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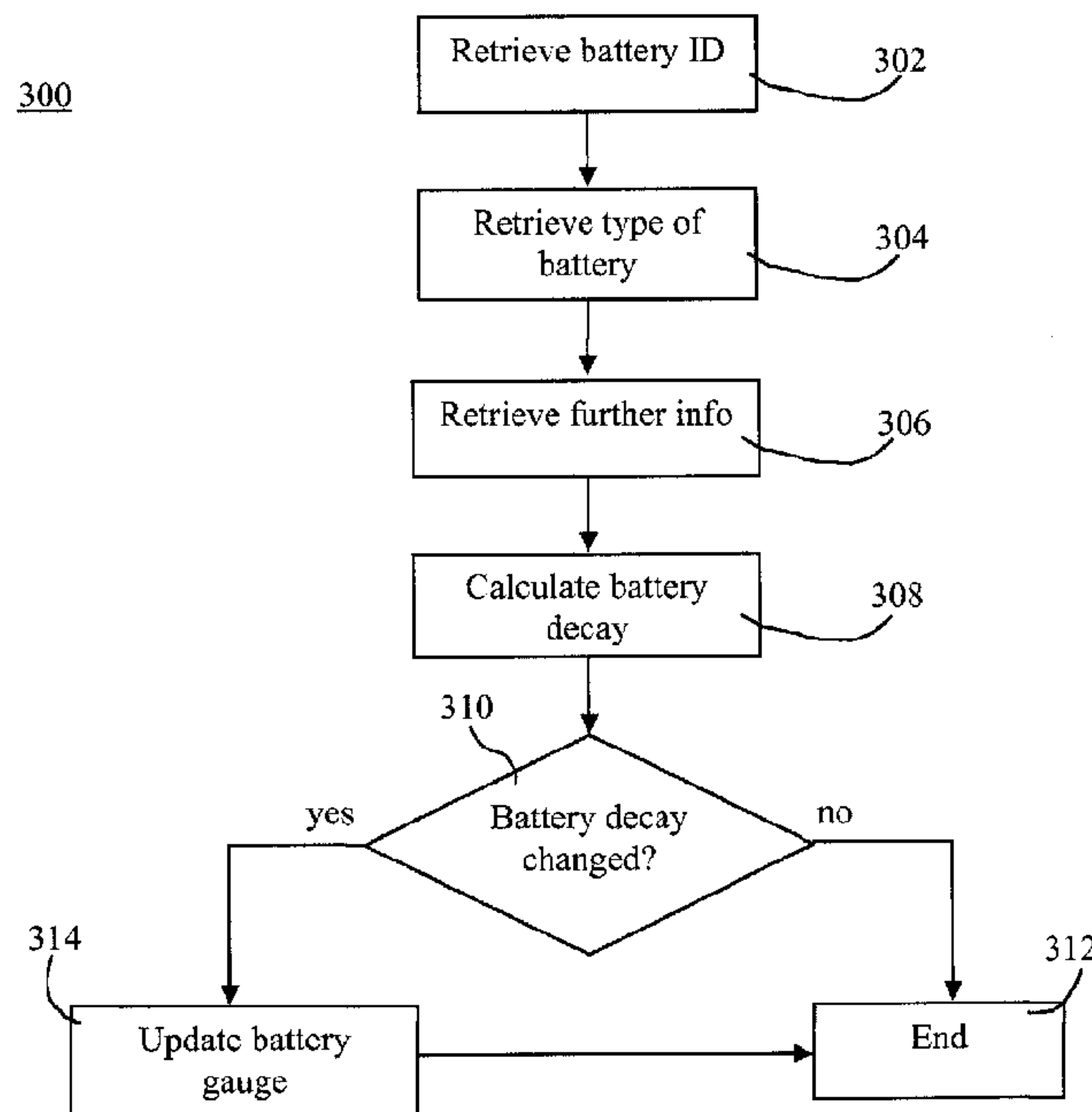
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(54) Title: BATTERY STATE INDICATOR ON A BATTERY POWERED DEVICE



(57) Abrégé/Abstract:

A method is provided for representing battery degradation of a rechargeable battery for use with a battery operated device. The method comprises the following steps. At predefined intervals, the battery degradation of the rechargeable battery is determined. An indicator is selected from one of a plurality of predefined indicators based on the determined battery degradation. The selected indicator is displayed on a screen of a computing device for representing the battery degradation. A computing device configured to implement the method is also described.

ABSTRACT

A method is provided for representing battery degradation of a rechargeable battery for use with a battery operated device. The method comprises the following steps. At predefined intervals, the battery degradation of the rechargeable battery is determined. An indicator is selected from one of a plurality of predefined indicators based on the determined battery degradation. The selected indicator is displayed on a screen of a computing device for representing the battery degradation. A computing device configured to implement the method is also described.

BATTERY STATE INDICATOR ON A BATTERY POWERED DEVICE

RELATED APPLICATIONS

This application claims the benefit of priority from U.S. patent application, serial
5 number 12/766,171, filed April 23, 2010 and entitled "Replacement Battery
Indicator on a Battery Powered Device" and from U.S. patent application, serial
number 13/070,930 filed March 24, 2011 and entitled, "Battery State Indicator on
a Battery Powered Device".

The present invention relates generally to battery powered devices and
10 specifically to a method for displaying on the battery powered device an indicator
of the state of the battery. This application is a continuation-in-part of U.S.
Patent Application No. 12/766,171, titled "Replacement Battery Indicator on a
Battery Powered Device", filed April 23, 2010.

BACKGROUND

15 The proliferation of wireless data transfer technologies, including cellular
technology, Wi-Fi and Bluetooth for example, has resulted in an explosion in the
number of portable devices available to consumers. Examples of such portable
devices include personal entertainment devices, such as game, music and video
players, personal communication devices, such as smart phones and personal
20 digital assistants, data collection devices and portable computers.

The vast majority of these portable devices are powered by rechargeable
batteries. The batteries may be off-the-shelf batteries or comprise a prepackaged
battery pack. In use, a portable device user typically charges the batteries using
a standard power source, such as an electrical outlet. The batteries may be
25 charged while remaining within the portable device or removed from the device
and charged via an external battery charger. Once the batteries are charged they
are used to power the portable device. Once the batteries are drained, they are
recharged and the process begins anew.

However, rechargeable batteries have a fixed life-cycle. That is, they have a
30 limited number of charge cycles before they can no longer be effectively
recharged. Further, environmental conditions such as high or low
temperatures,

or improper charging strategies, can affect the performance of the batteries. This decrease in performance and/or ability to be recharged is referred to as battery degradation. Therefore, as rechargeable batteries are used it only becomes possible to recharge them to a maximum energy storage (often expressed in
5 ampere hours aH or milli-ampere hours maH) capacity that is some fraction of their original maximum energy storage capacity. Once this maximum energy storage capacity falls below a certain threshold, the batteries will no longer be practically useful.

However, it is difficult for the user to know when the rechargeable batteries will
10 need to be replaced. Typically, the user will not know that a rechargeable battery needs to be replaced until it fails to last for an expected useful time period. Accordingly, a number of extra batteries need to be kept on hand to ensure that replacement batteries are available when the degraded rechargeable batteries can no longer effectively be recharged. The more portable devices one has, the
15 larger the inventory and associated costs for storing the replacement batteries. Furthermore, the replacement batteries also have a limited life span and degrade, to some extent, when they are in storage.

Further, it is common that a user will have multiple sets of batteries for a device so that the device can be used with one set while another set, or sets, are being
20 charged. It can be difficult for most users to manage two or more sets of batteries to ensure that the battery sets are utilized in the device on a regular rotation (which can optimize their useful lifetime) and to identify degraded batteries for disposal/recycling.

Accordingly, it is desirable to provide a system and method that facilitates the
25 determination and display an indication of the battery degradation so that the user can make an informed decision when to replace the battery.

SUMMARY

As described above, a common problem among portable device users is not knowing when to replace the device's batteries. Some users are aware that, at
30 least for some battery chemistries, the batteries should typically be replaced after no more than two years, but the actual replacement time depends on how the

batteries are being used and charged. Replacing batteries prematurely results in users wasting money as the batteries could still be utilized. Conversely, users who wait too long to replace their batteries may result in the batteries failing at a critical time, thereby wasting time and money. Accordingly, a visual indication of the amount of the batteries' degradation is provided in an easy to understand format so that the user can improve their battery management with relative ease. In accordance with an aspect of the present invention, there is provided a method of representing battery degradation of a rechargeable battery for use with a battery operated device, the method comprising the steps of: determining, at predefined intervals, the battery degradation of the rechargeable battery; selecting an indicator from one of a plurality of predefined indicators based on the determined battery degradation; and displaying the selected indicator on a screen of a computing device for representing the battery degradation.

In accordance with a further aspect of the present invention, there is provided a computing device configured to represent battery degradation of a rechargeable battery for use with a battery operated device, the computing device comprising: a screen; memory for storing computer readable instructions; and a processor configured to execute the computer readable instruction, thereby implementing the method as described above.

20 BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the present invention will now be described by way of example only with reference to the following drawings in which:

Figure 1 is a perspective view of the front and side of a portable computer using a rechargeable battery;

25 Figure 2 is a battery information screen that can be displayed on the portable computer of Figure 1;

Figure 3 is a flow chart describing steps for determining battery discharge for smart batteries;

30 Figure 4 is a flow chart describing steps for determining battery discharge for dumb batteries;

Figure 5 is a taskbar portion of a screen that can be displayed on the portable computer of Figure 1;

Figures 6A-6C are schematic representations of battery information screens;

Figures 7A-7B are schematic representations of battery information screens
5 showing a detail portion;

Figure 8 is a schematic representation of a battery health configuration screen;

Figure 9 is a schematic representation of a battery health viewing screen;

Figure 10 is a schematic representation of a text editing interface;

Figures 11 to 13 are screen shots of a battery information screen; and

10 Figure 14 is a screen shot of an alternative embodiment of a battery information screen.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

For convenience, like numerals in the description refer to like structures in the drawings. Referring to Figure 1, a portable computer is illustrated generally by
15 numeral 100. The portable computer 100 comprises a main body 102, a display 104, a keyboard 106 and a battery compartment 108 for housing a rechargeable battery (not shown). For ease of explanation, the rechargeable battery will simply be referred to as the battery.

The battery can be any suitable rechargeable power source for portable
20 computer 100 and typically comprises one or more battery cells and a battery controller which are mounted in a enclosure sized and shaped to be received in battery compartment 108. The battery controller is a semiconductor device which can monitor and/or control charging of the battery and which can develop and maintain relevant statistics with respect to the battery, such as the number of
25 times the battery has been recharged, as well as information about the battery, such as a serial number of the battery, the chemistry of the battery (NiMH, lion, etc.). Battery controllers are well known to those of skill in the art and suitable devices are available from Texas Instruments and other manufacturers and will not be discussed in further detail herein.

30 The portable computer 100 and the battery are in communication using a battery interface (not shown). The battery interface may use known or proprietary

protocols for communication. The portable computer 100 also comprises a plurality of optional components such as a barcode scanner or radio-frequency identification (RFID) tag reader, for example.

As will be appreciated, battery management software is provided on the portable
5 computer 100 that determines the battery degradation and presents the information on the screen 104. In one embodiment, the battery degradation information is displayed graphically as a "battery gauge". Referring to Figure 2, a battery information screen, which can be displayed on screen 104, is shown generally by numeral 200. The battery information screen 200 includes a battery
10 gauge 202, a battery type indicator 204, a battery status indicator 206 and a charge status indicator 208.

The charge status indicator 208 indicates whether or not the battery is being charged. This provides the user with a quick check to verify that the battery is being charged when the portable computer 100 is placed in a cradle, docking
15 station, or otherwise connected to a power source.

The battery status indicator 206 indicates whether or not the battery has been authorized. To prevent counterfeit batteries from being employed, which could lead to safety and/or other concerns, it is known to use cryptographic authentication to authenticate the battery with the device. If the portable
20 computer 100 supports such an authentication scheme, the battery is considered to be authorized if it contains the necessary credentials. Such an authentication scheme is known in the art and is beyond the scope of the present invention and, as such, is not described in detail.

The battery type 204 indicates the type of battery. The battery type 204 often
25 relates to the chemical composition of the battery such as nickel-metal hydride (NiMH), Lithium-ion (Li-on) and the like. The battery type 204 can be determined in a variety of manners and/or retrieved from the battery controller.

The battery gauge 202 is bar-shaped in the present embodiment and comprises three different condition sections. A critical condition section 202a, is located at
30 the left-most portion of battery gauge 202. The critical condition section is relatively small. It is used to indicate to the user that, due to battery degradation,

the battery discharge is critical and the portable computer 100 will likely not function effectively, even with a fully charged battery. Thus, the battery should be replaced. A good condition section 202c is located at the right-most portion of the battery gauge 202. The good condition section 202c is relatively large and is
5 used to indicate to the user that battery degradation is not a concern. A warning condition section 202b is located between the critical condition section 202a and the good condition section 202c. The warning condition section 202b is mid-sized. It is used to indicate to the user that battery degradation is becoming a concern and that a new battery should be obtained, as it will soon be needed.
10 The portable computer 100 will likely work just long enough to be useful to the user, as will be described.

