EUROPEAN PATENT SPECIFICATION

METHOD, DEVICE, AND ADAPTOR FOR DYNAMICALLY ADJUSTING CHARGING CURRENT OF ADAPTOR TO ACHIEVE THERMAL PROTECTION AND FAST CHARGING

VERFAHREN, VORRICHTUNG UND ADAPTER ZUM DYNAMISCHEN EINSTELLEN DES LADESTROMS EINES ADAPTERS FÜR WÄRMESCHUTZ UND SCHNELLLADEN

PROCÉDÉ, DISPOSITIF ET ADAPTATEUR POUR AJUSTER DYNAMIQUEMENT UN COURANT DE CHARGEMENT D’UN ADAPTATEUR AFIN D’ASSURER LA PROTECTION THERMIQUE ET UN CHARGEMENT RAPIDE

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Description

FIELD OF INVENTION

[0001] The present invention relates to a charging scheme for controlling an adaptor, and more particularly to a charging scheme for dynamically adjusting charging current of an adaptor.

BACKGROUND OF THE INVENTION

[0002] Generally speaking, the storage capacity of a battery nowadays becomes larger and larger, and it is usually to employ a large charging current to charge the battery so as to decrease the waiting time for charging the battery. However, due to limitations of circuit elements within a conventional charger and a conventional adaptor, the conventional adaptor actually cannot supply a rated maximum charging current or even a large charging current to the battery via the conventional charger. In addition, an over large charging current may cause the circuit elements of the conventional charger thermally damaged. Accordingly, considering both of thermal protection and fast charging, it is necessary and important to provide a novel scheme for obtaining an appropriate charging current to charge the battery.

[0003] Document US 2009/0051329 A1 discloses a control method used in a charge-up circuit. The charge-up circuit comprises a charge-up transistor configured to supply a charge-up current to a secondary battery in accordance with a control signal and a detection resistor connected in series with the charge-up transistor to detect the charge-up current. The control method comprises a step of generating a voltage in accordance with the charge-up current based on each voltage at both end terminals of the detection resistor and a step of controlling the charge-up transistor so that a generated voltage becomes a predetermined reference voltage. Therein, the reference voltage is adjusted so that the charge-up current becomes a desired current.

SUMMARY OF THE INVENTION

[0004] Therefore one of the objectives of the present invention is to provide a charging system, a charger device, and a method for dynamically adjusting a charging current supplied by an adaptor by adjusting the charging voltage so as to obtain an appropriate charging current and solve the above-mentioned problems.

[0005] According to an embodiment of the present invention, a method for adjusting a charging current supplied by an adaptor is disclosed. The method comprises: checking whether the adaptor is capable of providing a target current for a battery connected to a charger device, to generate a check result; and according to the check result, making the adaptor to adjust a charging voltage provided by the adaptor from a first voltage to a second voltage so as to adjust the charging current supplied by the adaptor. Therein, the step of checking whether the adaptor is capable of providing the target current for the battery and the step of making the adaptor to adjust the charging voltage are performed iteratively to search for a minimum charging voltage for the adaptor to provide the target current.

[0006] According to an embodiment of the present invention, a device for adjusting a charging current supplied by an adaptor is disclosed. The device comprises a sensor and a controller. The sensor is utilized for sensing a current corresponding to the charging current supplied by the adaptor. The controller is coupled to the sensor and utilized for checking whether the adaptor is capable of providing a target current for a battery connected to the device, to generate a check result. The controller is arranged to make the adaptor to adjust a charging voltage provided by the adaptor from a first voltage to a second voltage according to the check result, so as to adjust the charging current supplied by the adaptor. Therein, the controller iteratively checks whether the adaptor is capable of providing the target current for the battery and makes the adaptor to adjust the charging voltage to search for a minimum charging voltage for the adaptor to provide the target current.

[0007] According to an embodiment of the present invention, an adaptor for supplying a charging current to a charger is disclosed. The adaptor comprises a controller at least. The controller is utilized for adjusting a charging voltage provided by the adaptor from a first level to a second level according to a charging current supplied by the adaptor and a target current for a battery charged by the adaptor. Therein, the controller iteratively adjusts the charging voltage for searching for a minimum charging voltage for the adaptor to provide the target current.

[0008] According to the above-mentioned embodiments, by dynamically adjusting the charging current and charging voltage of an adaptor, the charging system, charger device, and corresponding method can achieve the advantages of thermal protection and fast charging, to effectively improve the efficiency of the charger device and reduce the whole waiting time for charging a battery.

[0009] These and other objectives of the present invention will no doubt become obvious to those of ordinary skill in the art after reading the following detailed description of the preferred embodiment that is illustrated in the various figures and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram of a charging system according to an embodiment of the present invention. FIG. 2 is a flowchart of the operations of the charger device as shown in FIG. 1.
DETAILED DESCRIPTION

[0011] Please refer to FIG. 1, which is a block diagram of a charging system 100 according to an embodiment of the present invention. The charging system 100 comprises an adaptor 105 and a charger device 110. The charging system 100 is capable of dynamically adjusting the charging current Ichg actually supplied/provided by the adaptor 105 to a battery 115 connected to the charger device 110 according to a control signal S1 and/or a message S2 sent by the charger device 110. The charging system 100 can be used for increasing the charging current Ichg provided by the adaptor 105 as far as possible, to achieve the purpose of fast charging. That is, the charging system 100 can effectively decrease or reduce the whole waiting time for charging the battery 115.

