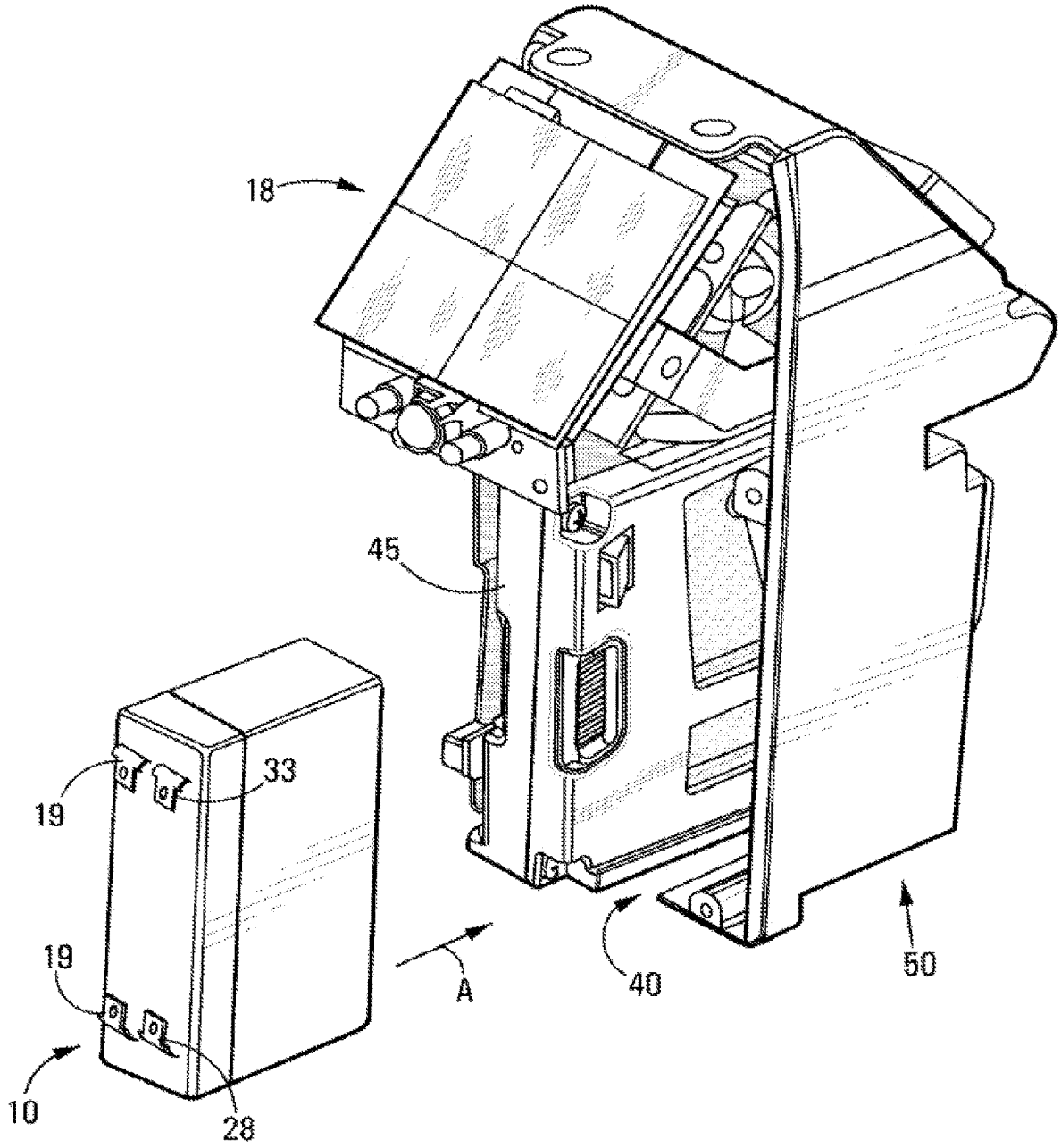


FIG. 2