Battery degradation is illustrated on the battery gauge 202 by a degradation indicator 202d. The degradation indicator 202d begins at the right-most edge of the battery gauge 202 and moves to the left as the battery degrades.
15 Accordingly, the degradation indicator 202d can be seen to increasingly occupy a greater portion of the battery gauge as the battery degrades

In the present embodiment the critical condition section 202a is coloured red, the warning condition section 202b is coloured yellow and the good condition section 202c is coloured green. The degradation indicator 202d is in the form of a black
20 bar that covers an increasing portion of the battery gauge 202 as the battery degrades. Accordingly, the user will quickly be able determine the level of degradation by the visible colours. That is, for example, if all three colours are visible then the battery is in good condition. As less green becomes visible then the user knows that battery is degrading. Once green is no longer visible then
25 user should consider obtaining a replacement battery. Once yellow is no longer visible then the user should consider replacing the battery with the replacement battery.

As will be appreciated by a person of ordinary skill in the art, the size of each of the good section 202c, the warning section 202b and the critical section 202a
30 depends on how much charge the battery contains and how much charge the portable computer 100 needs to be considered to be useful to the user. Thus, the

proportion of each of the sections 202a, 202b and 202c may vary for different implementations. For example, a portable computer 100 that is used three hours between recharging will have different requirements for a portable computer 100 that is used eight hours between recharging.

5 The following describes how the battery degradation is determined by the battery management software. There are two general types of batteries: smart batteries and dumb batteries. Smart batteries include means to monitor certain parameters and determine the remaining battery energy storage capacity. These parameters are used by the battery management software to generate the battery gauge
10 202. Dumb batteries lack the means present in the smart batteries but still include parameters that can be used by the battery software to determine and generate the battery gauge 202.

In the present embodiment, the battery gauge 202 is displayed to the user via a battery utility screen. A person of ordinary skill in the art will appreciate that the
15 battery gauge 202 can be displayed as part of other utility or status screens. In an alternate embodiment, the battery gauge 202 could be displayed on the main screen of the portable computer 100, either constantly or intermittently.

Referring to Figure 3, a flow chart illustrating a method for determining battery degradation of a smart battery is shown generally by numeral 300. In the present
20 embodiment, the battery degradation is determined after each charge cycle. A person of ordinary skill in the art will appreciate that the frequency of determining battery degradation can vary depending on the implementation.

Smart batteries generally provide a battery degradation calculation, but do not provide it as a total percentage of the maximum energy storage capacity. At step
25 302, a battery identifier is retrieved. Each battery identifier is unique and is used for identifying the battery.

At step 304, a chemistry or type for the battery is retrieved. In the present embodiment, this information is retrieved from the battery itself. Alternatively, the chemistry or type information may be able to be determined based on a portion
30 of the battery identifier. The chemistry or type of battery is used to determine

which of a plurality of predefined degradation factors to use when calculating battery degradation.

At step 306, further battery information is retrieved from the battery. This information includes date of manufacture, voltage, temperature, the maximum
5 battery capacity and the calculated battery capacity. The maximum battery capacity represents the maximum energy storage capacity of the battery when new. The calculated battery capacity represents the energy storage capacity of the battery remaining after the battery has calculated the degradation.

At step 308, a battery percentage decay is calculated. The battery percentage
10 decay refers to the degradation and represents a percentage of the battery that can no longer be used. Specifically, Battery Percentage Decay = (Maximum Battery Capacity – Calculated Battery Capacity) / Maximum Battery Capacity.

At step 310, it is determined whether or not the battery percentage decay has changed since the previous calculation. If the battery percentage decay has not
15 changed, then the method continues to step 312 and the operation is complete. If the battery percentage decay has changed, then the method continued to step 314 and the degradation progress bar on the battery gauge is updated to represent the change in degradation. The method then continues to step 312.

Referring to Figure 4, a flow chart illustrating a method for determining battery
20 degradation of a dumb battery is shown generally by numeral 400. In the present embodiment, the battery degradation is determined after each charge cycle. A person of ordinary skill in the art will appreciate that the frequency of determining battery degradation can vary depending on the implementation.

At step 402, the battery identifier is retrieved. Each battery identifier is unique
25 and is used for identifying the battery. At step 404, the chemistry or type for the battery is retrieved.

At step 406, further battery information is retrieved from the battery. This information includes date of manufacture, voltage, temperature and the maximum battery capacity. This information also includes a charge current
30 accumulator (CCA), a discharge current accumulator (DCA) and the degradation factor. The CCA is a count of how many times the battery has been charged. The

DCA is a count of how many times the battery has been discharged. The degradation factor is used in calculating the battery degradation by adjusting the CCA and DCA as different battery chemistries will have a different discharge curve when charging and discharging.

5 At step 408, the battery percentage decay is calculated in several steps. At step 408a, a degraded maximum capacity of the battery is determined as Degraded Maximum Capacity = Maximum Battery Capacity – (CCA + DCA) / Degradation Factor. The degraded maximum capacity represents the maximum energy storage capacity of the battery after degradation has been factored.

10 At step 408b, a battery percent life left is determined as Battery Percent Life Left = (Degraded Maximum Capacity * 100) / Maximum Battery Capacity. The battery percent life left reflects the degraded maximum capacity as a percentage of the maximum battery capacity.

At step 408c, the battery percentage decay is determined as Battery Percentage
15 Decay= 100 – Main Battery Percent Life Left.

At step 410, depending on the capacity at which the battery started charging the CCA and DCA are updated accordingly. That is, in order to increase the CCA or DCA count the battery should complete approximately one full charge or discharge, respectively. In order to determine whether one full charge or
20 discharge has occurred the energy storage capacity of the battery needs to be analyzed. If the battery for example has 90% of its energy storage capacity and is then charged, then the CCA will not be updated as this is not close enough to be considered a full charge. On the other hand if the battery has 20% energy capacity and is charged then the CCA will be updated. Similarly, if only 10% of
25 the battery capacity is used before a charge, then the DCA will not be updated as this is not close enough to be considered a full discharge. On the other hand if 80% of the battery capacity is used before a charge, then the DCA will be updated.

At step 412, it is determined whether or not the battery percentage decay has
30 changed since the previous calculation. If the battery percentage decay has not changed, then the method continues to step 414 and the operation is complete. If

the battery percentage decay has changed, then the method continued to step 416 and the degradation progress bar on the battery gauge is updated to represent the change in degradation. The method then continues to step 414.

Accordingly, it will be appreciated that in both embodiments described above, the
5 battery gauge is updated to graphically represent the battery degradation to the user.

In an alternate embodiment once the battery percentage decay reaches a predefined threshold, a new battery is automatically ordered. This threshold, referred to for clarity as an order threshold, can be determined based on a
10 number of different criteria. For example, the order threshold can be based on an estimated time to receive the new battery once it has been ordered. Thus, the longer the estimated time to receive the battery, the lower the order threshold and vice versa. In another example, the order threshold can be based on the estimated usage of the mobile computer. Thus, the more frequently, or longer,
15 the portable computer 100 is expected to be used, the lower the order threshold and vice versa. In yet another example, the order threshold can be based on the number of batteries already in inventory. Thus, the greater the number of batteries in inventory, the higher the order threshold and vice versa. Further examples, and combinations thereof, will become apparent to a person of
20 ordinary skill in the art.

Once the order threshold is crossed, the battery management software executing on the portable computer 100 contacts a predefined supplier to order the new battery. In the present embodiment, the portable computer 100 is equipped with Wi-Fi access and the battery degradation software attempts to connect with a
25 supplier server via a Wi-Fi network to order the battery. Alternatively, the portable computer 100 is equipped with radio technology and the battery degradation software attempts to connect with a supplier server via a cellular network, such as a 3G network for example, to order the battery. In yet an alternate embodiment, the portable computer 100, may wait until it is docked and
30 communicate with a supplier server via a wired network connection. In yet an alternate embodiment, the portable computer 100 may communicate with a local

server rather than directly with the supplier server. In this embodiment, the local server is configured to accumulate parts requests and submit an order at predefined intervals.

Although described with specific reference to portable devices, such as the portable computer 100, it will be appreciated by a person of ordinary skill in the art that the invention can be implemented on other electronic devices that use rechargeable batteries including, for example, laptop computers, personal digital assistants, mobile phones, portable media devices, such as mp3 players, digital image recording devices, such as cameras and camcorders, battery powered vehicles and the like.

Further, although described with reference to a bar-shaped indicator, the battery gauge can be displayed differently to the user. For example, a pie-shaped indicator may also be used. As another example, a multiple-bar graph may also be used that takes other factors, such as temperature, into consideration. Other graphical representations will be apparent to a person skilled in the art.

Yet further, although the embodiments described above are described with specific reference to determining battery degradation for the battery of the electronic device itself, the invention may also be applied to batteries external to the electronic device.

For example, rechargeable batteries are often charged in external charging stations. An electronic device, such as the portable computer 100 described above, can be used to communicate with a plurality of batteries via RFID. In order to facilitate this communication, each battery is configured with a writable RFID tag. At predefined intervals, such as after each charge cycle for example, the battery writes its battery information to the RFID tag. Also, the battery identifier included in the battery information, or at least a portion thereof, is clearly labeled on the battery so that it is visible to the user.

The battery software is configured to represent a plurality of battery gauges 202, one for each battery. The battery identifier is presented along with each of the battery gauges so that the user can easily reconcile a battery gauge with its corresponding battery. As will be appreciated by a person of ordinary skill in the

art, the number of battery gauges 202 that can be accommodated on the display 104 depends on the size and resolution of the display 104. Accordingly, if there are too many battery gauges 202 to be easily accommodated on the display, multiple pages can be used.

5 In yet an alternate embodiment, the battery gauge can represent battery degradation in a different manner than the embodiment described above. Referring to Figure 5, a screen shot of a portion of a main screen displayed by the portable computer 100 is illustrated generally by numeral 500. Specifically, Figure 5 shows a taskbar 502. In the present embodiment, the taskbar 502 is a
10 taskbar of the Windows CE operating system. However, a person of ordinary skill in the art will appreciate that the invention can be applied to other taskbar configurations as well as other operating systems. A plurality of icons 504 are displayed on the taskbar 502. As is known in the art, the icons 504 can be used to display information to a user. Further, the icons 504 are selectable by the user
15 to initiate an application or a popup user interface.

In accordance with the present invention, the icons 504 include a battery status icon 504a. The battery status icon 504a has a battery meter 506 and a localized background 508. The battery meter 506 visually represents the estimated remaining charge in the battery. That is, as the charge available on the battery
20 decreases, the battery meter decreases in size. Thus, the battery meter 506 provides a quick, visual cue to the user regarding the approximate charge remaining until the battery needs to be recharged.

The localized background 508 visually represents the estimated battery degradation. That is, as the health of the battery decreases, and thereby the
25 number of useable recharge cycles decreases, the localized background 508 changes colour. Specifically, the localized background 506 changes colour when the battery degradation passes one of a plurality of predefined thresholds. The localized background 508 can include only the space immediately surrounding the battery status icon 504a, as illustrated, or can comprise a larger area, such
30 as the entire taskbar 502, for example.

In the present embodiment, an upper threshold and a lower threshold are set. When the battery degradation is above the upper threshold, the localized background 508 is coloured green. A green localized background 508 generally indicates that the battery is in good condition and has relatively little degradation.

5 When the battery degradation is between the upper threshold and the lower threshold, the localized background 508 is coloured yellow. A yellow localized background 508 generally indicates that the battery has degraded to the extent that even a full charge may not be sufficient to operate the portable computer 100 as desired.

10 When the battery degradation is below the lower threshold, the localized background 508 is coloured red. A red localized background 508 generally indicates that the battery has degraded to the extent that even a full charge will likely not be sufficient to operate the portable computer 100 as desired.

In accordance with a further embodiment, battery health grades can be used as a
15 battery gauge in lieu of or in addition to other battery gauges previously described. For example, in the present embodiment the battery health grades include the letters A, B, C and F. As will be appreciated by a person of ordinary skill in the art, the selection of which letters or symbols are used as battery health grades can be determined depending on the application for which the battery
20 gauge is used, language of the user and the like.

In order to provide further visual cues to the user, the battery health grades are presented in a predefined colour. For example, the letters A and B are shown in green, the letter C is shown in yellow, and the letter F is shown in red. The letter A is an indication that the battery is in relatively good condition and has degraded
25 relatively little. In contrast, the letter F indicates that the battery has failed or is in critical condition. The letters B and C indicate, respectively, progressively worse battery degradation between the letters A and F. For example letter B may be a warning that the battery may not have enough capacity to last an entire work shift when fully charged and letter C may be a warning to replace the battery soon.