[0012] Specifically, the adaptor 105 is arranged to supply the charging current Ichg to the charger device 110, and the charger device 110 is arranged to charge the battery 115 according to the charging current Ichg. The charger device 110 comprises a sensor 1101, a controller 1102, and a converter 1103. The converter 1103 is arranged to convert the charging current Ichg to generate a current flowing into the battery 115. The charging current Ichg may be equal to or may not be equal to the current flowing into the battery 115, and the charging voltage Vchg may be equal to or may not be equal to a voltage actually provided for the battery 115 (i.e. a voltage level of the battery 115). In practice, the converter 1103 can be implemented by using a buck converter, a boost converter, or a buck-boost converter, or a bipolar junction transistor (BJT). The converter 1103 is controlled by the controller 1102. The sensor 1101 is used for sensing a current corresponding to the charging current Ichg where this current can indicate the current flowing into the battery 115, a current passing through the charger device 110, or a current flowing into the charger device 110 (i.e. the charging current Ichg). In this embodiment, the sensor 1101 is used for sensing (but not limited) the current flowing into the battery 115. Since the current flowing into the battery 115 corresponds to the charging current Ichg, by sensing the current flowing into the battery 115, the charging current Ichg can be also equivalently estimated.

[0013] The controller 1102 is coupled to the sensor 1101 and converter 1103 and is arranged to configure a target current outputted from the adaptor 105 as a first current. The level of target current is configurable. It should be noted that the level of target current of an adaptor configured by the charger device 110 may be not equal to the charging current Ichg that can be actually provided by such adaptor due to that a higher and undesired voltage drop may cause the voltage level actually provided to the battery 115 becomes lower or a rated value of charging current Ichg of this adaptor is lower than the level of target current configured by the charger device 110. When the adaptor 105 is connected to charger device 110 for charging the battery 115, the charger device 110 may configure the target current of the adaptor 105. After configuring the target current, the controller 1102 is arranged to check whether the adaptor 105 is capable of supplying/providing the first current (i.e. the target current) to the charger device 110 according to a sensed result from the sensor 1101, so as to generate a check result. The controller 1102 can estimate whether the adaptor 105 can actually provide the target current that has been configured by the charger device 110. It should be noted that the controller 1102 may also estimate whether the adaptor 105 can provide some current or not without needing to configure the target current of adaptor 105. That is, the operation for configuring the target current of adaptor 105 is not intended to be a limitation of the present invention.

[0014] If the check result shows that the adaptor 105 actually is capable of supplying/providing the target current to the charger device 110, the controller 1102 is arranged to control the adaptor 105 to lower the charging voltage Vchg so as to increase the charging current Ichg. That is, this makes the adaptor 105 adjust the charging voltage Vchg from a first voltage to a second voltage to adjust the charging current Ichg. The controller 1102 can transmit the control signal S1 to notify the adaptor 105 of how to adjust the charging voltage Vchg. This scheme is preferred when the adaptor 105 includes a DC-DC converter. In addition, to notify the adaptor 105 of how to adjust the charging voltage Vchg, the controller 1102 can transmit the voltage adjusting message S2 to the adaptor 105 by controlling the converter 1103 to generate current variation(s) on the interface between the converter 1103 and the adaptor 105. Accordingly, via the control signal S1 and/or the voltage adjusting message S2, the adaptor 105 can be aware of voltage adjusting for the charging voltage Vchg.

[0015] In this embodiment, the adaptor 105 comprises a sensor 1051 and a controller 1052. The control signal S1 and the voltage variation(s) and/or current variation(s) are transmitted to the adaptor 105 via a connecting interface of the adaptor 105. The sensor 1051 is used for sensing current variation and/or voltage variation on the connecting interface, and then sending the sensed result to the controller 1052 to notify controller 1052 of the voltage adjusting message S2. That is, the sensor 1051 notifies the controller 1052 of adjusting the charging voltage Vchg according to its sensed result. In addition, the sensor 1051 is used for receiving the control signal S1 transmitted on the connecting interface by charger device 110, and notifying the controller 1052 of adjusting the charging voltage Vchg according to the received control signal S1. Thus, the controller 1052 is capable of adjusting the charging voltage Vchg provided by the adaptor 105 from the first level to the second level according to the charging current Ichg supplied by the adaptor 105 and the target current for the battery 115. The controller 1052 is arranged to lower the charging voltage Vchg so as to make the adaptor 105 lower the charging voltage Vchg when the adaptor 105 is capable of providing the target current, and to heighten the charging voltage Vchg so as to make...
the adaptor 105 heighten the charging voltage Vchg when the adaptor 105 is not capable of providing the target current. The operation of checking whether adaptor 105 is capable of providing the target current for battery 115 and the operation of making adaptor 105 to adjust charging voltage Vchg can be performed iteratively to search for a minimum charging voltage Vchg for adaptor 105 to provide the target current.

