# QUICK CHARGING METHOD, POWER ADAPTER AND MOBILE TERMINAL

## CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a SG national phase application based upon an International Application No. PCT/CN2015/078898, filed on May 13, 2015, which is based on and claims priority to International Application No. PCT/CN2014/090846, filed on November 11, 2014; International Application No. PCT/CN2015/074049, filed on March 11, 2015, the entire contents of which are incorporated herein by reference.

## FIELD

The present disclosure relates to charging technical field, and more particularly, to a quick charging method, a power adapter and a mobile terminal.

## BACKGROUND

At present, a mobile terminal (such as a smart phone) has become increasingly popular among consumers, but the mobile terminal consumes a lot of electricity and needs to be charged frequently. With the increasing of battery capacity of the mobile terminal, the charging time becomes longer and longer. How to achieve quick charging has become a problem which needs to be solved.

In the related art, in order to achieve the quick charging, an output current of a power adapter is directly increased without considering the tolerance capacity of the mobile terminal, which may lead to a phenomenon of overheating or even burning out of the mobile terminal and decrease the life time of the mobile terminal.

## SUMMARY

Embodiments of the present disclosure provide a quick charging method, a power adapter and a mobile terminal, so as to improve the security in the quick charging process.

In an embodiment, a quick charging method is provided. The method is applied to a power adapter, the power adapter is coupled to a mobile terminal through a universal serial bus (USB) interface, a power line in the USB interface is used by the power adapter to charge the mobile terminal, a data line in the USB interface is used by the power adapter to conduct a bidirectional communication with the mobile terminal, and the power adapter supports a common charging mode and a quick charging mode, in which a charging current of the quick charging mode is greater than that of the common charging mode. The method includes: conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine to charge the mobile terminal in the quick charging mode; and adjusting by the power adapter a charging current to a charging current corresponding to the quick charging mode so as to charge the mobile terminal.

In an embodiment, conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine to

charge the mobile terminal in the quick charging mode includes: sending by the power adapter a first instruction to the mobile terminal, in which the first instruction is configured to ask the mobile terminal whether to start the quick charging mode; and receiving by the power adapter a replying instruction of the first instruction from the mobile terminal, in which the replying instruction of the first instruction is configured to indicate that the mobile terminal agrees to start the quick charging mode.

In an embodiment, before sending by the power adapter a first instruction to the mobile terminal, the method further includes: performing a charging between the power adapter and the mobile terminal in the common charging mode; in which sending by the power adapter a first instruction to the mobile terminal, includes: after the power adapter determines that a charging time of the common charging mode is larger than a preset threshold, sending by the power adapter the first instruction to the mobile terminal.

In an embodiment, before adjusting by the power adapter the charging current to the charging current corresponding to the quick charging mode so as to charge the mobile terminal, the method includes: conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine a charging voltage corresponding to the quick charging mode; and adjusting by the power adapter a charging voltage to the charging voltage corresponding to the quick charging mode.

In an embodiment, conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine a charging voltage corresponding to the quick charging mode includes: sending by the power adapter a second instruction to the mobile terminal, in which the second

instruction is configured to ask whether a current voltage of the power adapter is suitable as a charging voltage of the quick charging mode; receiving by the power adapter a replying instruction of the second instruction sent by the mobile terminal, in which the replying instruction of the second instruction is configured to indicate that the current voltage of the power adapter is suitable, high or low; and determining by the power adapter the charging voltage of the quick charging mode according to the replying instruction of the second instruction.

In an embodiment, before adjusting by the power adapter the charging current to the charging current corresponding to the quick charging mode so as to charge the mobile terminal, the method includes: conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine the charging current corresponding to the quick charging mode.

In an embodiment, conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine the charging current corresponding to the quick charging mode, includes: sending by the power adapter a third instruction to the mobile terminal, in which the third instruction is configured to inquire a maximum charging current supported currently by the mobile terminal; receiving by the power adapter a replying instruction of the third instruction sent by the mobile terminal, in which the replying instruction of the third instruction is configured to indicate the maximum charging current supported currently by the mobile terminal; and determining by the power adapter the charging current of the quick charging mode according to the replying instruction of the third instruction.

In an embodiment, the method further includes: in a process that the power adapter charges the mobile terminal in the quick charging mode, conducting by the power

adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to adjust the charging current of the power adapter continuously.

In an embodiment, conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to adjust the charging current of the power adapter continuously, includes: sending by the power adapter a fourth instruction to the mobile terminal, in which the fourth instruction is configured to inquire a current voltage of a battery in the mobile terminal; receiving by the power adapter a replying instruction of the fourth instruction sent by the mobile terminal, in which the replying instruction of the fourth instruction is configured to indicate the current voltage of the battery in the mobile terminal; and adjusting by the power adapter the charging current according to the current voltage of the battery.

In an embodiment, adjusting by the power adapter the charging current according to the current voltage of the battery, includes: adjusting by the power adapter the charging current of the power adapter to a charging current value corresponding to the current voltage of the battery according to the current voltage of the battery and preset correspondences between battery voltage values and charging current values.

In an embodiment, the method also includes: in a process that the power adapter charges the mobile terminal in the quick charging mode, conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine whether a poor contact occurs in the USB interface; and if it is determined that the poor contact occurs in the USB interface, quitting by the power adapter the quick charging mode.

In an embodiment, before conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine whether a poor contact occurs in the USB interface, the method further includes: receiving by the power adapter information for indicating a path impedance of the mobile terminal from the mobile terminal; in which conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine whether a poor contact occurs in the USB interface, includes: sending by the power adapter a fourth instruction to the mobile terminal, in which the fourth instruction is configured to inquire a voltage of a battery in the mobile terminal; receiving by the power adapter a replying instruction of the fourth instruction sent by the mobile terminal, in which the replying instruction of the fourth instruction is configured to indicate the voltage of the battery in the mobile terminal; determining by the power adapter a path impedance from the power adapter to the battery according to a charging voltage of the power adapter and the voltage of the battery; and determining by the power adapter whether the poor contact occurs in the USB interface according to the path impedance from the power adapter to the battery, the path impedance of the mobile terminal and a path impedance of a charging circuit between the power adapter and the mobile terminal.

In an embodiment, before quitting by the power adapter the quick charging mode, the method further includes: sending by the power adapter a fifth instruction to the mobile terminal, in which the fifth instruction is configured to indicate that the poor contact occurs in the USB interface.