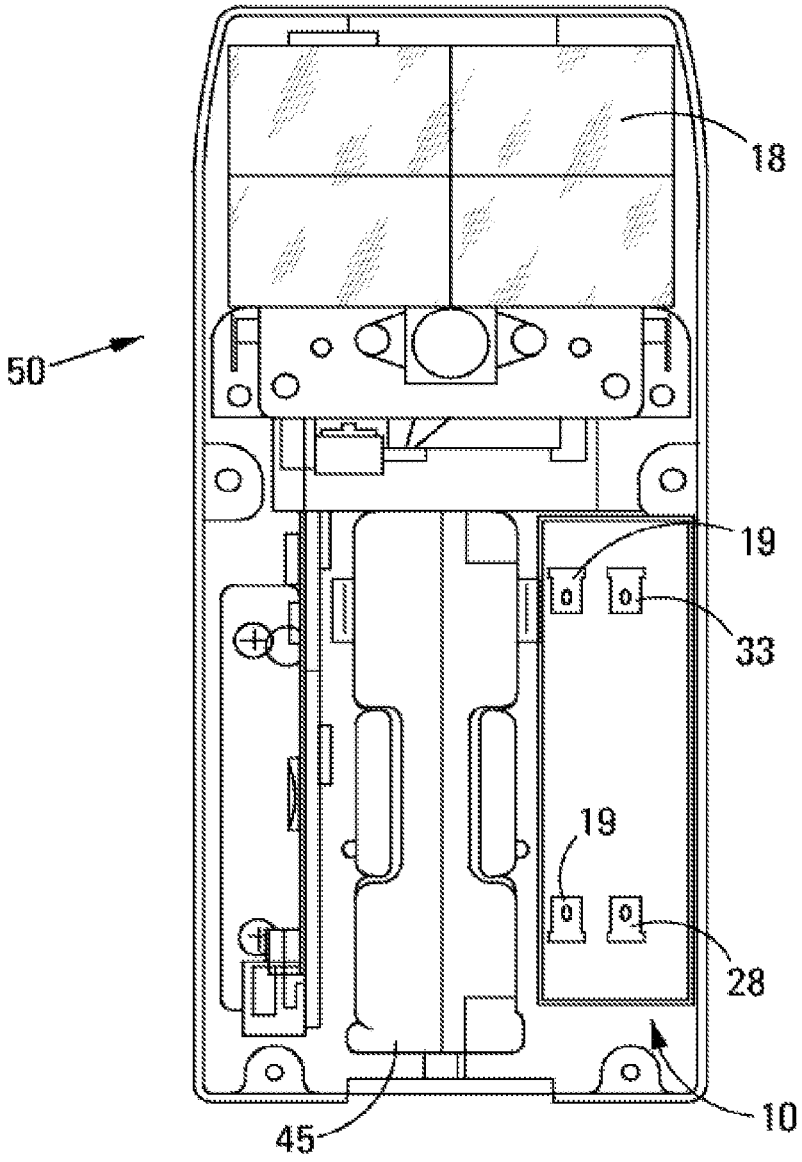


FIG. 3

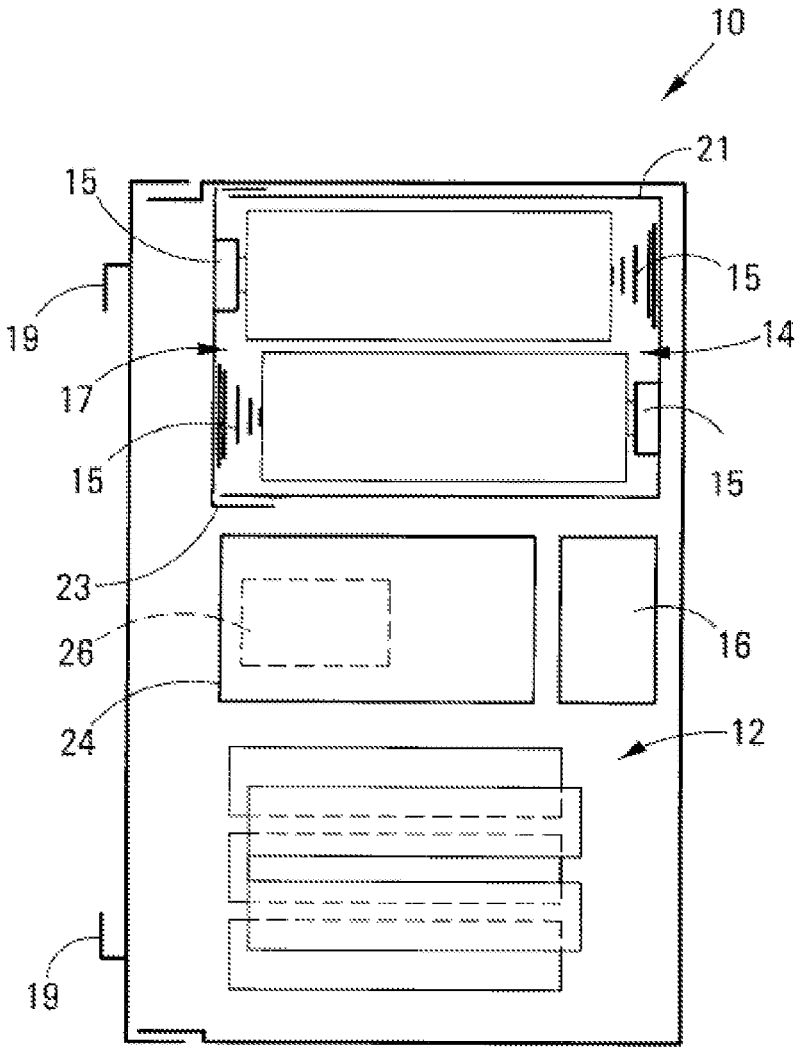