[0016] The charger device 110 may control the adaptor 105 to lower the charging voltage Vchg so as to gradually increase the charging current Ichg outputted from the adaptor 105 as far as possible until the adaptor 105 is not capable of supplying the increased charging current Ichg and/or the charger device 110 may control the adaptor 105 to keep/maintain the previously adjusted charging current Ichg when the adaptor 105 is not capable of supplying the increased charging current Ichg. For the adaptor 105, the controller 1052 iteratively adjusts the charging voltage Vchg for searching for a minimum level for the adaptor 105 to provide the target current. For example, the controller 1102 may configure the target current as 1A and the controller 1102 checks whether the adaptor 105 is capable of supplying the current of 1A to the charger device 110 for charging the battery 115. If the adaptor 105 is capable of supplying the current of 1A, then the controller 1102 may control the adaptor 105 to increase the charging current Ichg from 1A to 1.2A by sending the control signal S1 and/or the signal S2 to the adaptor 105, and may check whether the adaptor 105 is capable of supplying the current of 1.2A to the charger device 110. In this situation, when receiving the control signal S1 and/or the voltage adjusting message S2, the controller 1052 of adaptor 105 increases the charging current Ichg by lowering the level of charging voltage Vchg. If the adaptor 105 is capable of supplying the current of 1.2A, then the controller 1102 may control the adaptor 105 to increase the charging current Ichg from 1A to 1.4A or other currents, and so on. The controller 1102 may control the adaptor 105 to increase the charging current Ichg to 1.8A and checks whether the adaptor 105 is capable of supplying the current of 1.8A to the charger device 110. If the adaptor 105 actually is not capable of supplying the current of 1.8A, the controller 1102 is arranged to control the adaptor 105 to keep/maintain the previously adjusted charging current Ichg such as 1.6A as the charging current Ichg outputted from the adaptor 105 to the charger device 110. Accordingly, by dynamically making the adaptor 105 to adjust the level of charging voltage Vchg to adjust the charging current Ichg and checking whether an adaptor is capable of actually supplying the adjusted charging current Ichg, the charger device 110 can effectively increase the charging current Ichg that can be actually supplied by an adaptor, to preferably maximize the charging current Ichg that can be actually supplied by an adaptor.

[0017] In addition, in other embodiments, the value of target current may be configured as a higher value such as 2A. The controller 1102 estimates whether the adaptor 105 actually can provide the current of 2A that has been configured by the charger device 110. If the adaptor 105 is not capable of supplying the current of 2A to the charger device 110, the controller 1102 is arranged to control the adaptor 105 to gradually heighten the level of charging voltage Vchg that provided by the adaptor 105 so that there is opportunity for the adaptor 105 to provide the charging current Ichg which is slightly lower than the target current of 2A. That is, once an adaptor actually cannot supply a higher current for the charger device 110, the charger device 110 can control this adaptor to try to supply the slightly lower charging current Ichg by heightening the charging voltage Vchg provided by the adaptor. The charger device 110 may control the adaptor 105 to gradually increase the level of charging voltage Vchg outputted from the adaptor 105 as far as possible until the adaptor 105 is capable of supplying the charging current Ichg corresponding to the increased level of charging voltage Vchg. The charger device 110 may control the adaptor 105 to keep/maintain the finally adjusted charging current Ichg when the adaptor 105 is capable of supplying the adjusted charging current Ichg. For example, when the controller 1102 configures the target current of the adaptor 105 as 2A, and the controller 1102 checks whether the adaptor 105 actually is capable of supplying the current of 2A to the charger device 110 for charging the battery 115. In this example, the level of charging voltage corresponding to the target current of 2A is equal to 2.5Volts. If the adaptor 105 actually is not capable of supplying the current of 2A due to a higher voltage drop consumption, the controller 1102 may increase the level of charging voltage Vchg from 2.5Volts to 2.7Volts. The controller 1102 controls the adaptor 105 to try output the current of 1.8A as the charging current Ichg in response to the level 2.7Volts of the charging voltage Vchg. If the adaptor 105 is not capable of supplying the current of 1.8A to the charger device 110 for charging the battery 115, the controller 1102 may increase the level of charging voltage Vchg from 2.7Volts to 3.12Volts so that the adaptor 105 can try output the current of 1.6A as the charging current Ichg in response to the level 3.12Volts of the charging voltage Vchg. If the adaptor 105 actually is capable of supplying the current of 1.6A to the charger device 110, the controller 1102 is arranged to control the adaptor 105 to keep/maintain the charging voltage Vchg that has been adjusted and the corresponding charging current Ichg such as 1.6A. Accordingly, by dynamically adjusting the level of charging voltage Vchg and checking whether an adaptor is capable of actually supplying a charging current corresponding to the adjusted level of charging voltage Vchg, the charger device 110 can effectively determine the value of charging current that can be actually supplied by an adaptor, to preferably maximize the charging current that can be actually supplied by an adaptor. This scheme also solves the problem caused by the higher voltage drop consumption.