In an embodiment, a quick charging method is provided. The method is applied to a mobile terminal, the mobile terminal is coupled to a power adapter through a universal

serial bus (USB) interface, a power line in the USB interface is configured to charge the mobile terminal, a data line in the USB interface is used by the mobile terminal to conduct a bidirectional communication with the power adapter, and the mobile terminal supports a common charging mode and a quick charging mode, in which a charging current of the quick charging mode is greater than that of the common charging mode. The method includes: conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines to charge the mobile terminal in the quick charging mode; and receiving by the mobile terminal a charging current corresponding to the quick charging mode from the power adapter so as to charge a battery in the mobile terminal.

In an embodiment, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines to charge the mobile terminal in the quick charging mode, includes: receiving by the mobile terminal a first instruction sent by the power adapter, in which the first instruction is configured to ask the mobile terminal whether to start the quick charging mode; and sending by the mobile terminal a replying instruction of the first instruction to the power adapter, in which the replying instruction of the first instruction is configured to indicate that the mobile terminal agrees to start the quick charging mode.

In an embodiment, before receiving by the mobile terminal a first instruction sent by the power adapter, the method further includes: performing a charging between the mobile terminal and the power adapter in the common charging mode; in which receiving by the mobile terminal a first instruction sent by the power adapter, includes: after the power adapter determines that a charging time of the common charging mode

is larger than a preset threshold, receiving by the mobile terminal the first instruction sent by the power adapter.

In an embodiment, before receiving by the mobile terminal a charging current corresponding to the quick charging mode from the power adapter so as to charge a battery in the mobile terminal, the method includes: conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines a charging voltage corresponding to the quick charging mode.

In an embodiment, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines a charging voltage corresponding to the quick charging mode, includes: receiving by the mobile terminal a second instruction sent by the power adapter, in which the second instruction is configured to ask whether a current voltage of the power adapter is suitable as a charging voltage of the quick charging mode; and sending by the mobile terminal a replying instruction of the second instruction to the power adapter, in which the replying instruction of the second instruction is configured to indicate that the current voltage of the power adapter is suitable, high or low.

In an embodiment, before receiving by the mobile terminal a charging current corresponding to the quick charging mode from the power adapter so as to charge a battery in the mobile terminal, the method includes: conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines the charging current corresponding to the quick charging mode.

In an embodiment, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines the charging current corresponding to the quick charging mode, includes: receiving by the mobile terminal a third instruction sent by the power adapter, in which the third instruction is configured to inquire a maximum charging current supported currently by the mobile terminal; and sending by the mobile terminal a replying instruction of the third instruction to the power adapter, in which the replying instruction of the third instruction is configured to indicate the maximum charging current supported currently by the mobile terminal, such that the power adapter determines the charging current corresponding to the quick charging mode according to the maximum charging current.

In an embodiment, the method further includes: in a process that the power adapter charges the mobile terminal in the quick charging mode, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter adjusts the charging current of the power adapter continuously.

In an embodiment, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter adjusts the charging current of the power adapter continuously, includes: receiving by the mobile terminal a fourth instruction sent by the power adapter, in which the fourth instruction is configured to inquire a current voltage of a battery in the mobile terminal; and sending by the mobile terminal a replying instruction of the fourth instruction to the power adapter, in which the replying instruction of the fourth instruction is configured to indicate the current voltage of the battery in the mobile

terminal, such that the power adapter adjusts the charging current of the power adapter continuously according to the current voltage of the battery.

In an embodiment, the method further includes: in a process that the power adapter charges the mobile terminal in the quick charging mode, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface, such that the power adapter determines whether a poor contact occurs in the USB interface.

In an embodiment, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface, such that the mobile terminal determines whether a poor contact occurs in the USB interface, includes: receiving by the mobile terminal a fourth instruction sent by the power adapter, in which the fourth instruction is configured to inquire a current voltage of a battery in the mobile terminal; and sending by the mobile terminal a replying instruction of the fourth instruction to the power adapter, in which the replying instruction of the fourth instruction is configured to indicate the current voltage of the battery in the mobile terminal, such that the power adapter determines whether the poor contact occurs in the USB interface according to a charging voltage of the power adapter and the current voltage of the battery.

In an embodiment, the method further includes: receiving by the mobile terminal a fifth instruction sent by the power adapter, in which the fifth instruction is configured to indicate that the poor contact occurs in the USB interface.

In an embodiment, a power adapter is provided. The power adapter is coupled to a mobile terminal through a universal serial bus (USB) interface, a power line in the USB interface is used by the power adapter to charge the mobile terminal, a data line in the

USB interface is used by the power adapter to conduct a bidirectional communication with the mobile terminal, and the power adapter supports a common charging mode and a quick charging mode, in which a charging current of the quick charging mode is greater than that of the common charging mode. The power adapter includes: a communication unit, configured to conduct a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine to charge the mobile terminal in the quick charging mode; and a current adjusting unit, configured to adjust a charging current to a charging current corresponding to the quick charging mode so as to charge the mobile terminal.

In an embodiment, the communication unit is configured to send a first instruction to the mobile terminal, in which the first instruction is configured to ask the mobile terminal whether to start the quick charging mode; and to receive a replying instruction of the first instruction from the mobile terminal, in which the replying instruction of the first instruction is configured to indicate that the mobile terminal agrees to start the quick charging mode.

In an embodiment, the power adapter further includes: a power conversion unit, configured to perform a charging with the mobile terminal in the common charging mode; in which the communication unit is configured to send the first instruction to the mobile terminal after it is determined that a charging time of the common charging mode is larger than a preset threshold.

In an embodiment, the communication unit is further configured to conduct a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine a charging voltage corresponding to the quick charging mode; in which the power adapter further includes: a voltage adjusting unit, configured

to adjust a charging voltage to the charging voltage corresponding to the quick charging mode.

In an embodiment, the communication unit is further configured to: send a second instruction to the mobile terminal, in which the second instruction is configured to ask whether a current voltage of the power adapter is suitable as a charging voltage of the quick charging mode; receive a replying instruction of the second instruction sent by the mobile terminal, in which the replying instruction of the second instruction is configured to indicate that the current voltage of the power adapter is suitable, high or low; and the voltage adjusting unit is configured to determine the charging voltage of the quick charging mode according to the replying instruction of the second instruction.

In an embodiment, the communication unit is configured to conduct a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine the charging current corresponding to the quick charging mode.

In an embodiment, the communication unit is configured to send a third instruction to the mobile terminal, in which the third instruction is configured to inquire a maximum charging current supported currently by the mobile terminal; to receive a replying instruction of the third instruction sent by the mobile terminal, in which the replying instruction of the third instruction is configured to indicate the maximum charging current supported currently by the mobile terminal; and to determine the charging current of the quick charging mode according to the replying instruction of the third instruction.