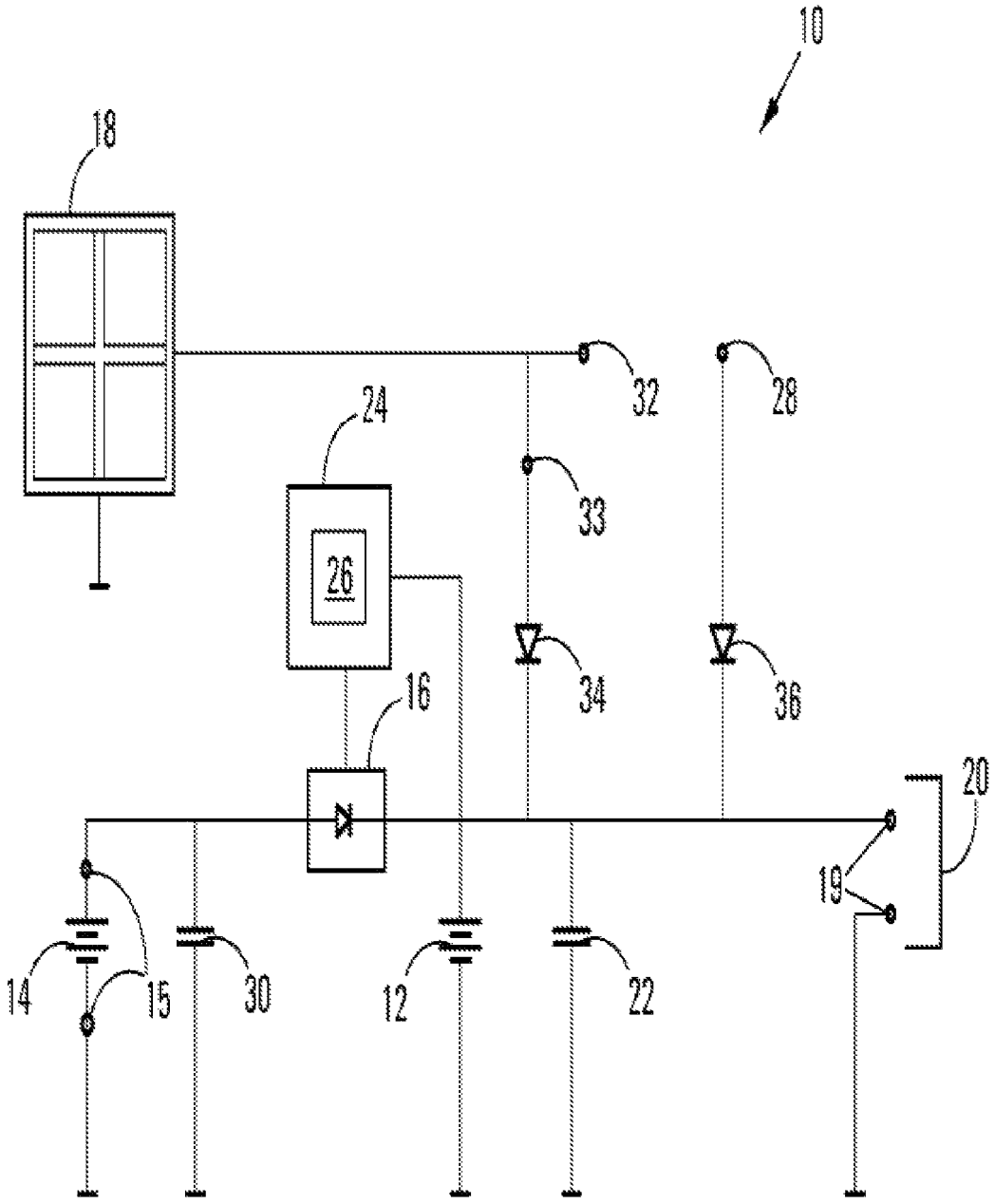