[0018] In addition, the above-mentioned scheme of
gradually increasing the value of charging current from a lower value to obtain the value of charging current that can be actually supplied by an adaptor and the scheme of gradually heightening the level of charging voltage to obtain the value of charging current that can be actually supplied by an adaptor can be integrated in other embodiments. This modification also falls within the scope of the present invention.

[0019] In order to more clearly describe the spirit of the present invention, FIG. 2 illustrates a flowchart of the operations of the charger device 110 as shown in FIG. 1. Provided that substantially the same result is achieved, the steps of the flowchart shown in FIG. 2 need not be in the exact order shown and need not be contiguous, that is, other steps can be intermediate. The steps are detailed in the following:

Step 205: Start;

Step 210: The controller 1102 checks whether the charger device 110 is in a constant current mode. If the charge device 110 is in the constant current mode, the flow proceeds to Step 215; otherwise, the flow proceeds to Step 250;

Step 215: The controller 1102 configures the target current of the adaptor 105; the value of target current may be higher or lower than the maximum value of current which can be supplied by the adaptor 105;

Step 220: The controller 1102 checks whether the adaptor 105 is capable of supplying the target current to the charger device 110 for charging the battery 115. If the adaptor 105 is not capable of providing the target current, the flow proceeds to Step 225; otherwise, the flow proceeds to Step 225A;

Step 225A: The controller 1102 controls the adaptor 105 to increase the charging voltage Vchg of the adaptor 105 so as to try to output a smaller charging current;

Step 230A: The controller 1102 checks whether the adaptor 105 is capable of supplying the smaller charging current to the charger device 110 for charging the battery 115. If the adaptor 105 is not capable of providing the smaller charging current, the flow proceeds to Step 235; otherwise, the flow proceeds to Step 235A;

Step 235A: The controller 1102 controls the adaptor 105 to maintain the charging current Ichg and charging voltage Vchg that are finally adjusted;

Step 235B: The controller 1102 controls the adaptor 105 to decrease the charging voltage Vchg of the adaptor 105 so as to increase the charging current Ichg that can be actually provided by the adaptor 105 as far as possible;

Step 240: The controller 1102 controls the sensor 1101 to detect whether it is needed to perform a thermal protection by sensing the temperature of the charger device 110. If it is needed to perform the thermal protection, the flow proceeds to Step 245; otherwise, the flow proceeds to Step 250;

Step 245: The controller 1102 controls the adaptor 105 to finely adjust and output the charging current Ichg that is lower than the value of the maximum current that can be supplied by the adaptor 105; and Step 250: End.

[0020] As mentioned above, in Step 220, the controller 1102 is arranged to check whether the adaptor 105 can actually provide the value of the target current that has been configured by the charger device 110. That is, the controller 1102 equivalently is arranged to check whether the target current is higher than the maximum charging current that can be actually provided by the adaptor 105. If the value of the charging current Ichg that actually can be supplied from the adaptor 105 does not meet the value of target current configured by the charger device 110, this indicates that the value of target current is over higher than the maximum current which actually can be provided by the adaptor 105, and accordingly the controller 1102 is arranged to find the maximum current which actually can be provided from the adaptor 105 by dynamically adjusting the level of charging voltage Vchg of the adaptor 105.

[0021] In practice, the controller 1102 may find the maximum current that can be provided from the adaptor 105 by making the adaptor 105 to gradually increase the level of charging voltage Vchg so that the adaptor 105 can output the maximum current which actually can be provided from the adaptor 105 when the level of charging voltage Vchg is increased to a corresponding higher level. It should be noted that the controller 1102 is arranged to configure the value of target current by selecting one value from a rated range of current which ideally can be provided by the adaptor 105. In some situations, the adaptor 105 may not output the value of target current when the target current is configured as a higher value in order to achieve fast charging, and the adaptor 105 can find the maximum current which actually can be provided from the adaptor 105 by dynamically adjusting the level of charging voltage Vchg of the adaptor 105. Thus, the controller 1102 can control the adaptor 105 to keep and maintain the value of charging current Ichg at the maximum current which actually can be provided by the adaptor 105. This achieves the purpose of fast charging.