In an embodiment, the communication unit is further configured to conduct a bidirectional communication with the mobile terminal through the data line in the USB

interface in a process that the power adapter charges the mobile terminal in the quick charging mode, so as to adjust the charging current of the power adapter continuously.

In an embodiment, the communication unit is configured to send a fourth instruction to the mobile terminal, in which the fourth instruction is configured to inquire a current voltage of a battery in the mobile terminal; and to receive a replying instruction of the fourth instruction sent by the mobile terminal, in which the replying instruction of the fourth instruction is configured to indicate the current voltage of the battery in the mobile terminal; and the current adjusting unit is configured to adjust the charging current of the power adapter according to the current voltage of the battery.

In an embodiment, the current adjusting unit is configured to adjust the charging current of the power adapter to a charging current value corresponding to the current voltage of the battery according to the current voltage of the battery and preset correspondences between battery voltage values and charging current values.

In an embodiment, the communication unit is further configured to conduct a bidirectional communication with the mobile terminal through the data line in the USB interface in a process that the power adapter charges the mobile terminal in the quick charging mode, so as to determine whether a poor contact occurs in the USB interface; and to quit the quick charging mode if it is determined that the poor contact occurs in the USB interface.

In an embodiment, the communication unit is configured to receive information for indicating a path impedance of the mobile terminal from the mobile terminal; to receive a replying instruction of the fourth instruction sent by the mobile terminal, in which the replying instruction of the fourth instruction is configured to indicate a voltage of a battery in the mobile terminal; to determine a path impedance from the power adapter to

the battery according to a charging voltage of the power adapter and the voltage of the battery; and to determine whether the poor contact occurs in the USB interface according to the path impedance from the power adapter to the battery, the path impedance of the mobile terminal and a path impedance of a charging circuit between the power adapter and the mobile terminal.

In an embodiment, the communication unit is further configured to send a fifth instruction to the mobile terminal, in which the fifth instruction is configured to indicate that the poor contact occurs in the USB interface.

In an embodiment, a mobile terminal is provided. The mobile terminal is coupled to a power adapter through a universal serial bus (USB) interface, a power line in the USB interface is configured to charge the mobile terminal, a data line in the USB interface is used by the mobile terminal to conduct a bidirectional communication with the power adapter, and the mobile terminal supports a common charging mode and a quick charging mode, in which a charging current of the quick charging mode is greater than that of the common charging mode. The mobile terminal includes: a communication unit, configured to conduct a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines to charge the mobile terminal in the quick charging mode; and a charging unit, configured to receive a charging current corresponding to the quick charging mode from the power adapter so as to charge a battery in the mobile terminal.

In an embodiment, the communication unit is configured to receive a first instruction sent by the power adapter, in which the first instruction is configured to ask the mobile terminal whether to start the quick charging mode; and to send a replying instruction of the first instruction to the power adapter, in which the replying instruction

of the first instruction is configured to indicate that the mobile terminal agrees to start the quick charging mode.

In an embodiment, the charging unit is further configured to perform a charging with the power adapter in the common charging mode; and the communication unit is configured to receive the first instruction sent by the power adapter after the power adapter determines that a charging time of the common charging mode is larger than a preset threshold.

In an embodiment, the communication unit is further configured to conduct a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines a charging voltage corresponding to the quick charging mode.

In an embodiment, the communication unit is configured to receive a second instruction from the power adapter, in which the second instruction is configured to ask whether a current voltage of the power adapter is suitable as a charging voltage of the quick charging mode; and to send a replying instruction of the second instruction to the power adapter, in which the replying instruction of the second instruction is configured to indicate that the current voltage of the power adapter is suitable, high or low.

In an embodiment, the communication unit is further configured to conduct a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines the charging current corresponding to the quick charging mode.

In an embodiment, the communication unit is configured to receive a third instruction sent by the power adapter, in which the third instruction is configured to inquire a maximum charging current supported currently by the mobile terminal; and to

send a replying instruction of the third instruction to the power adapter, in which the replying instruction of the third instruction is configured to indicate the maximum charging current supported currently by the mobile terminal, such that the power adapter determines the charging current of the quick charging mode according to the maximum charging current.

In an embodiment, the communication unit is further configured to conduct a bidirectional communication with the power adapter through the data line in the USB interface in a process that the power adapter charges the mobile terminal in the quick charging mode, such that the power adapter adjusts the charging current of the power adapter continuously.

In an embodiment, the communication unit is configured to receive a fourth instruction sent by the power adapter, in which the fourth instruction is configured to inquire a current voltage of a battery in the mobile terminal; and to send a replying instruction of the fourth instruction to the power adapter, in which the replying instruction of the fourth instruction is configured to indicate the current voltage of the battery in the mobile terminal, such that the power adapter adjusts the charging current of the power adapter continuously according to the current voltage of the battery.

In an embodiment, the communication unit is further configured to conduct a bidirectional communication with the power adapter through the data line in the USB interface in a process that the power adapter charges the mobile terminal in the quick charging mode, such that the power adapter determines whether a poor contact occurs in the USB interface.

In an embodiment, the communication unit is configured to receive a fourth instruction sent by the power adapter, in which the fourth instruction is configured to

inquire a current voltage of a battery in the mobile terminal; to send a replying instruction of the fourth instruction to the power adapter, in which the replying instruction of the fourth instruction is configured to indicate the current voltage of the battery in the mobile terminal, such that the power adapter determines whether the poor contact occurs in the USB interface according to a charging voltage of the power adapter and the current voltage of the battery.

In an embodiment, the communication unit is further configured to receive a fifth instruction sent by the power adapter, in which the fifth instruction is configured to indicate that the poor contact occurs in the USB interface.

In embodiments of the present disclosure, the power adapter needs to conduct a bidirectional communication with the mobile terminal and negotiates whether a quick charging mode may be adopted, instead of blindly increasing the output current for performing a quick charging. Compared to the related art, the security in the quick charging process is improved.

## BRIEF DESCRIPTION OF THE DRAWINGS

In order to make the technical solutions of embodiments of the present invention more clearly, the accompanying drawings used in the description of embodiments of the present invention are briefly described hereunder. Obviously, the described drawings are merely some embodiments of present invention. For persons skilled in the art, other drawings may be obtained based on these drawings without any creative work.

Fig. 1 is a schematic flow chart of a quick charging method according to an embodiment of the present disclosure;

Fig. 2 is a schematic flow chart of a quick charging method according to an embodiment of the present disclosure;

Fig. 3 is a schematic diagram of a process of starting the quick charging according to an embodiment of the present disclosure;

Fig. 4 is a schematic diagram of a quick charging process according to an embodiment of the present disclosure;

Fig. 5 is a schematic block diagram of a power adapter according to an embodiment of the present disclosure; and

Fig. 6 is a schematic block diagram of a mobile terminal according to an embodiment of the present disclosure.