30 In the present embodiment, the health grades are presented to the user via a battery information screen. Referring to Figure 6A, a sample screenshot of the

battery information screen is illustrated generally by 600. The battery information screen 600 includes a battery capacity icon 602 with a capacity meter 604, a battery charge percentage 606, a battery health fill-bar 608 with a battery charge meter 609, a battery health grade 610, descriptive text 612, a details button 614 and a cancel button 618.

In the present embodiment, the battery information screen 600 is presented to the user upon selection of the battery icon 504a. Alternatively, or additionally, the battery information screen 600 may appear when the portable computer 100 resumes from a sleeping state, when it is turned on, or at pre-set periodic time intervals.

The battery capacity icon 602 provides a visual cue to indicate the estimated degradation of the battery. Similar to the battery status icon 504a, the battery capacity icon represents the battery degradation as a colour. Unlike the battery meter 506, which represents the remaining charge of the battery, the capacity meter 604 represents the estimated degradation of the battery. In the present embodiment, the height of the capacity meter 604 represents the estimated maximum battery capacity. The higher the capacity meter 604 the greater the available maximum capacity for the battery and the lesser the degradation.

The battery percentage 606 is an estimated percentage of the remaining charge of the battery. The remaining charge is also illustrated by the charge meter 609 in the battery health fill-bar 608. When the charge meter 609 fills the battery health fill-bar 608, then the battery is at full charge. As the charge in the battery decreases, the charge meter 609 moves from right to left. When the fill bar 608 is empty, then the battery does not have any remaining charge.

The battery health grade 610 provides a further an indication of the degradation level of the battery, as described above.

Descriptive text 612 is a written description of the health of the battery that is displayed on the battery information screen 600. Descriptive text 612 can be associated with the battery health grade 610 so that a meaningful description of the battery degradation will be displayed in the battery information screen 600 along with the associated battery health grade 610.

The details button 614 is a virtual button that can be selected by user input (e.g. a mouse-click or touch-screen selection) to display further details of the status of the battery.

The cancel button 618, indicated by the 'X' closes the battery information screen
5 800 when selected.

Referring to Figures 6B and 6C, other examples of the battery information screen 600 are illustrated. Each battery information screen shows the battery capacity icon 602 with the capacity meter 604, the battery charge percentage 606, the fill bar 608, the charge meter 609, the battery health grade 610, the descriptive text
10 612, the details button 614 and the cancel button 618.

Referring to Figure 6B the battery charge percentage 606 is '42%' indicating that the battery has approximately 42% of its charge remaining. Accordingly, the battery charge meter 609 is reduced to a portion (approximately 42%) of the fill bar 608 indicating that the battery is partially charged. The battery gauge 610
15 indicates a battery health grade level of 'A' and the descriptive text 612 provides the user with practical information relating to the battery degradation. In the present example, the descriptive text 612 states "The detected battery is fairly new. When fully-charged, it is expected to last the entire work-shift with continual device-use."

Referring to Figure 6C the battery charge percentage 606 is 100%, indicating
20 that the battery is fully charged. Accordingly, the charge meter 609 occupies the entire fill bar 608. The battery gauge 610 indicates a battery health grade of 'F' and the descriptive text provides the user with practical information relating to the battery degradation. In the present example, the descriptive text states "It is recommended that this battery is replaced soon. When fully-charged, it will not
25 last the entire work-shift."

Referring to Figure 7A, an example of the battery information screen 600 after the details button 614 has been selected is illustrated. Once the details button 614 is selected, a details portion 700 is revealed. In the present example, the details portion 700 displays an estimated maximum charge capacity 702, a
30 charge cycle count 704 and a battery serial number 706. The details portion 700

of the battery information screen 600 can be closed by selecting the details button 614.

Referring to Figure 7B, another example of the battery information screen 600 after the details button 614 has been selected is illustrated. The details portion
 5 700 of the battery information screen 600 displays the cycle count 704 and the battery serial number 706. The details portion 700 of the battery information screen 600 can be closed by selecting the details button 614.

The battery information screen 600 described above displays battery status information in accordance with battery health profiles. In the present
 10 embodiment, the battery health profiles are initially set to default value but are dynamically configurable by a system administrator of the portable computer 100. Information stored in the battery health profile includes thresholds used to define the battery health grades, the colour assigned to specific battery health grades and the number of charge cycles to reach specific battery health grade levels. For
 15 example, a battery health grade "A" can be assigned to a battery degradation level of 20% or less, meaning that the battery has degraded by less than 20%. Battery health profiles can also include descriptive text related to one or more battery health grades. Battery health profiles can be created edited and stored locally on the portable computer 100 or can be stored remotely at a remote or
 20 central server. Further, battery health profiles can be edited remotely at a central location and accessed by multiple portable computers 100.

Referring to Figure 8, a battery health configuration screen is shown generally at 800. The battery health configuration screen 800 is for editing or modifying the battery health profile. The battery health configuration screen 800 includes a
 25 profile field 802, a threshold chart 804, a text button 806, a warning selection button 808, a dismiss warning button 810, an allow details button 812, a health threshold field 814, a timing threshold field 816, a cancel button 820 and an 'OK' button 818. The battery health configuration screen 800 can be initiated from the portable computer 100 or from a remote location.

30 The profile field 802 allows a user to select an existing battery health profile that has been stored in memory or a storage. The storage can be a remote storage

accessible by the portable computer 100 for example. When a battery health profile is selected, profile information is displayed in the threshold chart 804. The threshold chart 804 is a text based chart that sets out the logical relationships between the battery health grade, the degradation percentage of the battery, the charge cycle count and the colour of the fill bar 608.

The threshold chart 804 includes a health grade column 822, a degradation percentage column 824, a charge cycle count column 826 and a fill bar colour column 828. The values in each column align horizontally with the values in the remaining columns so that the aligned values correspond with one another in the battery profile. According to the battery profile shown in Figure 8, the degradation value of 90% corresponds with a battery health grade of 'C', a charge cycle count of '300' and a fill bar colour of yellow.

The text button 806 is a virtual button that can be selected by user input. When the text button 806 is selected via user input, a UI (not shown) for editing the description text 802 of the battery information screen 800 for any of the battery health grades shown on the threshold chart 804 is displayed.

The warning selection button 808 is a virtual button that can be selected by user input. In the embodiment shown in Figure 8, the warning selection button 808 is shown with an 'X' indicating that the warning selection button 808 is selected.

When the warning selection button 808 is selected a popup battery warning, such as a battery information screen 800, will be displayed on the portable computer's 100 UI when the battery health grade is at a pre-determined threshold level. The threshold field 814 is a virtual button that can be selected by user input in order to set the pre-determined threshold that determines when the popup battery warning will be displayed on the UI. When the threshold field 814 is selected a drop down menu showing battery health grades is displayed on the UI. One of the battery health grades shown on the drop down menu can be selected by user input. The pre-determined threshold level is set to the battery health grade selected by the user input from the drop down menu of the threshold field 814.

The dismiss warning button 810 is a virtual button that can be selected by user input. In the embodiment shown in Figure 8, the dismiss warning button 810 is

shown with an 'X' indicating that the dismiss warning button 810 is selected. When the dismiss warning button 810 is selected the popup battery warning, as set by the warning selection button 808, will be automatically closed after a pre-determined amount of time. The timing threshold field 816 is a virtual button that
 5 can be selected by user input in order to set the pre-determined amount of time after which the popup battery warning will be automatically closed. When the timing threshold field 816 is selected a drop down menu showing time amounts (e.g. 2 second, 3 second, 5 seconds, etc.) is displayed on the UI. One of the time amounts shown in the drop down menu can be selected by user input. The pre-
 10 determined amount of time after which the popup battery warning is closed is set to the time amount selected by the user from the drop down menu of the threshold field 816.

The allow details button 812 is a button that can be selected by user input. When the allow details button 812 is selected a details button 614 will be included in the
 15 popup battery warnings shown on the UI of the portable computer 100 after the battery health grade is at the pre-determined threshold level and when the warning selection button 808 has been selected.

The cancel button 820, indicated by the letter 'X' closes the battery health configuration screen 800 when selected. Data input into the battery configuration
 20 screen 800, such as edits made to a battery profile, will not be saved when the battery health configuration screen 800 is closed with the cancel button 820.

The 'OK' button 818 closes the battery health configuration screen 800 when selected. According to an embodiment, data input into the battery configuration screen 800, such as edits made to a battery profile, are saved and stored in
 25 memory. Alternatively, upon selection of the 'OK' button 818 a prompt (not shown) may be displayed on the user interface requesting a confirmation via user input that the data input into the battery configuration screen 800, such as edits made to a battery profile, is to be saved and stored in memory.

Referring to Figure 10, when the user selects the text button 806 a text editing
 30 interface 1000 is displayed on a UI. The text editing interface 1000 includes the warning selection button 808, the dismiss warning button 810, the allow details

button 812, the health threshold field 814, the timing threshold field 816, the cancel button 820 and the 'OK' button 818. The text editing interface 1000 further includes text boxes to edit the description text 612 to appear in association with battery health grade A 1022, grade B 1024, grade C 1026 and grade F. The text
 5 editing interface 1000 additionally includes a restore defaults button 1030 for restoring default text to each of the text boxes. The description text 612 in the text boxes is saved as part of the profile.

Referring to Figure 9, a battery health viewing screen is shown generally at 900. The battery health viewing screen 900 is for viewing the battery profile
 10 information presented in the battery information screen 800. The battery health viewing screen 900 includes a profile field 902, a threshold chart 904, a text button 906, a cancel button 920 and an 'OK' button 918.

The profile field 902 is a virtual button that can be selected by user input. When the profile field 902 button is selected, a pull down menu for selecting the profile
 15 to view is displayed. The pull down menu shows a list of battery profiles that can be displayed in the health viewing screen 900. The list of battery profiles shown in the pull down menu can be scrollable. In the embodiment shown in Figure 9, the profile being displayed is called "Cycle count only, using 2 grades."

The threshold chart 904 shows corresponding values of the selected battery
 20 profile. The threshold chart 904 includes a health grade column 822, a degradation percentage column 824, a charge cycle count column 826 and a fill bar colour column 828. The values in each column align horizontally with the values in the remaining columns so that the aligned values correspond with one another in the battery profile. According to the battery profile shown in Figure 9,
 25 the battery health grade of 'C', corresponds with a fill bar colour of green and the battery health grade of 'F' corresponds with a fill bar colour of red.

The text button 906 is a virtual button that can be selected by user input. When the text button 906 is selected, the descriptive text 612 associated with the different battery health grades is displayed (not shown).

30 The cancel button 920, indicated by 'X' closes the battery health viewing screen 900 when selected.

The 'OK' button 918 closes the battery health viewing screen 900 when selected. Figures 11 to 13 are sample screen shots of another embodiment of a battery information screen shown generally by 1100. The battery information screen 1100 includes a battery capacity icon 602 with a capacity meter 604, a battery charge percentage 606, a battery health grade 610, descriptive text 612, a battery health meter 1102 and a localized background 1104.

The battery health meter 1102 provides a visual indication of the battery health grade 610. For example, the battery health meter 1102 can comprise a number of symbols or a number of filled-in symbols. The number of symbols or filled-in symbols corresponds to a relative maximum possible capacity of the battery. Each levels of battery health can correspond to a specific number of symbols or a specific number of filled-in symbols. The battery health can be divided into specific discrete levels manually or automatically.

According to the sample screenshot of Figure 11, the battery charge percentage 606 is "83%", the battery health grade 610 comprises a battery health meter 1102 having one out of a possible five stars. The descriptive text 612 reads, "Battery should be replaced," and the localized background 1104 around the battery capacity icon 602 is red.

According to the sample screenshot of Figure 12, the battery charge percentage 606 is "84%", the battery health grade 610 comprises a battery health meter 1102 having five out of a possible five stars. The descriptive text 612 reads, "Excellent," and the localized background 1104 around the battery capacity icon 602 is green.

According to the sample screenshot of Figure 13, the battery charge percentage 606 is "83%", the battery health grade 610 comprises a battery health meter 1102 having three out of a possible five stars. The descriptive text 612 reads, "Used," and the localized background 1104 around the battery capacity icon 602 is yellow.

Figure 14 shows a sample screenshot of a further embodiment of the battery health screen indicated generally by 1400. The battery information screen 1400 includes a battery capacity icon 602 with a capacity meter 604, a battery charge

percentage 606, a battery health grade 610, descriptive text 612, a battery health meter 1102, a localized background 1104 and a cycle count 1402. The cycle count 1402 displays the number of battery cycles.

Still referring to Figure 14, the battery charge percentage 606 is "97%", the
5 battery health grade 610 comprises a battery health meter 1102 having five out of a possible five stars. The descriptive text 612 reads, "Excellent," and the localized background 1104 around the battery capacity icon 602 is green. The cycle count 1402 is 004.