[0022] In addition, when the value of target current initially configured by the controller 1102 is lower than the
Further, it should be noted that the operation of the adaptor 105 can be provided from the adaptor 105 by gradually decreasing the level of charging voltage Vchg from the adaptor 105. The controller 1102 may control the adaptor 105 to lower the level of charging voltage Vchg to try to increase the value of charging current Ichg outputted from the adaptor 105 until the adaptor 105 actually cannot output the increased value of current. The controller 1102 is arranged to select the value of charging current Ichg before last adjusted, and control the adaptor 105 to keep and maintain the value of charging current Ichg at the selected charging current for charging the battery 115. By doing this, the controller 1102 can find the maximum current which actually can be outputted by the adaptor 105 to charge the battery 115. That is, whether the value of target current is configured to be higher or lower, the controller 1102 can find the maximum current which actually can be outputted by the adaptor 105. It is not necessary for the controller 1102 to configure the value of the target current initially. In other embodiments, even though the value of the target current is not configured initially, the controller 1102 can find the maximum current which actually can be outputted from the adaptor 105 by dynamically adjusting the level of charging voltage Vchg of the adaptor 105. Equivalently, in this situation, the adaptor 105 iteratively searches for a minimum charging voltage Vchg corresponding to a maximum charging current that can be provided from the adaptor 105.

[0023] Further, it should be noted that the operation of thermal protection is also not intended to be a limitation of the present invention. In addition, the type of the adaptor 105 is not intended to a limitation of the present invention. The adaptor 105 can be an AC-to-DC adaptor or a DC-to-DC converter. In addition, the charger device 110 can be a linear mode charger device, a buck mode charger device, or a switching mode charger device. This is not meant to be a limitation of the present invention.

[0024] Those skilled in the art will readily observe that numerous modifications and alterations of the device and method may be made while retaining the teachings of the invention. Accordingly, the above disclosure should be construed as limited only by the metes and bounds of the appended claims.

Claims

1. A method for adjusting a charging current (Ichg) supplied by an adaptor (105), comprising:

- checking whether the adaptor (105) is capable of providing a target current for a battery (115) connected to a charger device (110), to generate a check result; and
- according to the check result, making the adaptor (105) to adjust a charging voltage (Vchg) provided by the adaptor (105) from a first voltage to a second voltage so as to adjust the charging current (Ichg) supplied by the adaptor (105); characterized in that

- the step of checking whether the adaptor (105) is capable of providing the target current for the battery (115) and the step of making the adaptor (105) to adjust the charging voltage (Vchg) are performed iteratively to search for a minimum charging voltage for the adaptor (105) to provide the target current.

2. The method of claim 1, wherein the step of making the adaptor (105) to adjust the charging voltage (Vchg) comprises:

- when the adaptor (105) is capable of providing the target current for the battery (115), making the adaptor (105) to lower the charging voltage (Vchg) provided by the adaptor (105); and
- when the adaptor (105) is not capable of providing the target current for the battery (115), making the adaptor (105) to heighten the charging voltage (Vchg) provided by the adaptor (105).

3. The method of claim 1, wherein the step of making the adaptor (105) to adjust the charging voltage (Vchg) comprises:

- generating a current/voltage variation on a connecting interface between the adaptor (105) and the charger device (110) so as to notify the adaptor (105) to adjust the charging voltage (Vchg); or
- wherein the step of making the adaptor (105) to adjust the charging voltage (Vchg) comprises:

- sending a control signal (S1) to adjust the charging voltage (Vchg).

4. The method of claim 1, wherein the step of checking whether the adaptor (105) is capable of providing the target current for the battery (115) to generate the check result comprises:

- sensing a current flowing into the battery (115).

5. The method of claim 1, further comprising:

- configuring a level of the target current.

6. A device (110) for adjusting a charging current (Ichg) supplied by an adaptor (105), comprising:

- a sensor (1101), for sensing a current corresponding to the charging current (Ichg) supplied by the adaptor (105); and
- a controller (1102), coupled to the sensor
(1101), for checking whether the adaptor (105) is capable of providing a target current for a battery (115) connected to the device (110), to generate a check result;

wherein the controller (1102) is arranged to make the adaptor (105) to adjust a charging voltage (Vchg) provided by the adaptor (105) from a first voltage to a second voltage according to the check result, so as to adjust the charging current (Ichg) supplied by the adaptor (105);

categorized in that the controller (1102) iteratively checks whether the adaptor (105) is capable of providing the target current for the battery (115) and makes the adaptor (105) to adjust the charging voltage (Vchg) to search for a minimum charging voltage for the adaptor (105) to provide the target current.

7. The device (110) of claim 6, wherein when the adaptor (105) is capable of providing the target current for the battery (115), the controller (1102) is arranged to make the adaptor (105) to lower the charging voltage (Vchg) provided by the adaptor (105); and, when the adaptor (105) is not capable of providing the target current for the battery (115), the controller (1102) is arranged to make the adaptor (105) to heighten the charging voltage (Vchg) provided by the adaptor (105).

8. The device (110) of claim 6, wherein the controller (1102) generates a current/voltage variation on a connecting interface of the adaptor (105) so as to notify the adaptor (105) to adjust the charging voltage (Vchg); or wherein the controller (1102) sends a control signal (S1) to adjust the charging voltage (Vchg) provided by the adaptor (105).