**DETAILED DESCRIPTION**

The technical solutions in embodiments of the present invention are hereinafter described clearly and completely with reference to accompanying drawings in embodiments of the present invention. Apparently, embodiments described are a part of embodiments of the present invention, but not all embodiments. All other embodiments obtained by those skilled in the art based on the embodiments in the present invention without creative labor shall fall in the protection scope of the present invention.

Fig. 1 is a schematic flow chart of a quick charging method according to an embodiment of the present disclosure. The method shown in Fig. 1 is applied to a power adapter. The power adapter is coupled to a mobile terminal through a Universal Serial Bus (USB) interface, the USB interface may be a common USB interface or a micro

USB interface. A power line in the USB interface is used by the power adapter to charge the mobile terminal, in which the power line in the USB interface may be a VBus line and/or a ground line in the USB interface. A data line in the USB interface is used by the power adapter to conduct a bidirectional communication with the mobile terminal, in which the data line may be a D+ line and/or a D- line in the USB interface, and the bidirectional communication may refer to an information interaction between the power adapter and the mobile terminal. The power adapter supports a common charging mode and a quick charging mode, in which a charging current of the quick charging mode is greater than that of the common charging mode. For example, the charging current of the common charging mode is generally less than 2.5A, and the charging current of the quick charging mode may be greater than 3A.

The method shown in Fig. 1 includes following acts.

At block 110, the power adapter conducts a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine to charge the mobile terminal in the quick charging mode.

In at least one embodiment, in a process that the power adapter and the mobile terminal negotiate whether the quick charging mode is adopted for charging the mobile terminal, the power adapter may only keep being coupled to the mobile terminal without performing a charging, or may charge the mobile terminal in the common charging mode, or may charge the mobile terminal with a low current, which is not limited in the present disclosure.

At block 120, the power adapter adjusts charging current to a charging current corresponding to the quick charging mode to charge the mobile terminal.

After determining to charge the mobile terminal in the quick charging mode, the power adapter may adjust the charging current to the charging current corresponding to the quick charging mode directly, or may negotiate with the mobile terminal about the charging current of the quick charging mode. For example, the charging current corresponding to the quick charging mode may be determined according to a current electric quantity of a battery in the mobile terminal.

In an embodiment of the present disclosure, the power adapter needs to conduct a bidirectional communication with the mobile terminal and negotiates whether a quick charging mode may be adopted, instead of blindly increasing the output current for performing a quick charging. Compared to the related art, the security in the quick charging process is improved.

In an embodiment, the act at block 110 may include: sending by the power adapter a first instruction to the mobile terminal, in which the first instruction is configured to ask the mobile terminal whether to start the quick charging mode; receiving by the power adapter a replying instruction of the first instruction from the mobile terminal, in which the replying instruction of the first instruction is configured to indicate that the mobile terminal agrees to start the quick charging mode.

In an embodiment, before the power adapter sends the first instruction to the mobile terminal, the method further includes: performing a charging between the power adapter and the mobile terminal in the common charging mode. Sending by the power adapter the first instruction to the mobile terminal, includes: after the power adapter determines that a charging time of the common charging mode is larger than a preset threshold, sending by the power adapter the first instruction to the mobile terminal.

In at least one embodiment, after the power adapter determines that the charging time of the common charging mode is larger than the preset threshold, the power adapter can consider that the mobile terminal has recognized it as a power adapter, and a quick charging inquiry communication can be started.

In an embodiment, sending by the power adapter the first instruction to the mobile terminal, includes: after the power adapter determines that the charging is performed for a preset time period with a charging current larger than or equal to a preset current threshold, sending by the power adapter the first instruction to the mobile terminal.

In an embodiment, before the act at block 120, the method shown in Fig. 1 further includes: conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine a charging voltage corresponding to the quick charging mode; adjusting by the power adapter a charging voltage to the charging voltage corresponding to the quick charging mode.

In an embodiment, the act at block 110 may include: sending by the power adapter a second instruction to the mobile terminal, in which the second instruction is configured to ask whether a current voltage of the power adapter is suitable as a charging voltage of the quick charging mode; receiving by the power adapter a replying instruction of the second instruction sent by the mobile terminal, in which the replying instruction of the second instruction is configured to indicate that the current voltage of the power adapter is suitable, high or low; and determining by the power adapter the charging voltage of the quick charging mode according to the replying instruction of the second instruction.

In an embodiment, before the act at block 120, the method shown in Fig. 1 may further include: conducting by the power adapter a bidirectional communication with

the mobile terminal through the data line in the USB interface so as to determine the charging current corresponding to the quick charging mode.

In an embodiment, conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine the charging current corresponding to the quick charging mode, may include: sending by the power adapter a third instruction to the mobile terminal, in which the third instruction is configured to inquire a maximum charging current supported currently by the mobile terminal; receiving by the power adapter a replying instruction of the third instruction sent by the mobile terminal, in which the replying instruction of the third instruction is configured to indicate the maximum charging current supported currently by the mobile terminal; and determining by the power adapter the charging current of the quick charging mode according to the replying instruction of the third instruction.

The power adapter may determine the maximum charging current as the charging current of the quick charging mode directly, or set a current which is smaller than the maximum charging current as the charging current.

In an embodiment, the method shown in Fig. 1 may further include: in a process that the power adapter charges the mobile terminal in the quick charging mode, conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface to adjust the charging current of the power adapter continuously.

The power adapter may inquire a current working state of the mobile terminal continually so as to adjust the charging current continuously. For example, the power adapter may inquire a voltage, an electric quantity of the battery, or other information in the mobile terminal.

In an embodiment, conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to adjust the charging current of the power adapter continuously, may include: sending by the power adapter a fourth instruction to the mobile terminal, in which the fourth instruction is configured to inquire a current voltage of a battery in the mobile terminal; receiving by the power adapter a replying instruction of the fourth instruction sent by the mobile terminal, in which the replying instruction of the fourth instruction is configured to indicate the current voltage of the battery in the mobile terminal; adjusting by the power adapter the charging current of the power adapter according to the current voltage of the battery.

In an embodiment, adjusting by the power adapter the charging current of the power adapter according to the current voltage of the battery, includes: adjusting by the power adapter the charging current of the power adapter to a charging current value corresponding to the current voltage of the battery according to the current voltage of the battery and preset correspondences between battery voltage values and charging current values.

In at least one embodiment, the power adapter may pre-store the correspondences between battery voltage values and charging current values.

In an embodiment, the method shown in Fig. 1 may further include: in a process that the power adapter charges the mobile terminal in the quick charging mode, conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine whether a poor contact occurs in the USB interface; if it is determined that the poor contact occurs in the USB interface, quitting by the power adapter the quick charging mode.