FIG. 4



POWER SUPPLY UNIT

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 16/742,335, filed on Jan. 14, 2020, which is a continuation of U.S. patent application Ser. No. 15/599,827 filed on May 19, 2017, now issued as U.S. Pat. No. 10,574,085 on Feb. 25, 2020, which is a continuation of U.S. patent application Ser. No. 15/160,646 filed on May 20, 2016, now issued as U.S. Pat. No. 9,692,256 on Jun. 27, 2017, which is a continuation of U.S. patent application Ser. No. 13/928,058 filed on Jun. 26, 2013, now issued as U.S. Pat. No. 9,391,474 on Jul. 12, 2016, which is a continuation of U.S. patent application Ser. No. 12/059,909 filed on Mar. 31, 2008, now 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 on Mar. 30, 2007, entitled "POWER SUPPLY UNIT," the contents of each are incorporated herein by reference for all purposes.

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 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 parking meter comprising:

a) a rechargeable battery;

b) a charging arrangement comprising one or more terminals for connecting the rechargeable battery to one or more charging sources;

c) a non-rechargeable battery;

d) a wireless communication device; and

e) a housing at least partially enclosing the rechargeable battery, the non-rechargeable battery, and the wireless communication device;

wherein the parking meter is configured to perform operations comprising:

a) monitoring a status of the rechargeable battery or the non-rechargeable battery; and

b) wirelessly transmitting a status message regarding the status of the rechargeable battery or the non-rechargeable battery to a control system external to the parking meter.

2. The parking meter of claim **1**, wherein the rechargeable battery consists of one to five cells.

3. The parking meter of claim **1**, wherein the parking meter is configured to monitor the status of the rechargeable battery by monitoring the status of a voltage across the rechargeable battery.

4. The parking meter of claim **3**, wherein the parking meter is configured to wirelessly transmit a status message regarding the status of the rechargeable battery when the voltage across the rechargeable battery drops below a predetermined level.