According to an embodiment, an administrator at a central location can edit
10 profiles through the health configuration screen 800. These edited profiles can then be stored at a database. The portable computer 100 communicates with this database in order to obtain the edited profiles. Similarly, there may be an option in the health configuration screen 800 for creating profiles. Access to the health configuration screen 900 can be restricted so that only authorized users can edit
15 battery profiles. For example, access to the health configuration screen 800, either from the portable computer 100 or from a central administrator computer, or access to the profiles could be password protected.

According to a further embodiment, the central location maintains a database of degradation levels for the batteries in use in the portable computers 100 in a
20 network. The network could, for example, be an enterprise network associated with the central location. For example, the portable computers 100 in the network could periodically communicate battery degradation levels or battery capacities to the central location. The administrator at the central location could send notification messages, such as e-mails, text messages, instant messages and
25 the like, to the portable computers 100 at predefined battery degradation levels. Alternatively, the central location is programmed to automatically transmit the notification messages to the portable computers 100. Further, the central database may maintain a list of batteries at predefined degradation levels. The list may include all batteries and their associated degradation levels or only
30 batteries that have reached a certain level of degradation.

According to an alternative embodiment, the profiles can be edited and stored in the registry of the portable computer 100. Alternative ways or embodiments of storing, editing or creating profiles will be apparent to a skilled user upon reading this disclosure.

5 Although the embodiment described above uses RFID technology to communicate between the battery and the portable computer 100, other wireless technologies, such as Wi-Fi and Bluetooth or even a wired interface can be used. Using the foregoing specification, the invention may be implemented as a machine, process or article of manufacture by using standard programming
10 and/or engineering techniques to produce programming software, firmware, hardware or any combination thereof.

Any resulting program(s), having computer-readable instructions, may be embodied within one or more computer-readable media such as memory devices, thereby making a computer program product or article of manufacture
15 according to the invention. As such, the terms "software" and "application" as used herein are intended to encompass a computer program existent on any computer-readable medium such as on any memory device.

Examples of memory devices include, hard disk drives, diskettes, optical disks, magnetic tape, semiconductor memories such as FLASH, RAM, ROM, PROMS,
20 and the like.

A machine embodying the invention may involve one or more processing systems including, for example, a CPU, memory/storage devices, communication links, communication/transmitting devices, servers, I/O devices, or any subcomponents or individual parts of one or more processing systems, including
25 software, firmware, hardware, or any combination or subcombination thereof, which embody the invention as set forth in the claims.

Using the description provided herein, those skilled in the art will be readily able to combine software created as described with appropriate general purpose or special purpose computer hardware to create a computer system and/or
30 computer subcomponents embodying the invention, and to create a computer

system and/or computer subcomponents for carrying out the method of the invention.

Although the invention has been described with reference to certain specific embodiments, various modifications thereof will be apparent to those skilled in the art without departing from the scope of the invention as defined by the appended claims.

What is claimed is:

1. A method of operation of a portable computing device powered by a rechargeable battery wherein the rechargeable battery is housed within the portable computing device, the method comprising:

retrieving, from the rechargeable battery, by the portable computing device, information including a type of the rechargeable battery, a charge current accumulator (CCA), a discharge current accumulator (DCA) and a predefined degradation factor, wherein the predefined degradation factor is determined based upon the type of the rechargeable battery;

obtaining, by the portable computing device, an initial capacity of the rechargeable battery;

determining, by the portable computing device, a battery degradation as a function of the CCA, the DCA, and the predefined degradation factor; and

displaying, on a display of the portable computing device, the battery degradation relative to the initial capacity of the rechargeable battery as a battery gauge.

2. The method of claim 1, wherein the battery degradation equates to $(CCA+DCA)/\text{predefined degradation factor}$.

3. The method of claim 2, wherein the predefined degradation factor used to adjust the CCA and DCA is dependent on the type of the rechargeable battery.

4. The method of claim 2, wherein the CCA and DCA are updated when the rechargeable battery completes approximately one full charge or discharge.

5. The method of claim 4, wherein if the rechargeable battery has 20% capacity and is charged then the CCA will be updated, and if 80% of capacity of the rechargeable battery is used before a charge, then the DCA will be updated.

6. The method of claim 1, wherein obtaining the initial capacity of the rechargeable battery further comprises obtaining the initial capacity from the rechargeable battery.

7. The method of claim 1, wherein obtaining the initial capacity of the rechargeable battery further comprises: obtaining the initial capacity and battery

information from the rechargeable battery; and using the battery information to calculate the a degraded maximum capacity.

8. The method of claim 1, wherein the rechargeable battery is external to the portable computing device.

9. The method of claim 8, further comprising implementing the operations of obtaining, determining, and displaying for a plurality of rechargeable batteries external to the portable computing device.

10. The method of claim 1, further comprising:

automatically ordering a replacement battery when the battery degradation passes a predefined order threshold, wherein the threshold is based on an estimated time to receive a new battery once it has been ordered.

11. The method of claim 10, wherein the predefined order threshold is also based on an estimated usage of the portable computing device.

12. The method of claim 10, wherein the predefined order threshold is also based on a number of batteries already in inventory.

13. A portable computing device powered by a rechargeable battery wherein the rechargeable battery is housed within the portable computing device, the portable computing device comprising:

a display;

a memory storing computer readable code; and

a processor configured to execute the computer readable code to:

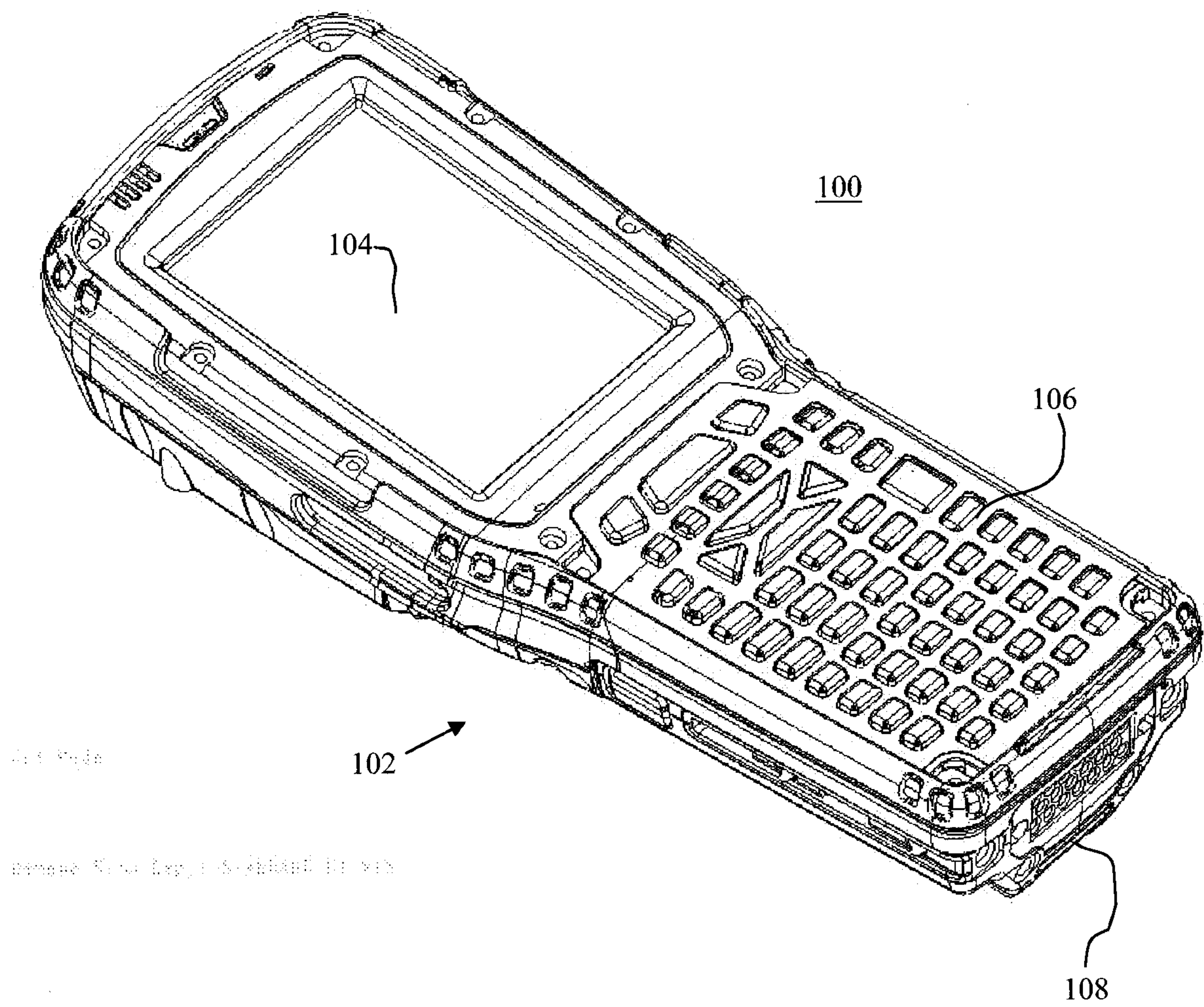
retrieve, from the rechargeable battery, information including a type of the rechargeable battery, a charge current accumulator (CCA), a discharge current accumulator (DCA) and a predefined degradation factor, wherein the predefined degradation factor is determined based upon the type of the rechargeable battery;

obtain an initial capacity of the rechargeable battery;

determine a battery degradation as a function of the CCA, the DCA, and the predefined degradation factor; and

display the battery degradation on the display relative to the initial capacity of the rechargeable battery as a battery gauge.

14. The portable computing device of claim 13, wherein the rechargeable battery is external to the portable computing device.
15. The portable computing device of claim 14 further comprising a communication interface operating to receive information from the rechargeable battery.
16. The portable computing device of claim 15, wherein the communication interface is a wireless communication interface.
17. The portable computing device of claim 13, wherein the processor is further operating to automatically order a replacement battery when the battery degradation passes a predefined order threshold, wherein the threshold is based on an estimated time to receive a new battery once it has been ordered.
18. The portable computing device of claim 17, wherein the predefined order threshold is also based on an estimated usage of the portable computing device.