In an embodiment, before the power adapter conducts a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine whether the poor contact occurs in the USB interface, the method shown in Fig. 1 may further include: receiving by the power adapter information for indicating a path impedance of the mobile terminal from the mobile terminal. Conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine whether a poor contact occurs in the USB interface, includes: sending by the power adapter a fourth instruction to the mobile terminal, in which the fourth instruction is configured to inquire a voltage of a battery in the mobile terminal; receiving by the power adapter a replying instruction of the fourth instruction sent by the mobile terminal, in which the replying instruction of the fourth instruction is configured to indicate the voltage of the battery in the mobile terminal; determining by the power adapter a path impedance from the power adapter to the battery according to a charging voltage of the power adapter and the voltage of the battery; and determining by the power adapter whether the poor contact occurs in the USB interface according to the path impedance from the power adapter to the battery, the path impedance of the mobile terminal and a path impedance of a charging circuit between the power adapter and the mobile terminal.

The power adapter may pre-record the path impedance 1 of the mobile terminal, for example, since the structures of mobile terminals with a same model number are the same, the path impedances of the mobile terminals may be set as the same value when configuring the factory settings. Similarly, the power adapter may pre-record the path impedance 2 of the charging circuit. When the power adapter acquires the voltage between two ends of the battery in the mobile terminal, the path impedance 3 of the

whole path may be determined according to the voltage drop from the power adapter to each of the two ends of the battery. If path impedance 3 > path impedance 1 + path impedance 2, or path impedance 3 – (path impedance 1 + path impedance 2) > impedance threshold, then it may be considered that a poor contact occurs in the USB interface.

In an embodiment, before the power adapter quits the quick charging mode, the method shown in Fig. 1 may further include: sending by the power adapter a fifth instruction to the mobile terminal, in which the fifth instruction is configured to indicate that a poor contact occurs in the USB interface.

After the fifth instruction is sent, the power adapter quits the quick charging mode or is reset.

Hereinbefore, by referring to Fig. 1, the quick charging method according to embodiments of the present disclosure is described in detail from the aspect of a power adapter. In the following, the quick charging method according to embodiments of the present disclosure will be described from the aspect of a mobile terminal by referring to Fig. 2.

In embodiments, the interaction between a power adapter and a mobile terminal, related features and functionality described from the mobile terminal side corresponds to the description from the power adapter side. For the sake of simplicity, repetitive description may be omitted properly.

Fig. 2 is a schematic flow chart of a quick charging method according to an embodiment of the present disclosure. The method shown in Fig. 2 is applied to a mobile terminal, the mobile terminal is coupled to a power adapter through a USB

interface, a power line in the USB interface is configured to charge the mobile terminal, a data line in the USB interface is used by the mobile terminal to conduct a bidirectional communication with the power adapter, and the mobile terminal supports a common charging mode and a quick charging mode, in which a charging current of the quick charging mode is greater than that of the common charging mode. The method shown in Fig. 2 includes following acts.

At block 210, the mobile terminal conducts a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines to charge the mobile terminal in the quick charging mode.

At block 220, the mobile terminal receives a charging current corresponding to the quick charging mode from the power adapter so as to charge a battery in the mobile terminal.

In embodiments of the present disclosure, the power adapter needs to conduct a bidirectional communication with the mobile terminal and negotiates whether a quick charging mode may be adopted, instead of blindly increasing the output current for performing a quick charging. Compared to the related art, the security in the quick charging process is improved.

In an embodiment, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines to charge the mobile terminal in the quick charging mode, includes: receiving by the mobile terminal a first instruction sent by the power adapter, in which the first instruction is configured to ask the mobile terminal whether to start the quick charging mode; sending by the mobile terminal a replying instruction of

the first instruction to the power adapter, in which the replying instruction of the first instruction is configured to indicate that the mobile terminal agrees to start the quick charging mode.

In an embodiment, before the mobile terminal receives the first instruction sent by the power adapter, the method further includes: performing a charging between the mobile terminal and the power adapter in the common charging mode. Receiving by the mobile terminal a first instruction sent by the power adapter, includes: after the power adapter determines that a charging time of the common charging mode is larger than a preset threshold, receiving by the mobile terminal the first instruction sent by the power adapter.

In an embodiment, before the mobile terminal receives the charging current corresponding to the quick charging mode from the power adapter so as to charge the battery in the mobile terminal, the method includes: conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines a charging voltage corresponding to the quick charging mode.

In an embodiment, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines a charging voltage corresponding to the quick charging mode, includes: receiving by the mobile terminal a second instruction sent by the power adapter, in which the second instruction is configured to ask whether a current voltage of the power adapter is suitable as the charging voltage of the quick charging mode; sending by the mobile terminal a replying instruction of the second instruction to the power adapter, in which the replying instruction of the second

instruction is configured to indicate that the current voltage of the power adapter is suitable, high or low.

In an embodiment, before the mobile terminal receives the charging current corresponding to the quick charging mode from the power adapter so as to charge the battery in the mobile terminal, the method includes: conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines the charging current corresponding to the quick charging mode.

In an embodiment, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines the charging current corresponding to the quick charging mode, includes: receiving by the mobile terminal a third instruction sent by the power adapter, in which the third instruction is configured to inquire a maximum charging current supported currently by the mobile terminal; sending by the mobile terminal a replying instruction of the third instruction to the power adapter, in which the replying instruction of the third instruction is configured to indicate the maximum charging current supported currently by the mobile terminal, such that the power adapter determines the charging current corresponding to the quick charging mode according to the maximum charging current.

In an embodiment, the method further includes: in a process that the power adapter charges the mobile terminal in the quick charging mode, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter adjusts the charging current of the power adapter continuously.

In an embodiment, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter adjusts the charging current of the power adapter continuously, includes: receiving by the mobile terminal a fourth instruction sent by the power adapter, in which the fourth instruction is configured to inquire a current voltage of a battery in the mobile terminal; sending by the mobile terminal a replying instruction of the fourth instruction to the power adapter, in which the replying instruction of the fourth instruction is configured to indicate the current voltage of the battery in the mobile terminal, such that the power adapter adjusts the charging current of the power adapter continuously according to the current voltage of the battery.

In an embodiment, the method further includes: in a process that the power adapter charges the mobile terminal in the quick charging mode, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface, such that the power adapter determines whether a poor contact occurs in the USB interface.