9. The device (110) of claim 6, wherein the sensor (1101) senses a current flowing into the battery (115).

10. The device (110) of claim 6, wherein the controller (1102) is arranged to configure a level of the target current.

11. An adaptor (105) for supplying a charging current (Ichg) to a charger (110), comprising:

    a controller (1052), for adjusting a charging voltage (Vchg) provided by the adaptor (105) from a first level to a second level according to a charging current (Ichg) supplied by the adaptor (105) and a target current for a battery (115) charged by the adaptor (105)

categorized in that the controller (1052) iteratively adjusts the charging voltage (Vchg) for searching for a minimum charging voltage for the adaptor (Vchg) to provide the target current.

12. The adaptor (105) of claim 11, wherein the controller (1052) lowers the charging voltage (Vchg) provided by the adaptor (105) when the adaptor (105) is capable of providing the target current for the battery (115), and heightens the charging voltage (Vchg) provided by the adaptor (105) when the adaptor (105) is not capable of providing the target current for the battery (115).

13. The adaptor (105) of claim 11, further comprising:

    a sensor (1051), coupled to the controller (152), for sensing a current/voltage variation on a connecting interface of the adaptor (105), and notifying the controller (105) to adjust the charging voltage (Vchg) according to the sensed result; or a sensor (1051), coupled to the controller (1051), for receiving a control signal (S1) on a connecting interface of the adaptor (105), and notifying the controller (1052) to adjust the charging voltage (Vchg) accordingly.

14. The adaptor (105) of claim 11, wherein a level of the target current is configurable.

Patentansprüche

1. Verfahren zum Regulieren eines Ladestroms (Ichg), der durch einen Adapter (105) bereitgestellt wird, aufweisend:

    Prüfen, ob der Adapter (105) in der Lage ist, einen Sollstrom für eine Batterie (115), die an eine Ladevorrichtung (110) angeschlossen ist, zur Verfügung zu stellen, um ein Prüfergebnis zu generieren; und
gemäß dem Prüfergebnis Veranlassen, dass der Adapter (105) eine Laderspannung (Vchg), die durch den Adapter (105) zur Verfügung gestellt wird, von einer ersten Spannung auf eine zweite Spannung reguliert, um so den Ladem Strom (Ichg), der durch den Adapter (105) bereitgestellt wird, zu regulieren;
dadurch gekennzeichnet, dass der Schritt des Prüfens, ob der Adapter (105) in der Lage ist, den Sollstrom für die Batterie (115) zur Verfügung zu stellen, und der Schritt des Veranlassens, dass der Adapter (105) die Ladespannung (Vchg) reguliert, iterativ ausgeführt werden, um nach einer minimalen Ladespannung für den Adapter (105) zu suchen, um den Sollstrom zur Verfügung zu stellen.
2. Verfahren gemäß Anspruch 1, wobei der Schritt des Veranlassens, dass der Adapter (105) die Ladespannung (Vchg) reguliert, umfasst:

wenn der Adapter (105) in der Lage ist, den Sollstrom für die Batterie (115) zur Verfügung zu stellen, Veranlassen, dass der Adapter (105) die Ladespannung (Vchg), die durch den Adapter (105) zur Verfügung gestellt wird, verringert; und wenn der Adapter (105) nicht in der Lage ist, den Sollstrom für die Batterie (115) zur Verfügung zu stellen, Veranlassen, dass der Adapter (105) die Ladespannung (Vchg), die durch den Adapter (105) zur Verfügung gestellt wird, erhöht.

3. Verfahren gemäß Anspruch 1, wobei der Schritt des Veranlassens, dass der Adapter (105) die Ladespannung (Vchg) reguliert, umfasst:

Generieren einer Strom-/Spannungsvariation an einer Verbindungsschnittstelle zwischen dem Adapter (105) und der Ladevorrichtung (110), um so den Adapter (105) zu benachrichtigen, die Ladespannung (Vchg) zu regulieren; oder wobei der Schritt des Veranlassens, dass der Adapter (105) die Ladespannung (Vchg) reguliert, umfasst:

Senden eines Steuersignals (S1), um die Ladespannung (Vchg) zu regulieren.

4. Verfahren gemäß Anspruch 1, wobei der Schritt des Prüfens, ob der Adapter (105) in der Lage ist, den Sollstrom für die Batterie (115) zur Verfügung zu stellen, um das Prüfergebnis zu generieren, umfasst:

Messen eines Stroms, der in die Batterie (115) fließt.

5. Verfahren gemäß Anspruch 1, weiter aufweisend:

Einstellen einer Höhe des Sollstroms.

6. Vorrichtung (110) zum Regulieren eines Ladestroms (Ichg), der durch einen Adapter (105) bereitgestellt wird, aufweisend:

einen Sensor (1101) zum Messen eines Stroms, der zu dem Ladestrom (Ichg) korrespondiert, der durch den Adapter (105) bereitgestellt wird; und

eine Steuerung (1102), die mit dem Sensor (1101) verbunden ist, zum Prüfen, ob der Adapter (105) in der Lage ist, einen Sollstrom für eine Batterie (115), die mit der Vorrichtung (110) verbunden ist, zur Verfügung zu stellen, um ein Prüfergebnis zu generieren; wobei die Steuerung (1102) eingerichtet ist, zu veranlassen, dass der Adapter (105) eine Ladespannung (Vchg), die durch den Adapter (105) zur Verfügung gestellt wird, gemäß dem Prüfergebnis von einer ersten Spannung auf eine zweite Spannung reguliert, um so den Sollstrom (Ichg), der durch den Adapter (105) bereitgestellt wird, zu regulieren; dadurch gekennzeichnet, dass die Steuerung (1102) iterativ prüft, ob der Adapter (105) in der Lage ist, den Sollstrom für die Batterie (115) zur Verfügung zu stellen, und veranlasst, dass der Adapter (105) die Ladespannung (Vchg) reguliert, um eine minimale Ladespannung für den Adapter (105) zu suchen, um den Sollstrom zur Verfügung zu stellen.