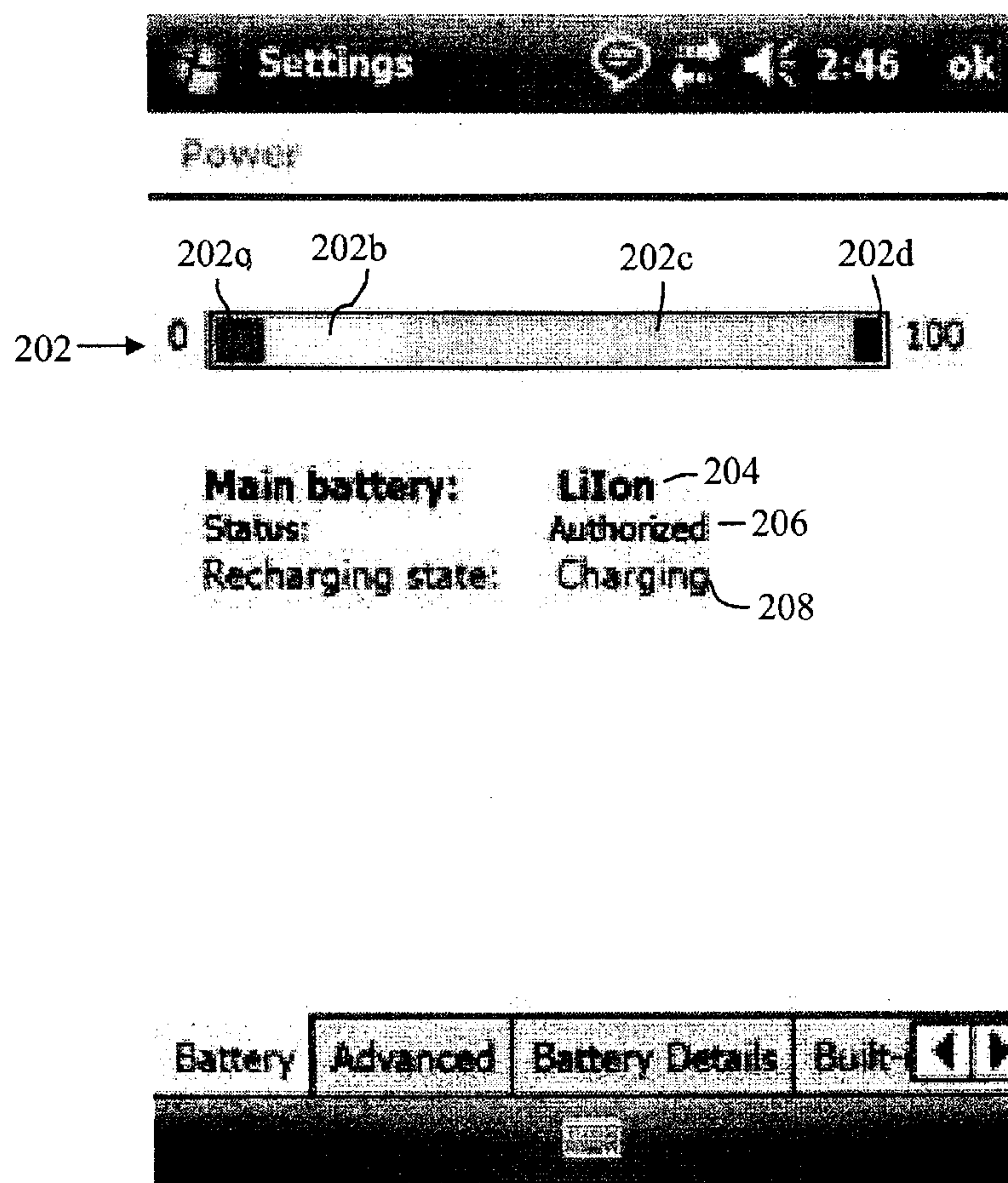
200

Figure 2

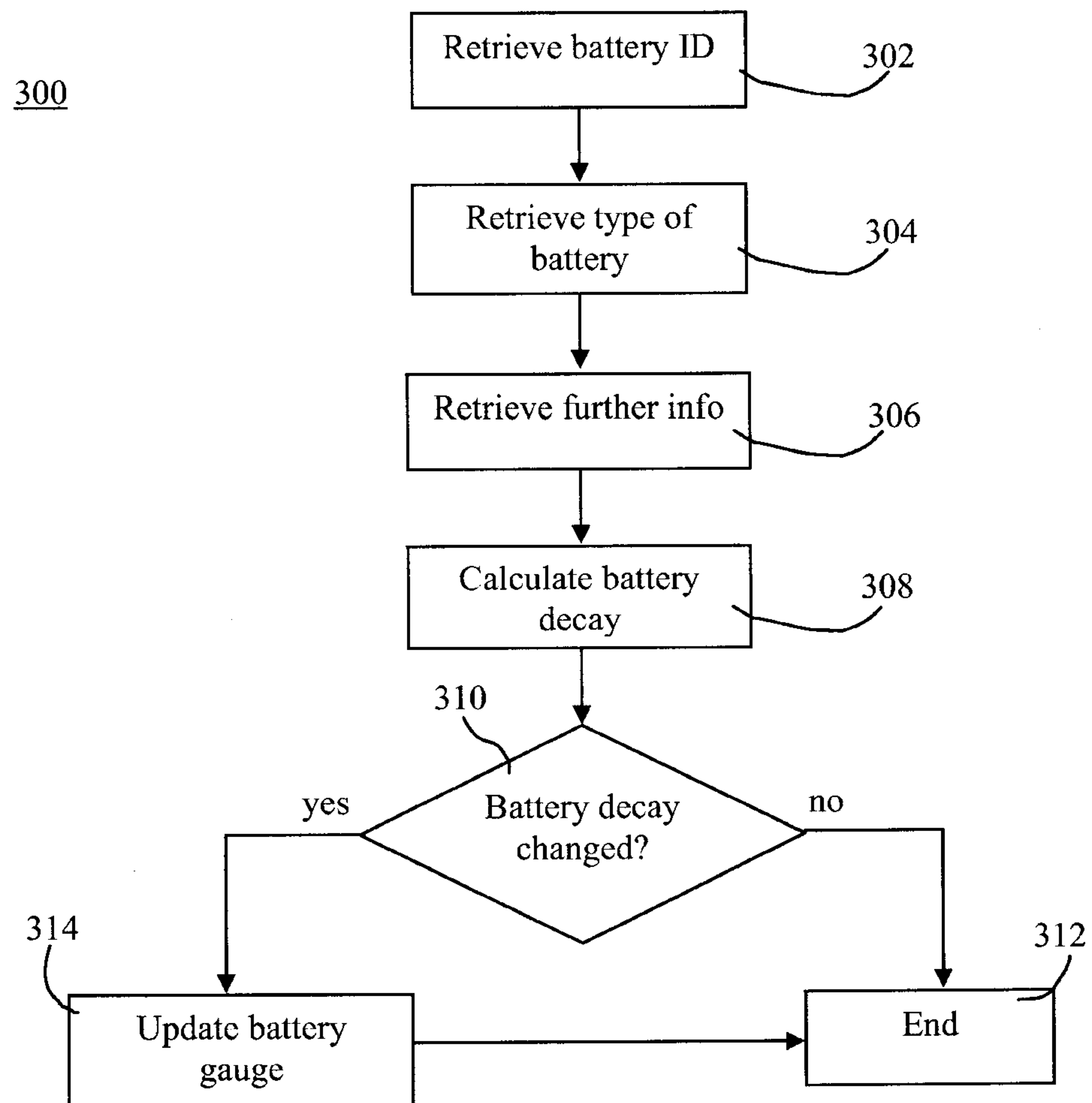


Figure 3

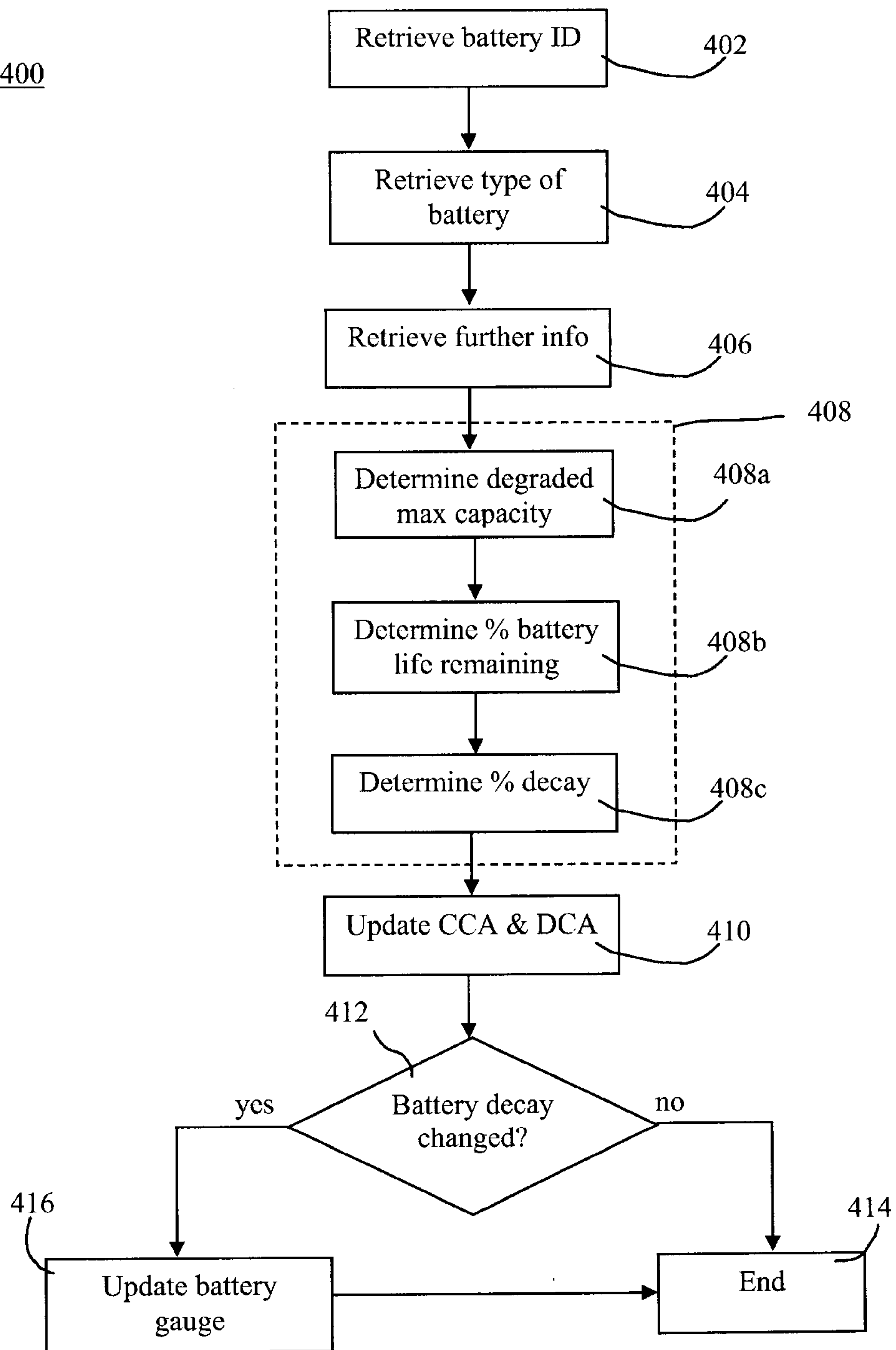
400

Figure 4

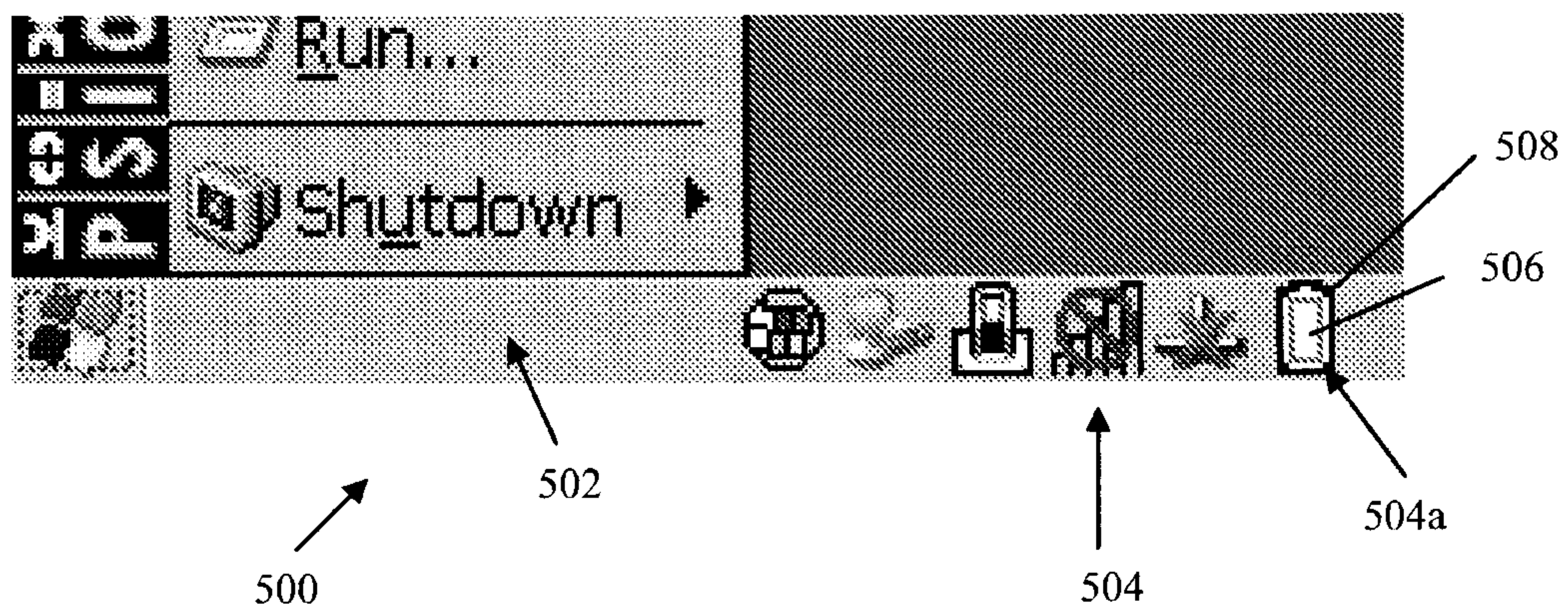


Figure 5

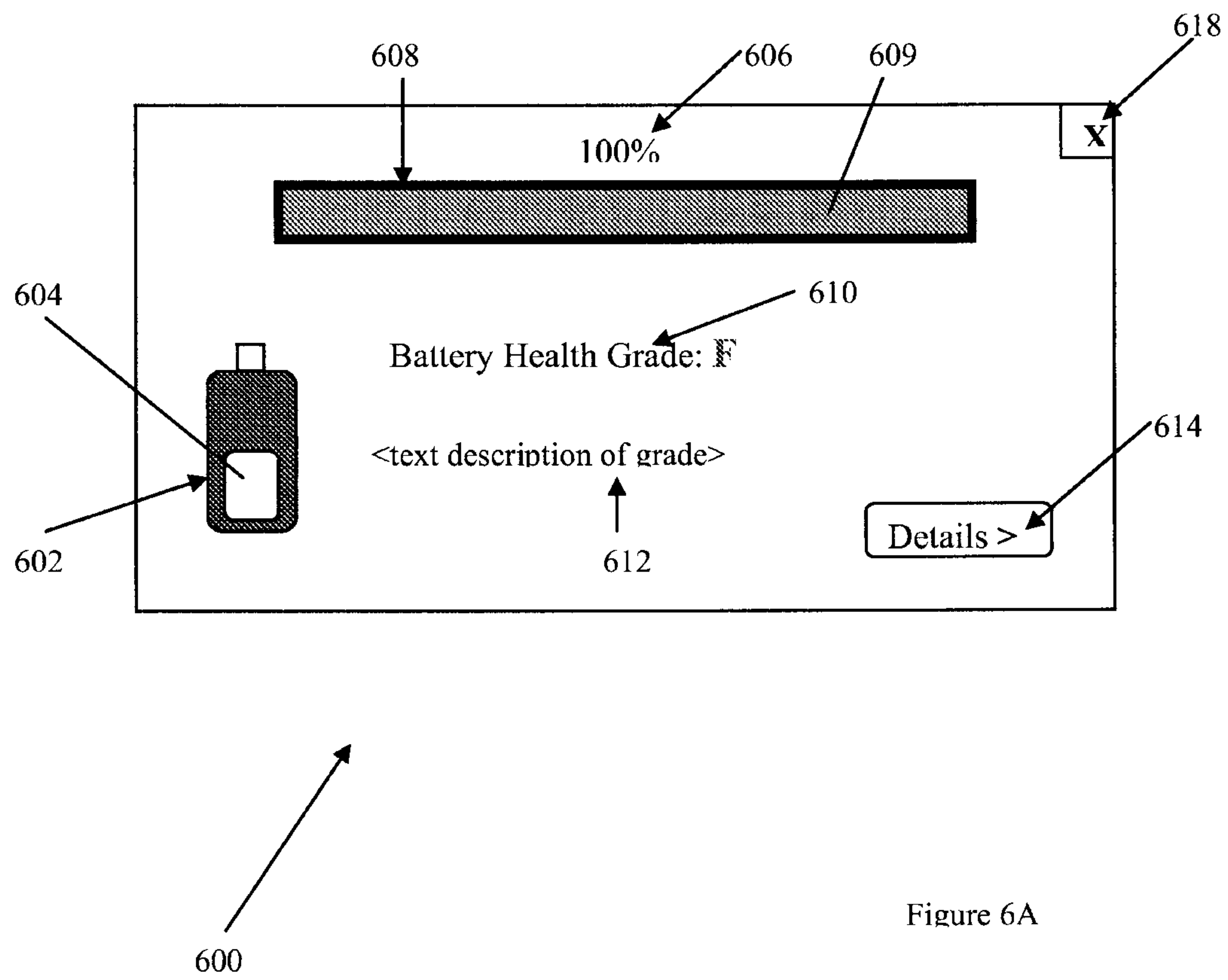


Figure 6A

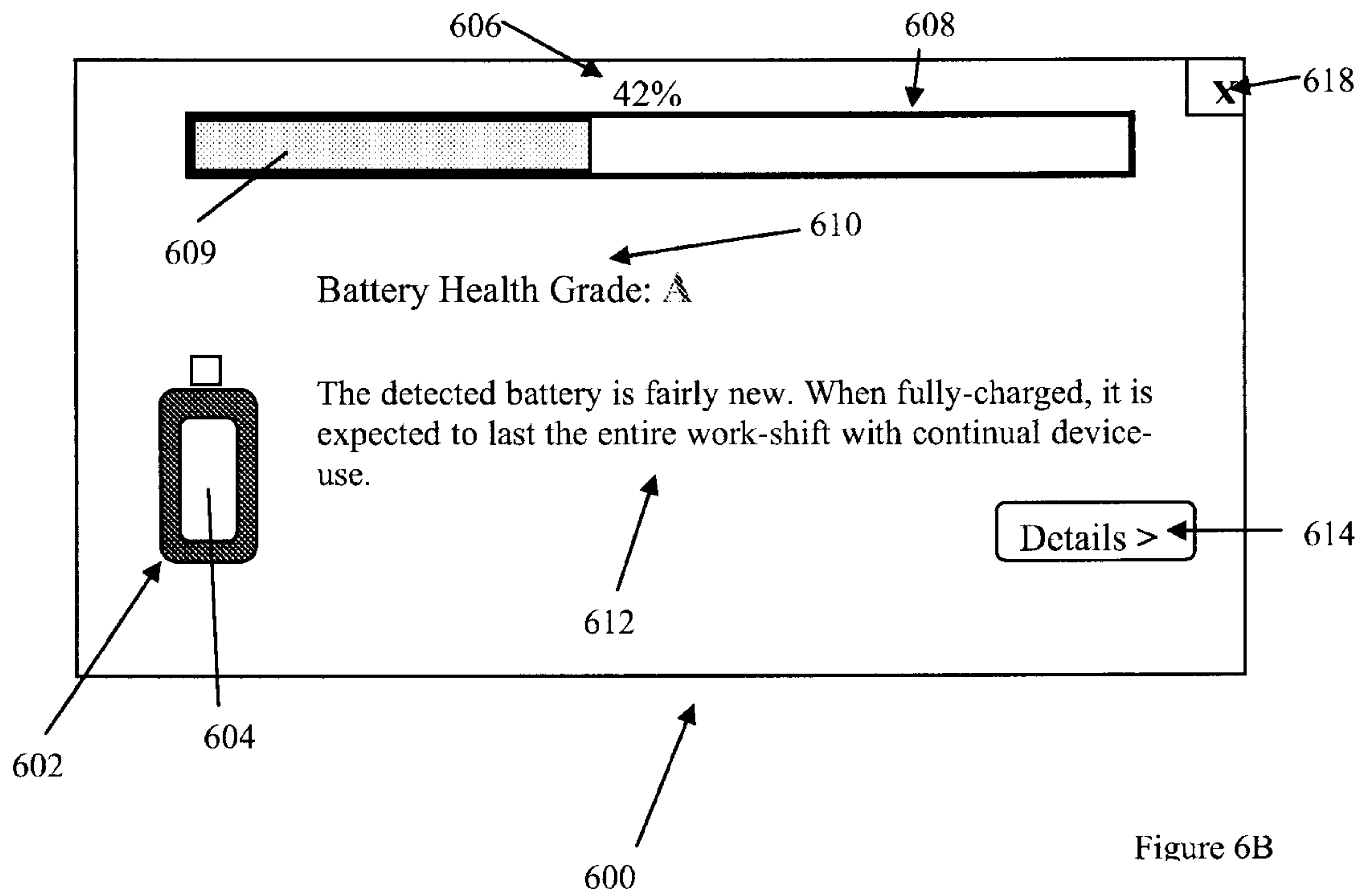


Figure 6B

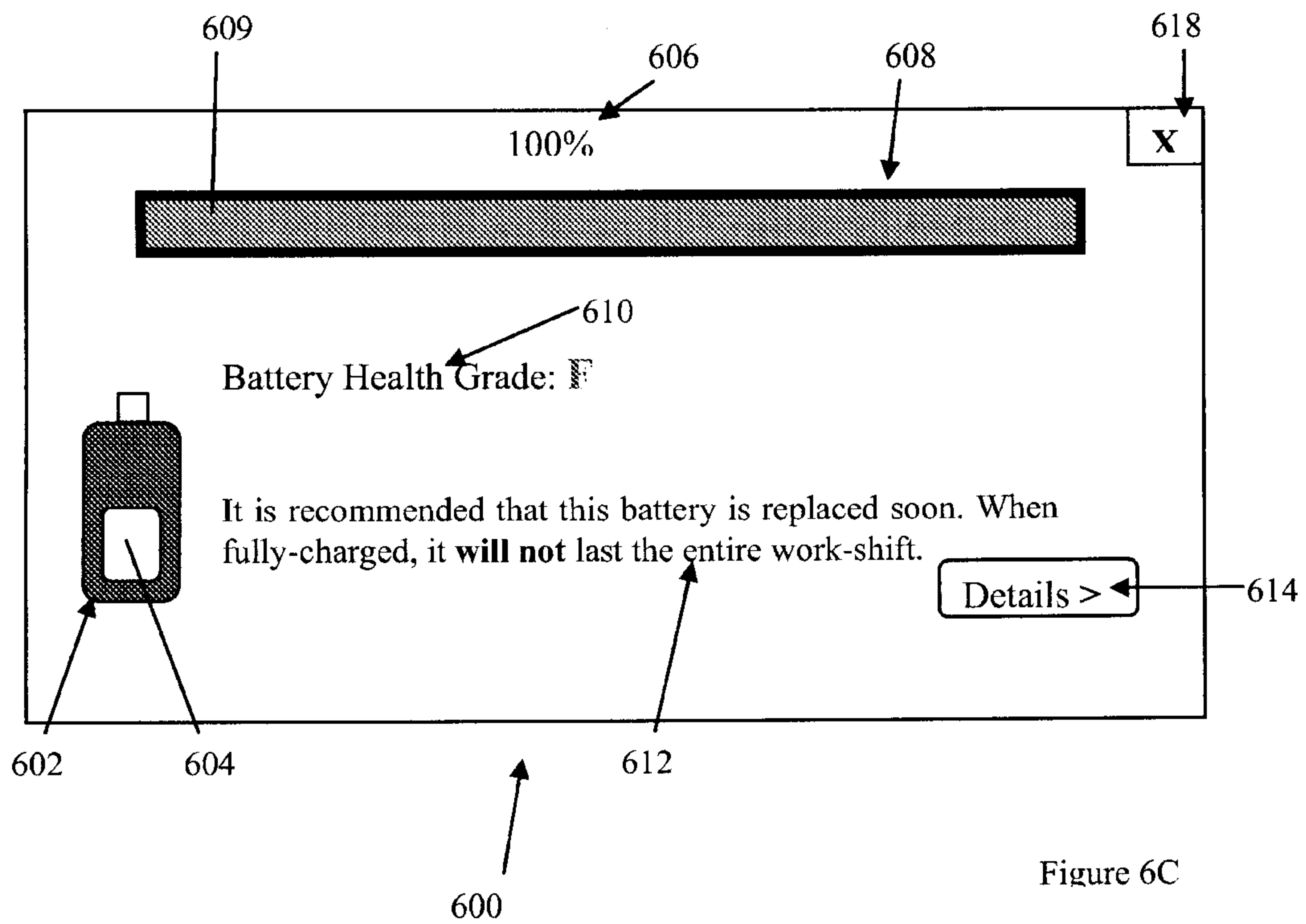


Figure 6C

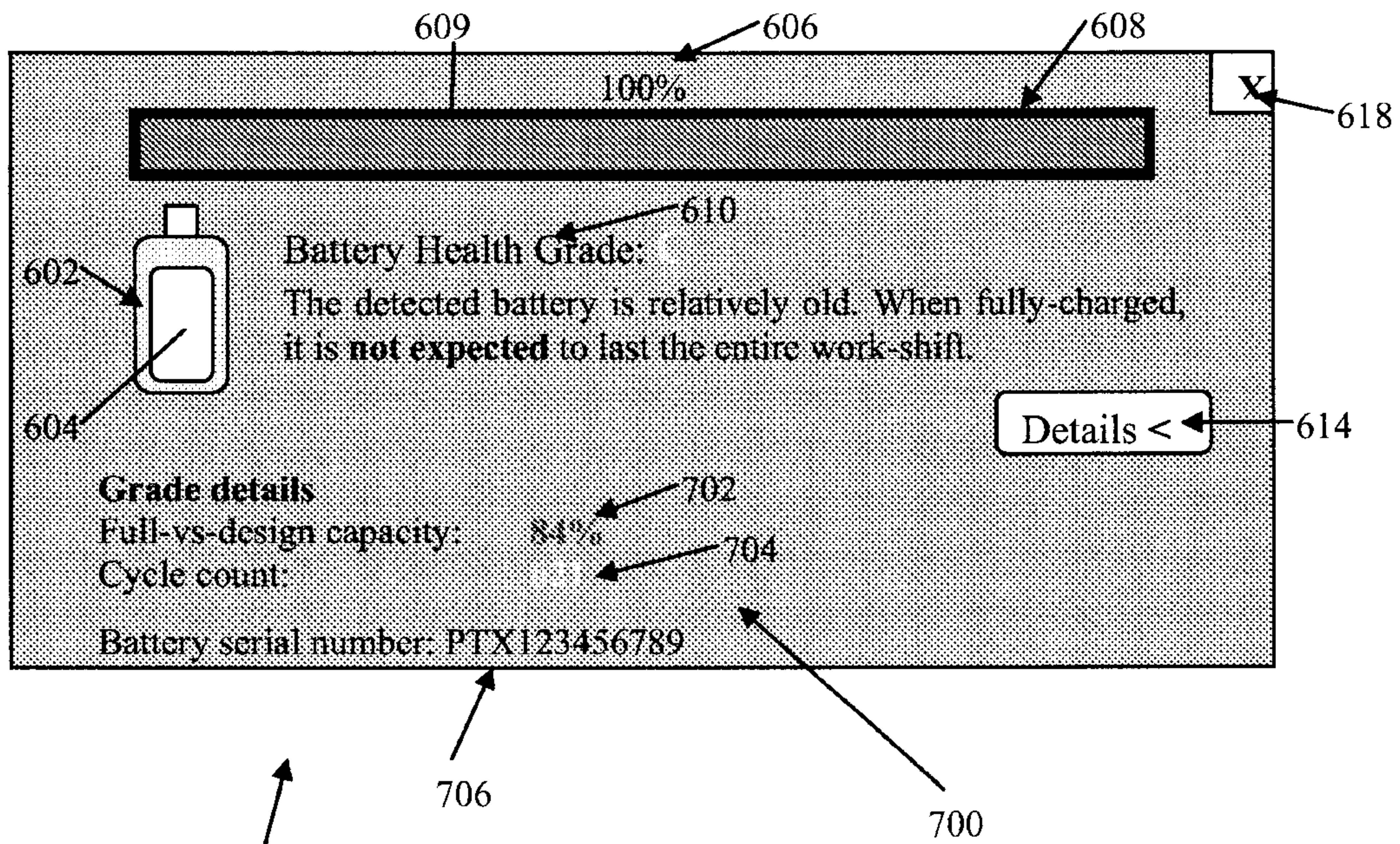


Figure 7A

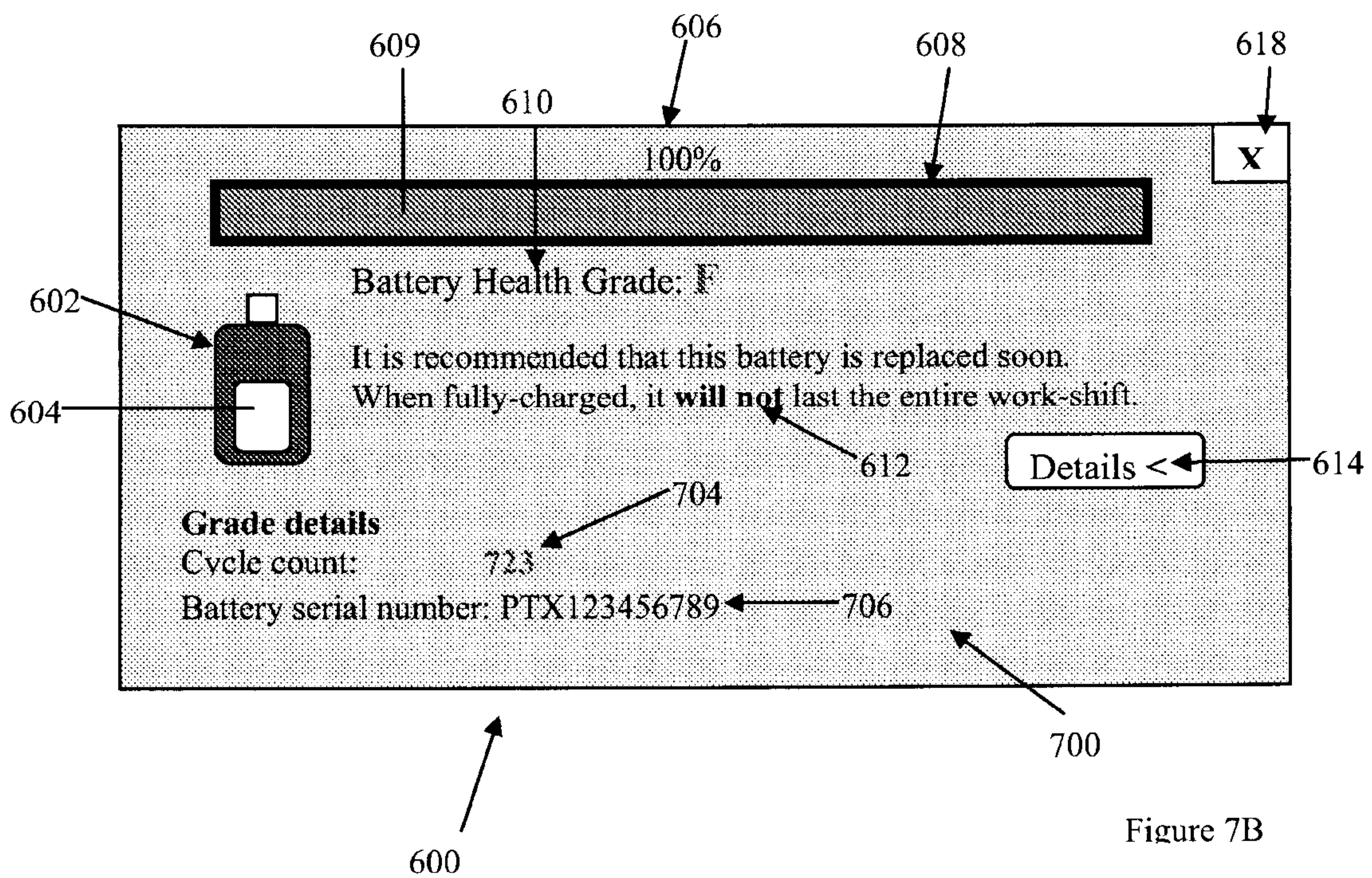


Figure 7B

818 820

Battery Health Grade Configuration

Select an existing profile, or create a new profile:

Recommended defaults **V** 802

Set the threshold values. The battery health grade is assigned when **any** of the thresholds are reached.

Grade	Full-vs-design Capacity	Cycle count	UI colour
A	---	---	
B	95%	200	
C	90%	300	
F	80%	400	

804 822 824 826 828 806

Change UI text

☒ Show popup warning on resume, when the battery health is:

on Grade F **V** 814

☒ Auto-dismiss popup warning after 3 seconds **V** 816

☒ Allow "more details" button in popup warning

808 810 812

800

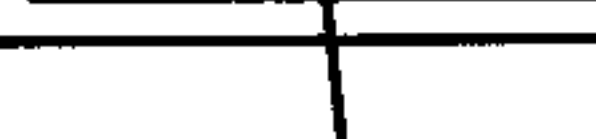
Figure 8

Battery Health Grade Configuration

Select an existing profile, or create a new profile:

Cycle count only, using 2 grades **V** 902

Set the threshold values. The battery health grade is assigned when **any** of the thresholds are reached.

Grade	Full-vs-design Capacity	Cycle count	UI colour
A	---	---	
B	---	---	
C	---	---	
-	---	---	