In an embodiment, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface, such that the mobile terminal determines whether a poor contact occurs in the USB interface, includes: receiving by the mobile terminal a fourth instruction sent by the power adapter, in which the fourth instruction is configured to inquire a current voltage of a battery in the mobile terminal; sending by the mobile terminal a replying instruction of the fourth instruction to the power adapter, in which the replying instruction of the fourth instruction is configured to indicate the current voltage of the battery in the mobile terminal, such that the power adapter determines whether the poor contact occurs in the

USB interface according to a charging voltage of the power adapter and the current voltage of the battery.

In an embodiment, the method further includes: receiving by the mobile terminal a fifth instruction sent by the power adapter, in which the fifth instruction is configured to indicate that the poor contact occurs in the USB interface.

In combination with specific examples, embodiments of the present disclosure will be described below in more detail. It should be noted that, examples shown in Fig. 3 to Fig. 4 merely help those skilled in the arts for understanding embodiments of the present disclosure, instead of limiting the embodiments of the present disclosure to illustrated specific values or scenarios. Obviously, various equivalent modifications and changes may be made according to the examples shown in Fig. 3 to Fig. 4 by those skilled in the arts, and the modifications or changes shall fall in the protection scope of the present invention.

Fig. 3 is a schematic diagram of a starting process of the quick charging according to an embodiment of the present disclosure.

As illustrated in Fig. 3, the process of starting a quick charging includes five stages.

Stage 1

If the power adapter detects that the output current in a continuous time period T1 is larger than or equal to I2, it is considered that the type recognition of the power adapter performed by the mobile terminal is finished (i.e. a device charging the mobile terminal is recognized as the power adapter, rather than other electric appliances such as a computer, etc.), the communication is started and instruction 1 is sent to ask the mobile terminal whether to start the quick charging (or flash charging), by the power

adapter. If the power adapter receives a reply indicating that the mobile terminal disagrees with the quick charging, the current may be detected repeatedly. If the current is still larger than or equal to I2, the request may be sent again by the power adapter, and that cycle repeats until the mobile terminal provides a reply indicating the mobile terminal agrees to perform the quick charging or until the current no longer satisfies the condition of that the current is larger than or equal to I2. After the mobile terminal agrees to perform the quick charging, the process goes to stage 2.

Stage 2

The power adapter sends instruction 2 to ask the mobile terminal whether the voltage of the power adapter is suitable. If the mobile terminal provides a reply indicating that the voltage is high or low, the voltage is adjusted correspondingly and the mobile terminal is again asked by the power adapter whether the voltage of the power adapter is suitable, and that cycle repeats until the mobile terminal provides a reply indicating the voltage is at a suitable position. And then, the process goes to stage 3.

Stage 3

After the power adapter receives a reply indicating that the voltage of the power adapter is suitable from the mobile terminal, the power adapter sends instruction 3 for inquiring the maximum charging current supported currently by the mobile terminal. And then, the process goes to stage 4.

Stage 4, 5

The power adapter sets the output current with specified values according to the current value replied by the mobile terminal and the process goes to a constant current stage. At the same time, the power adapter sends instruction 4 at regular intervals for

inquiring the battery voltage of the mobile terminal, and then it is judged according to the battery voltage whether the USB interface contacts well and whether it is required to decrease the charging current. If the power adapter judges that a poor contact occurs in the USB interface, instruction 5 is sent and a reset operation is performed thereafter.

In at least one embodiment, 1) in stage 1, when the mobile terminal provides the reply to the instruction 1, a path impedance of terminal may be attached in data of the reply, the path impedance of terminal may be used in stage 5 to judge the connection situation of the USB interface. 2) In stage 2, a time period from when the power adapter agrees to perform the quick charging to when the voltage of the power adapter is adjusted to a suitable value may be controlled within a certain range, so as to prevent the mobile terminal from being judged as abnormal and stopping the quick charging. 3) In stage 2, when the voltage of the power adapter is adjusted to a value higher than the battery voltage $\Delta V$, the terminal can provide the reply indicating that the voltage is suitable ($\Delta V$ may be set as 200~500mA). 4) In stage 4, an increasing speed of the output current may be controlled within a certain range, so as to avoid an abnormal interrupt of the quick charging due to an over-quick increasing speed of the charging current resulted from an over-quick increasing speed of the output current. In at least one embodiment, as illustrated in Fig. 3, the charging current increases gently in stage 4. 5) In stage 5, the control precision of the current in the constant current mode may be controlled within 5% to the greatest extent. 6) In stage 5, the power adapter detects the path impedance in real time, the impedance of the whole path for the quick charging may be computed by measuring the voltage of the power adapter, the current charging current and the read battery voltage. If the detected path impedance > path impedance of the terminal + impedance of the data line for quick charging, it is considered that a poor

contact occurs in the USB interface and the quick charging may be stopped. 7) After starting the quick charging, each interval between communications may be controlled within a certain range, so as to avoid an abnormal interrupt of the quick charging. 8) The termination of the quick charging may be divided into a recoverable type and a non-recoverable type. If the mobile terminal detects that the battery is fully charged or a poor contact occurs in the USB interface during the quick charging stage, the quick charging is stopped and the power adapter may not start the quick charging any more. If there is an abnormal communication between the power adapter and the mobile terminal, the power adapter may stop the quick charging, but the power adapter may re-start the quick charging process thereafter. If the power adapter detects that the battery is abnormal, the quick charging may be stopped, and the quick charging process may be re-started until the battery returns to normal.

Fig. 4 illustrates an example of a quick charging process. The whole process illustrated in Fig. 4 substantially corresponds to the process illustrated in Fig. 3.

As illustrated in Fig. 4, the power adapter is in a DCP mode at beginning, that is, the power adapter is in a D+, D- short circuit mode, and the mobile terminal is charged in a common charging mode. Before sending the first instruction, the power adapter may judge whether the data line is a quick charging data line, which may be implemented in various ways. For example, an identification circuit may be added to the data line, and the power adapter may identify whether the data line is a quick charging data line by conducting an information interaction with the identification circuit. Additionally, in at least one embodiment, when there is an abnormal communication or abnormal impedance in the whole quick charging process, the power adapter may quit the quick charging process or be reset.

Hereinbefore, by referring to Fig. 1 to Fig. 4, the quick charging method according to an embodiment of the present disclosure is described in detail. In the following, the power adapter and the mobile terminal according to embodiments of the present disclosure will be described in detail hereinafter with reference to Fig. 5 to Fig. 6.

Fig. 5 is a schematic block diagram of a power adapter according to an embodiment of the present disclosure. The power adapter 500 shown in Fig. 5 can achieve respective act executed by the power adapter in Fig. 1 to Fig. 4, which is not described herein in order to avoid repetition.