7. Vorrichtung (110) gemäß Anspruch 6, wobei, wenn der Adapter (105) in der Lage ist, den Sollstrom für die Batterie (115) zur Verfügung zu stellen, die Steuerung (1102) eingerichtet ist, zu veranlassen, dass der Adapter (105) die Ladespannung (Vchg), die durch den Adapter (105) zur Verfügung gestellt wird, verringert; und wenn der Adapter (105) nicht in der Lage ist, den Sollstrom für die Batterie (115) zur Verfügung zu stellen, die Steuerung (1102) eingerichtet ist, zu veranlassen, dass der Adapter (105) die Ladespannung (Vchg) reguliert, um eine minimale Ladespannung für den Adapter (105) zu suchen, um den Sollstrom zur Verfügung zu stellen.

8. Vorrichtung (110) gemäß Anspruch 6, wobei die Steuerung (1102) eine Strom-/Spannungsvariation an einer Verbindungsschnittstelle des Adapters (105) generiert, um so den Adapter (105) zu benachrichtigen, die Ladespannung (Vchg) zu regulieren; oder wobei die Steuerung (1102) ein Steuersignal (S1) sendet, um die Ladespannung (Vchg), die durch den Adapter (105) zur Verfügung gestellt wird, zu regulieren.

9. Vorrichtung (110) gemäß Anspruch 6, wobei der Sensor (1101) einen Strom misst, der in die Batterie (115) fließt.

10. Vorrichtung (110) gemäß Anspruch 6, wobei die Steuerung (1102) eingerichtet ist, eine Höhe des Sollstroms einzustellen.

11. Adapter (105) zum Bereitstellen eines Ladestroms (Ichg) an eine Ladevorrichtung (110), aufweisend:

eine Steuerung (1052) zum Regulieren einer Ladespannung (Vchg), die durch den Adapter (105) zur Verfügung gestellt wird, von einem ersten Pegel auf einen zweiten Pegel gemäß einem Ladestrom (Ichg), der durch den Adapter (105)
bereitgestellt wird, und einem Sollstrom für eine Batterie (115), die durch den Adapter (105) geladen wird
dadurch gekennzeichnet, dass
 die Steuerung (1052) iterativ die Ladespannung (Vchgl) regu- liert, um eine minimale Ladespann- nung für den Adapter (105) zu suchen, um den Sollstrom zur Verfügung zu stellen.

12. Adapter (105) gemäß Anspruch 11, wobei die Steuerung (1052) die Ladespannung (Vchgl), die durch den Adapter (105) zur Verfügung gestellt wird, verriert, wenn der Adapter (105) in der Lage ist, den Sollstrom für die Batterie (115) zur Verfügung zu stel- len, und die Ladespannung (Vchgl), die durch den Adapter (105) zur Verfügung gestellt wird, erhöht, wenn der Adapter (105) nicht in der Lage ist, den Sollstrom für die Batterie (115) zur Verfügung zu stel- len.

13. Adapter (105) gemäß Anspruch 11, weiter aufwei- send:

 einen Sensor (1051), der mit der Steuerung (152) verbunden ist, zum Messen einer Strom-/Spannungvariation an einer Verbin- dungsschnittstelle des Adapters (105) und zum Benachrichtigen der Steuerung (1052), wenn die Ladespannung (Vchgl) gemessen, um das gemesse- ne Ergebnis zu regulieren; oder

 einen Sensor (1051), der mit der Steuerung (1051) verbunden ist, zum Empfangen eines Steuersignals (S1) an einer Verbindungsschnittstelle des Adapters (105) und zum Benachrichtigen der Steuerung (1052), um die La- despannung (Vchgl) entsprechend zu regulie- ren.


Revendications

1. Procédé pour régler un courant de charge (Ichgl) fourni par un adaptateur (105), comprenant le fait:

devérifier si l’adaptateur (105) est capable de fournir un courant cible pour une batterie (115) reliée à un dispositif chargeur (110), pour générer un résultat de vérification; et
d’amener, selon le résultat de vérification, l’adaptateur (105) à régler une tension de charge (Vchgl) fournie par l’adaptateur (105) d’une première tension à une deuxième tension de manière à régler le courant de charge (Ichgl) fourni par l’adaptateur (105); caractérisé en ce que

l’étape qui consité à vérifier si l’adaptateur (105) est capable de fournir le courant cible pour la batterie (115) et l’étape qui consité à amener l’adaptateur (105) à régler la tension de charge (Vchgl) sont effectuées de manière itérative pour rechercher une tension de charge minimale pour l’adaptateur (105) pour fournir le courant cible.