5. The parking meter of claim **4**, wherein the predetermined level is 5.5V.

6. The parking meter of claim **1**, wherein the status message comprises one or more selected from the group consisting of: voltage across the rechargeable battery, remaining battery charge of the rechargeable battery, remaining battery life of the rechargeable battery, and an error message indicating failure of the rechargeable battery.

7. The parking meter of claim **1**, wherein the wireless communication device communicates the status message over a telecommunications network.

8. The parking meter of claim **1**, wherein the one or more charging sources comprises at least one solar panel.

9. The parking meter of claim **1**, wherein the parking meter is a single space parking meter.

10. The parking meter of claim **1**, wherein the parking meter is a dual space parking meter.

11. The parking meter of claim **1**, wherein the parking meter is a multi-space parking meter.

12. A power supply for a parking meter, the power supply comprising:

a) a rechargeable battery;

b) an interface for connecting to one or more charging sources;

c) a non-rechargeable battery; and

d) an interface for connecting to a wireless communication device;

wherein the parking meter is configured to perform operations comprising:

a) monitoring a status of the rechargeable battery or the non-rechargeable battery; and

b) wirelessly transmitting a status message regarding the status of the rechargeable battery or the non-rechargeable battery to a control system external to the parking meter;

wherein the power supply is configured to be at least partially enclosed within the parking meter.

13. The power supply of claim **12**, wherein the rechargeable battery consists of one to five cells.

14. The parking meter of claim **12**, wherein the parking meter is configured to monitor the status of the rechargeable battery by monitoring the status of a voltage across the rechargeable battery.

15. The parking meter of claim 14, wherein the parking meter is configured to wirelessly transmit a status message regarding the status of the rechargeable battery when the voltage across the rechargeable battery drops below a predetermined level.

16. The parking meter of claim 15, wherein the predetermined level is 5.5V.

17. The parking meter of claim 12, wherein the status message comprises one or more selected from the group consisting of: voltage across the rechargeable battery, remaining battery charge of the rechargeable battery, remaining battery life of the rechargeable battery, and an error message indicating failure of the rechargeable battery.

18. The parking meter of claim 12, wherein the parking meter comprises a wireless communication device configured to transmit the status message over a telecommunications network.

19. The parking meter of claim 12, wherein the one or more charging sources comprises at least one solar panel.

20. The parking meter of claim 12, wherein the parking meter is a single space parking meter.

21. The parking meter of claim 12, wherein the parking meter is a dual space parking meter.

22. The parking meter of claim 12, wherein the parking meter is a multi-space parking meter.

23. A method for managing the supply of power to a parking meter comprising:

a) monitoring the status of a rechargeable battery and a non-rechargeable battery; and

b) wirelessly transmitting a status message to a control system external to the parking meter regarding the status of the rechargeable battery or the non-rechargeable battery;

wherein the rechargeable battery and the non-rechargeable battery are at least partially enclosed within the parking meter.

24. The method of claim 23, wherein the rechargeable battery consists of one to five cells.

25. The method of claim 23, wherein the status of the rechargeable battery comprises a voltage across the rechargeable battery.

26. The method of claim 25, wherein the wireless transmission is triggered when the voltage across the rechargeable battery drops below a predetermined level.

27. The method of claim 26, wherein the predetermined level is 5.5V.

28. The method of claim 23, wherein the status message comprises one or more selected from the group consisting of: voltage across the rechargeable battery, remaining charge of the rechargeable battery, remaining life of the rechargeable battery, and an error message indicating failure of the rechargeable battery.

29. The method of claim 23, wherein the status message wirelessly transmitting over a telecommunications network.

30. The method of claim 23, wherein the parking meter is a single space parking meter.

31. The method of claim 23, wherein the parking meter is a dual space parking meter.

32. The method of claim 23, wherein the parking meter is a multi-space parking meter.

* * * * *