In at least one embodiment, the power adapter 500 is coupled to a mobile terminal through a USB interface, a power line in the USB interface is used by the power adapter 500 to charge the mobile terminal, a data line in the USB interface is used by the power adapter 500 to conduct a bidirectional communication with the mobile terminal, and the power adapter 500 supports a common charging mode and a quick charging mode, in which a charging current of the quick charging mode is greater than that of the common charging mode. The power adapter 500 includes: a communication circuit 510 and a current adjusting circuit 520.

The communication circuit 510 is configured to conduct a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine to charge the mobile terminal in the quick charging mode.

The current adjusting circuit 520 is configured to adjust a charging current to a charging current corresponding to the quick charging mode so as to charge the mobile terminal.

In embodiments of the present disclosure, the power adapter needs to conduct a bidirectional communication with the mobile terminal and negotiates whether a quick charging mode may be adopted, instead of blindly increasing the output current for performing a quick charging. Compared to the related art, the security in the quick charging process is improved.

In an embodiment, the communication circuit 510 is configured to send a first instruction to the mobile terminal, in which the first instruction is configured to ask the mobile terminal whether to start the quick charging mode; and to receive a replying instruction of the first instruction from the mobile terminal, in which the replying instruction of the first instruction is configured to indicate that the mobile terminal agrees to start the quick charging mode.

In an embodiment, the power adapter 500 further includes a power conversion circuit configured to perform a charging with the mobile terminal in the common charging mode. The communication circuit 510 is configured to send the first instruction to the mobile terminal after determining that a charging time of the common charging mode is larger than a preset threshold.

In an embodiment, the communication circuit 510 is further configured to conduct a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine a charging voltage corresponding to the quick charging mode. The power adapter 500 further includes a voltage adjusting circuit configured to adjust charging voltage to a charging voltage corresponding to the quick charging mode.

In an embodiment, the communication circuit 510 is further configured to send a second instruction to the mobile terminal, in which the second instruction is configured

to ask whether a current voltage of the power adapter 500 is suitable as a charging voltage of the quick charging mode; and receive a replying instruction of the second instruction sent by the mobile terminal, in which the replying instruction of the second instruction is configured to indicate that the current voltage of the power adapter 500 is suitable, high or low. The voltage adjusting circuit is configured to determine the charging voltage of the quick charging mode according to the replying instruction of the second instruction.

In an embodiment, the communication circuit 510 is configured to conduct a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine a charging current corresponding to the quick charging mode.

In an embodiment, the communication circuit 510 is configured to send a third instruction to the mobile terminal, in which the third instruction is configured to inquire the maximum charging current supported currently by the mobile terminal; to receive a replying instruction of the third instruction sent by the mobile terminal, in which the replying instruction of the third instruction is configured to indicate the maximum charging current supported currently by the mobile terminal; and to determine the charging current of the quick charging mode according to the replying instruction of the third instruction.

In an embodiment, the communication circuit 510 is further configured to conduct a bidirectional communication with the mobile terminal through the data line in the USB interface in a process that the power adapter 500 charges the mobile terminal in the quick charging mode, so as to adjust the charging current of the power adapter 500 continuously.

In an embodiment, the communication circuit 510 is configured to send a fourth instruction to the mobile terminal, in which the fourth instruction is configured to inquire a current voltage of the battery in the mobile terminal; and to receive a replying instruction of the fourth instruction sent by the mobile terminal, in which the replying instruction of the fourth instruction is configured to indicate the current voltage of the battery in the mobile terminal. The current adjusting circuit 520 is configured to adjust the charging current of the power adapter according to the current voltage of the battery.

In an embodiment, the current adjusting circuit 520 is configured to adjust the charging current of the power adapter 500 to a charging current value corresponding to the current voltage of the battery according to the current voltage of the battery and preset correspondences between battery voltage values and charging current values.

In an embodiment, the communication circuit 510 is configured to conduct a bidirectional communication with the mobile terminal through the data line in the USB interface in a process that the power adapter charges the mobile terminal in the quick charging mode, so as to determine whether a poor contact occurs in the USB interface; and to quit the quick charging mode if it is determined that the poor contact occurs in the USB interface.

In an embodiment, the communication circuit 510 is configured to receive information for indicating a path impedance of the mobile terminal from the mobile terminal; to receive a replying instruction of the fourth instruction sent by the mobile terminal, in which the replying instruction of the fourth instruction is configured to indicate the voltage of the battery in the mobile terminal; to determine a path impedance from the power adapter 500 to the battery according to the charging voltage of the power adapter 500 and the voltage of the battery; and to determine whether the poor

contact occurs in the USB interface according to the path impedance from the power adapter 500 to the battery, the path impedance of the mobile terminal and a path impedance of a charging line between the power adapter 500 and the mobile terminal.

In an embodiment, the communication circuit 510 is further configured to send a fifth instruction to the mobile terminal, in which the fifth instruction is configured to indicate that the poor contact occurs in the USB interface.

Fig. 6 is a schematic block diagram of a mobile terminal according to an embodiment of the present disclosure. The mobile terminal 600 illustrated in Fig. 6 is coupled to a power adapter through a USB interface, a power line in the USB interface is configured to charge the mobile terminal 600, a data line in the USB interface is used by the mobile terminal 600 to conduct a bidirectional communication with the power adapter, and the mobile terminal 600 supports a common charging mode and a quick charging mode, in which a charging current of the quick charging mode is greater than that of the common charging mode. The mobile terminal 600 includes a communication circuit 610 and a charging circuit 620.

The communication circuit 610 is configured to conduct a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines to charge the mobile terminal 600 in the quick charging mode.

The charging circuit 620 is configured to receive a charging current corresponding to the quick charging mode from the power adapter so as to charge a battery in the mobile terminal 600.

In embodiments of the present disclosure, the power adapter needs to conduct a bidirectional communication with the mobile terminal and negotiates whether a quick

charging mode may be adopted, instead of blindly increasing the output current for conducting a quick charging. Compared to the related art, the security in the quick charging process is improved.

In an embodiment, the communication circuit 610 is configured to receive a first instruction sent by the power adapter, in which the first instruction is configured to ask the mobile terminal 600 whether to start the quick charging mode; and to send a replying instruction of the first instruction to the power adapter, in which the replying instruction of the first instruction is configured to indicate that the mobile terminal 600 agrees to start the quick charging mode.

In an embodiment, the charging circuit 620 is further configured to perform a charging with the power adapter in the common charging mode. The communication circuit 610 is configured to receive the first instruction sent by the power adapter after the power adapter determines that a charging time of the common charging mode is larger than a preset threshold.

In an embodiment, the communication circuit 610 is further configured to conduct a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines a charging voltage corresponding to the quick charging mode.