2. Procédé de la revendication 1, dans lequel l’étape qui consité à amener l’adaptateur (105) à régler la tension de charge (Vchgl) comprend le fait:

d’amener, lorsque l’adaptateur (105) est capa- ble de fournir le courant cible pour la batterie (115), l’adaptateur (105) à abaisser la tension de charge (Vchgl) fournie par l’adaptateur (105); et
d’amener, lorsque l’adaptateur (105) n’est pas capable de fournir le courant cible pour la bat- terie (115), l’adaptateur (105) à augmenter la tension de charge (Vchgl) fournie par l’adaptateur (105).

3. Procédé de la revendication 1, dans lequel l’étape qui consité à amener l’adaptateur (105) à régler la tension de charge (Vchgl) comprend le fait:

dégénérer une variation de courant/tension sur une interface de liaison entre l’adaptateur (105) et le dispositif chargeur (110) de manière à no- tifier à l’adaptateur (105) de régler la tension de charge (Vchgl); ou
dans lequel l’étape qui consité à amener l’adaptateur (105) à régler la tension de charge (Vchgl) comprend le fait:

d’envoyer un signal de commande (S1)

4. Procédé de la revendication 1, dans lequel l’étape qui consité à vérifier si l’adaptateur (105) est capa- ble de fournir le courant cible pour la batterie (115) afin de générer le résultat de vérification comprend le fait:

de détecter un courant circulant dans la batterie (115).

5. Procédé de la revendication 1, comprenant en outre le fait:

de configurer un niveau du courant cible.

6. Dispositif (110) pour régler un courant de charge (Ichgl) fourni par un adaptateur (105), comprenant:

captur (1101), pour détecter un courant cor-
la charge (Ichg) fournie par l’adaptateur (105); et
d’une unité de commande (1102), couplée au cap-
teur (1101), pour vérifier si l’adaptateur (105) est
capable de fournir un courant cible pour une bat-
terie (115) reliée au dispositif (110), pour géné-
ner un résultat de vérification;
dans lequel l’unité de commande (1102) est
généralement agencée pour amener l’adaptateur (105) à ré-
gler une tension de charge (Vchg) fournie par
l’adaptateur (105) d’une première tension à une
deuxième tension selon le résultat de vérifica-
tion, de manière à régler le courant de charge
(Ichg) fourni par l’adaptateur (105);
caractérisé en ce que
l’unité de commande (1102) vérifie de manière
itérative si l’adaptateur (105) est capable de
fournir le courant cible pour la batterie (115) et
amène l’adaptateur (105) à régler la tension de
charge (Vchg) pour rechercher une tension de
charge minimale pour l’adaptateur (105) pour
fournir le courant cible.

7. Dispositif (110) de la revendication 6, dans lequel
lorsque l’adaptateur (105) est capable de fournir le
courant cible pour la batterie (115), l’unité de com-
mande (1102) est agencée pour amener l’adapta-
teur (105) à abaisser la tension de charge (Vchg)
fournie par l’adaptateur (105); et, lorsque l’adapta-
teur (105) n’est pas capable de fournir le courant
主治 pour la batterie (115), l’unité de commande
(1102) est agencée pour amener l’adaptateur (105)
à augmenter la tension de charge (Vchg) fournie par
l’adaptateur (105).

8. Dispositif (110) de la revendication 6, dans lequel
l’unité de commande (1102) génère une variation de
courant/tension sur une interface de liaison de
l’adaptateur (105) de manière à notifier à l’adapta-
teur (105) de régler la tension de charge (Vchg); ou
dans lequel l’unité de commande (1102) envoie un
signal de commande (S1) pour régler la tension de
charge (Vchg) fournie par l’adaptateur (105).

9. Dispositif (110) de la revendication 6, dans lequel
le capteur (1101) détecte un courant circulant dans la
batterie (115).

10. Dispositif (110) de la revendication 6, dans lequel
l’unité de commande (1102) est agencée pour con-
figurer un niveau du courant cible.

11. Adaptateur (105) pour fournir un courant de charge
(Ichg) à un chargeur (110), comprenant:

12. Adaptateur (105) de la revendication 11, dans lequel
l’unité de commande (1052) abaisse la tension de
charge (Vchg) fournie par l’adaptateur (105) lorsque
l’adaptateur (105) est capable de fournir le courant
cible pour la batterie (115), et augmente la tension
de charge (Vchg) fournie par l’adaptateur (105) lors-
que l’adaptateur (105) n’est pas capable de fournir
le courant cible pour la batterie (115).

13. Adaptateur (105) de la revendication 11, compre-
nant en outre:

14. Adaptateur (105) de la revendication 11, dans lequel
un niveau du courant cible est configurable.
FIG. 1
FIG. 2
REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description