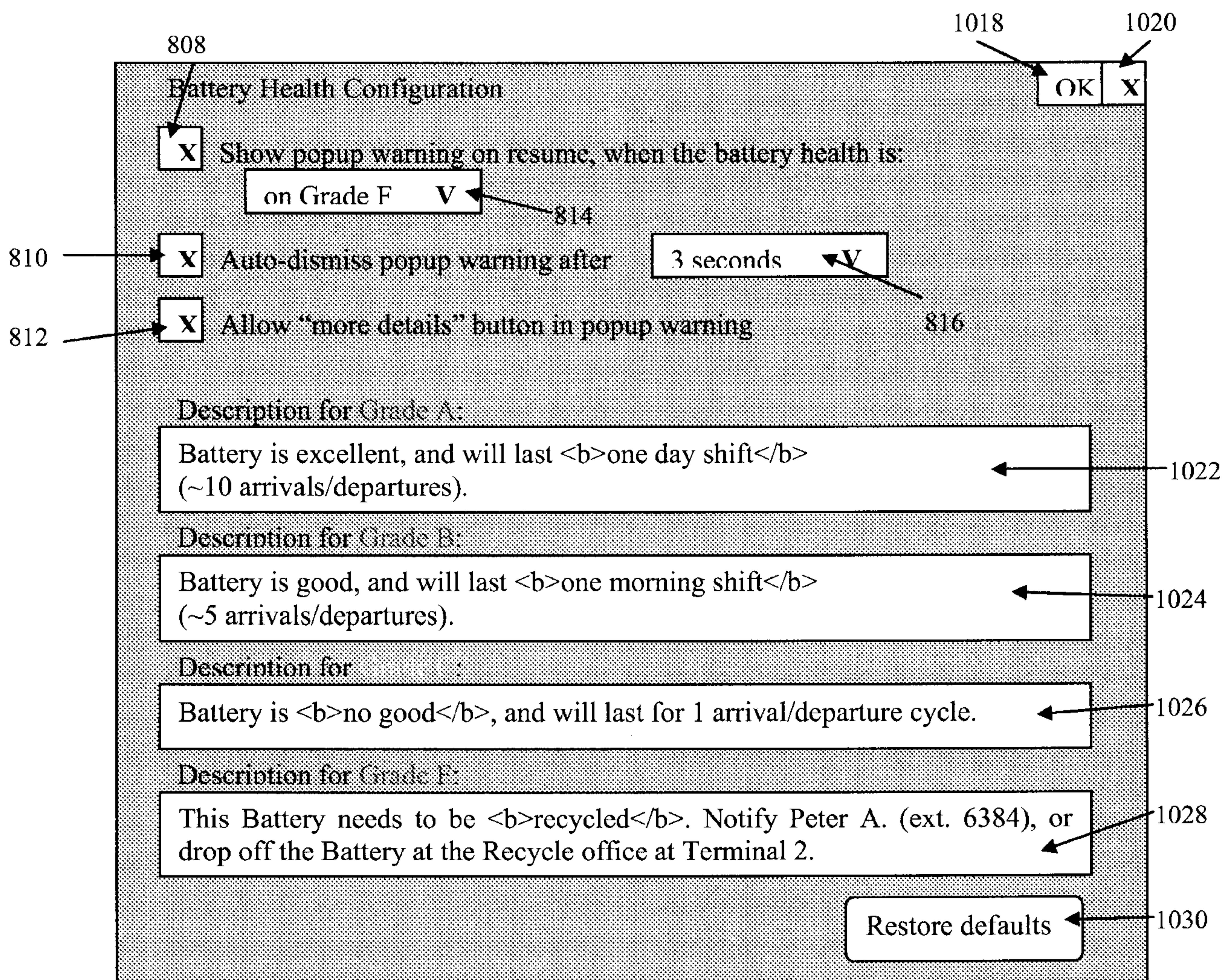
904 922 924 926 928 906

View UI text

918 920

900

Figure 9



1000

Figure 10

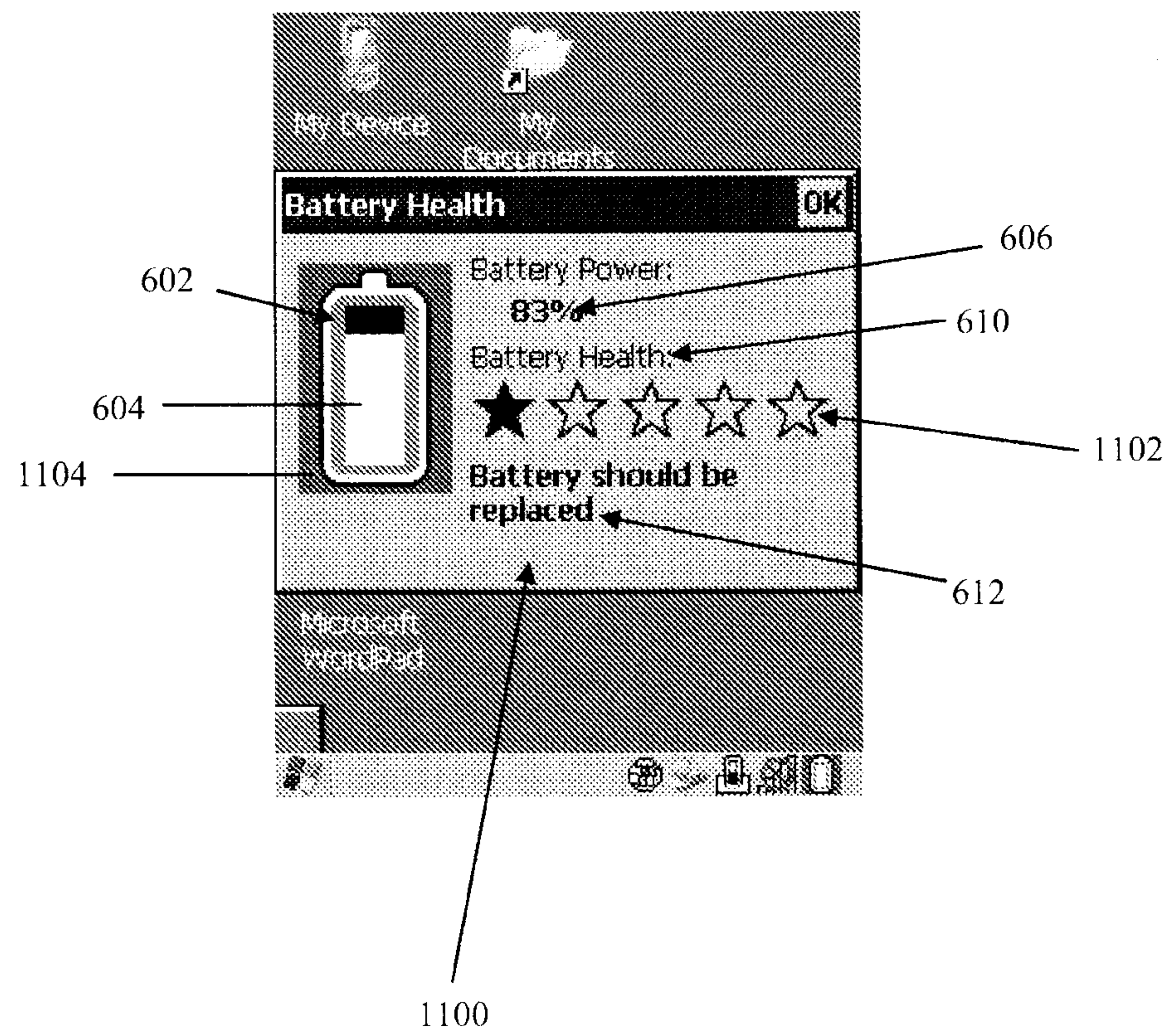


Figure 11

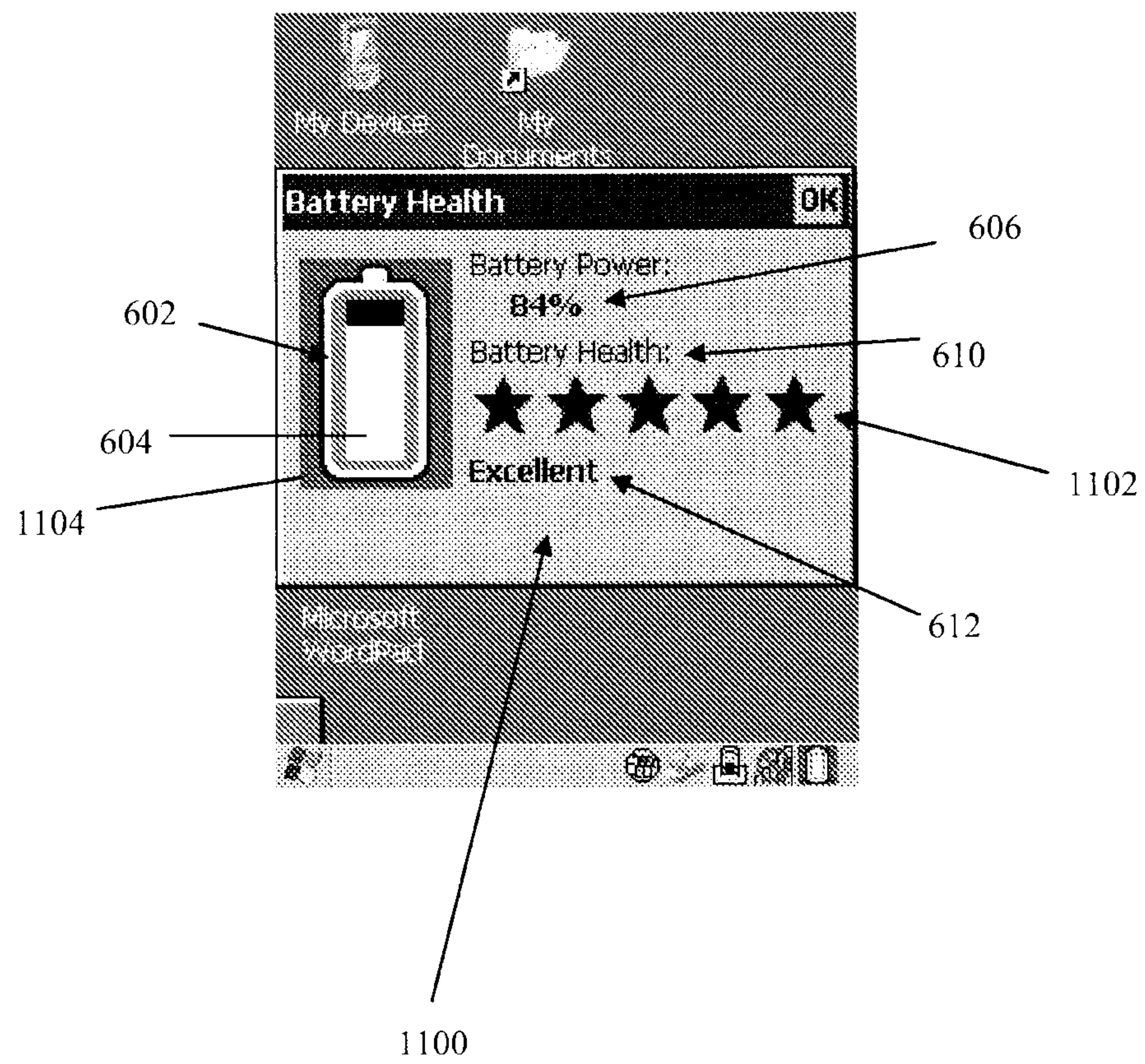


Figure 12

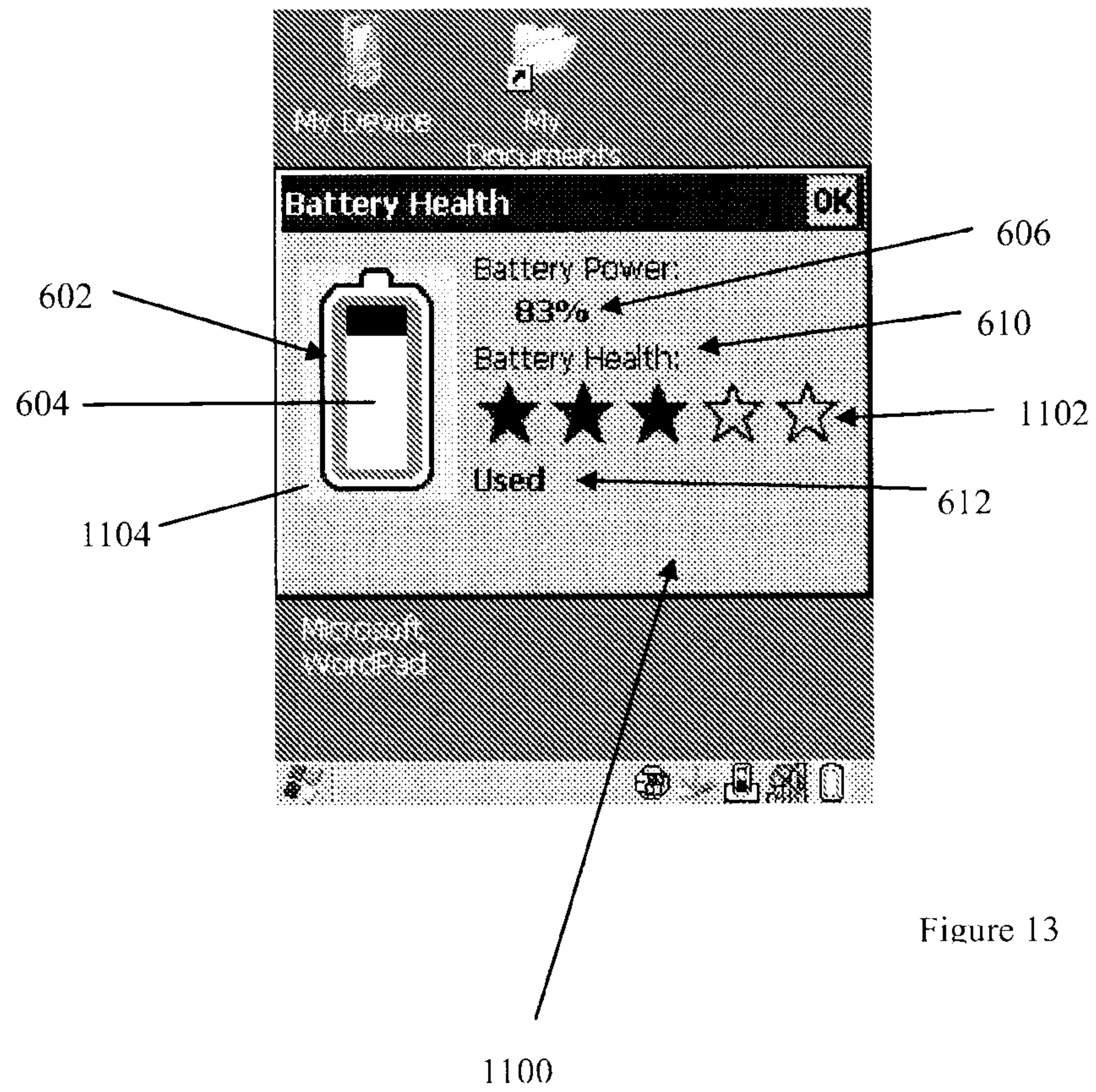


Figure 13

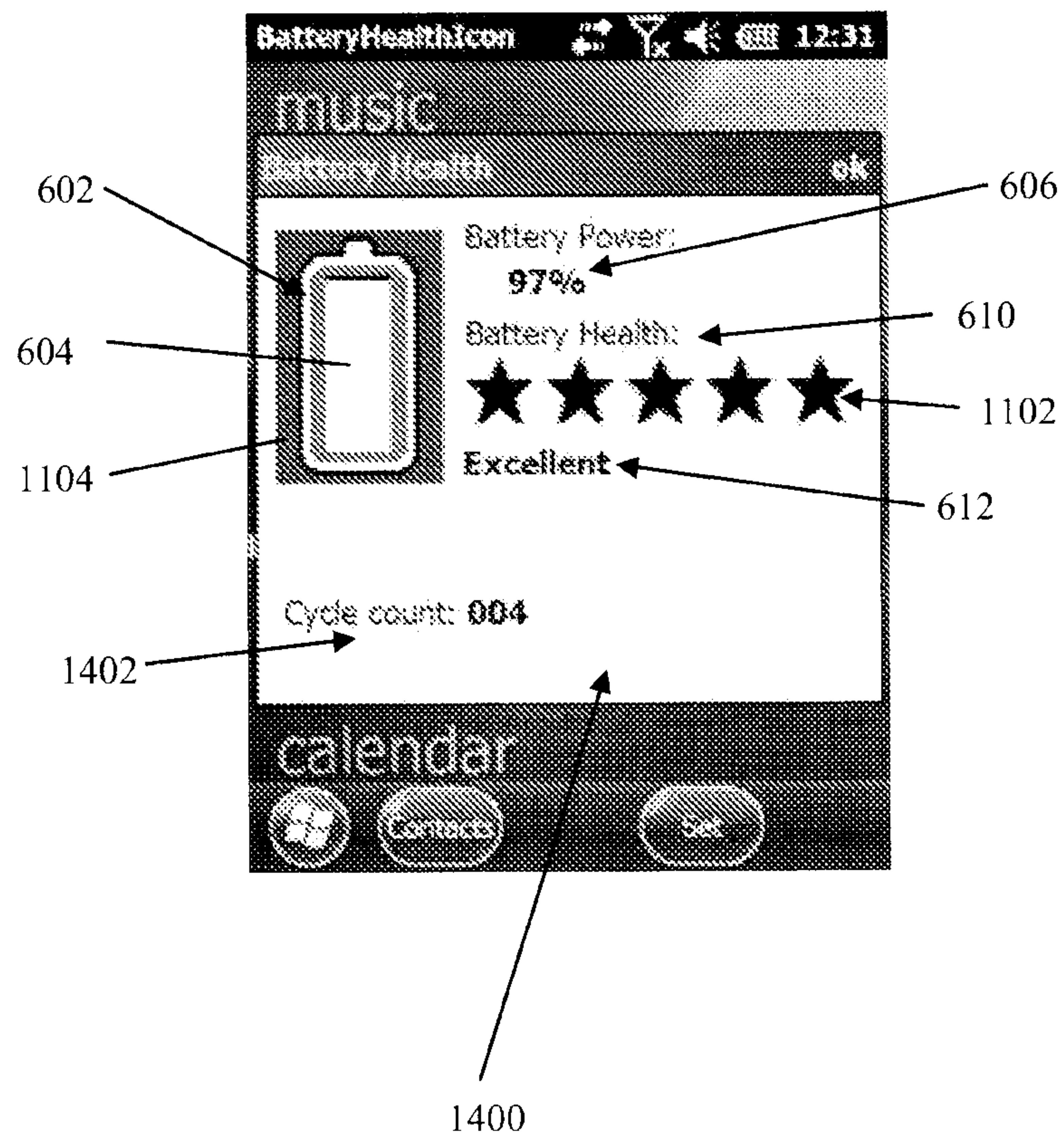


Figure 14

300