In an embodiment, the communication circuit 610 is configured to receive a second instruction sent by the power adapter, in which the second instruction is configured to ask whether a current voltage of the power adapter is suitable as a charging voltage of the quick charging mode; and to send a replying instruction of the second instruction to the power adapter, in which the replying instruction of the second instruction is

configured to indicate that the current voltage of the power adapter is suitable, high or low.

In an embodiment, the communication circuit 610 is further configured to conduct a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines the charging current corresponding to the quick charging mode.

In an embodiment, the communication circuit 610 is configured to receive a third instruction sent by the power adapter, in which the third instruction is configured to inquire a maximum charging current supported currently by the mobile terminal 600; and to send a replying instruction of the third instruction to the power adapter, in which the replying instruction of the third instruction is configured to indicate the maximum charging current supported currently by the mobile terminal 600, such that the power adapter determines the charging current corresponding to the quick charging mode according to the maximum charging current.

In an embodiment, the communication circuit 610 is further configured to conduct a bidirectional communication with the power adapter through the data line in the USB interface in a process that the power adapter charges the mobile terminal 600 in the quick charging mode, such that the power adapter adjusts the charging current of the power adapter continuously.

In an embodiment, the communication circuit 610 is configured to receive a fourth instruction sent by the power adapter, in which the fourth instruction is configured to inquire a current voltage of a battery in the mobile terminal 600; and to send a replying instruction of the fourth instruction to the power adapter, in which the replying instruction of the fourth instruction is configured to indicate the current voltage of the

battery in the mobile terminal 600, such that the power adapter adjusts the charging current of the power adapter continuously according to the current voltage of the battery.

In an embodiment, the communication circuit 610 is further configured to conduct a bidirectional communication with the power adapter through the data line in the USB interface in a process that the power adapter charges the mobile terminal 600 in the quick charging mode, such that the power adapter determines whether a poor contact occurs in the USB interface.

In an embodiment, the communication circuit 610 is configured to receive a fourth instruction sent by the power adapter, in which the fourth instruction is configured to inquire a current voltage of a battery in the mobile terminal 600; to send a replying instruction of the fourth instruction to the power adapter, in which the replying instruction of the fourth instruction is configured to indicate the current voltage of the battery in the mobile terminal 600, such that the power adapter determines whether the poor contact occurs in the USB interface according to the charging voltage of the power adapter and the current voltage of the battery.

In an embodiment, the communication circuit 610 is further configured to receive a fifth instruction sent by the power adapter, in which the fifth instruction is configured to indicate that the poor contact occurs in the USB interface.

Those skilled in the art can be aware that, units and algorithm steps in respective examples described with reference to embodiments disclosed in the present disclosure can be realized by electronic hardware or combination of computer software and electronic hardware. Executing these functions in hardware or software depends on

particular applications and design constraint conditions of the technical solutions. Technology professionals can use different methods to realize the described functions for each particular application, which should be regarded as being within the scope of the present disclosure.

Those skilled in the art can understand clearly that, for convenience and simplicity of description, specific working process of the above system, devices and units may refer to corresponding process in the above method embodiments, which will not be elaborated herein.

It should be understood that, the system, devices and method disclosed in several embodiments provided by the present disclosure can be realized in any other manner. For example, the device embodiments described above can be merely exemplary, for example, the units are just divided according to logic functions. In practical implementation, the units can be divided in other manners, for example, multiple units or components can be combined or integrated into another system, or some features can be omitted or not executed. In addition, the mutual coupling or direct coupling or communication connection described or discussed can be via some interfaces, and indirect coupling or communication connection between devices or units may be electrical, mechanical or of other forms.

The units illustrated as separate components can be or not be separated physically, and components described as units can be or not be physical units, i.e., can be located at one place, or can be distributed onto multiple network units. It is possible to select some or all of the units according to actual needs, for realizing the objective of embodiments of the present disclosure.

In addition, respective functional units in respective embodiments of the present disclosure can be integrated into one processing unit, or can be present as separate physical entities. It is also possible that two or more than two units are integrated into one unit.

If the functions are realized in form of functional software units and are sold or used as separate products, they can be stored in a computer readable storage medium. Based on this understanding, the parts of the technical solutions or the essential parts of the technical solutions (i.e. the parts making a contribution to the related art) can be embodied in form of software product, which is stored in a storage medium, and includes several instruction used for causing a computer device (for example, a personal computer, a server or a network device) to execute all or part of steps in the methods described in respective embodiments of the present disclosure. The above storage medium may be any medium capable of storing program codes, including a USB flash disk, a mobile hard disk, a Read-Only Memory (ROM), a Random Access Memory (RAM), a disc, or a light disk.

The forgoing description is only directed to preferred embodiments of the present disclosure, but not used to limit the present disclosure. All modifications, equivalents, variants and improvements made within the spirit and principle of the present disclosure shall fall within the protection scope of the present disclosure. Thus, the protection scope of the present disclosure shall be limited by the protection scope of the claims.

**WHAT IS CLAIMED IS:**

1. A quick charging method, wherein, the method is applied to a power adapter, the power adapter is coupled to a mobile terminal through a universal serial bus (USB) interface, a power line in the USB interface is used by the power adapter to charge the mobile terminal, a data line in the USB interface is used by the power adapter to conduct a bidirectional communication with the mobile terminal, and the power adapter supports a common charging mode and a quick charging mode, wherein a charging current of the quick charging mode is greater than that of the common charging mode; the method comprises:

conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine to charge the mobile terminal in the quick charging mode; and

adjusting by the power adapter a charging current to a charging current corresponding to the quick charging mode so as to charge the mobile terminal.

2. The method according to claim 1, further comprising:

conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine a charging voltage corresponding to the quick charging mode; and

adjusting by the power adapter a charging voltage to the charging voltage corresponding to the quick charging mode.

3. The method according to claim 1 or 2, further comprising:

conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine the charging current corresponding to the quick charging mode.

4. The method according to any of claims 1-3, further comprising:

in a process that the power adapter charges the mobile terminal in the quick charging mode, conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to adjust the charging current of the power adapter continuously.

5. The method according to any of claims 1-4, further comprising:

in a process that the power adapter charges the mobile terminal in the quick charging mode, conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine whether a poor contact occurs in the USB interface; and

if it is determined that the poor contact occurs in the USB interface, quitting by the power adapter the quick charging mode.

6. A quick charging method, wherein, the method is applied to a mobile terminal, the mobile terminal is coupled to a power adapter through a universal serial bus (USB) interface, a power line in the USB interface is configured to charge the mobile terminal, a data line in the USB interface is used by the mobile terminal to conduct a bidirectional communication with the power adapter, and the mobile terminal supports a common charging mode and a quick charging mode, in which a charging current of the quick charging mode is greater than that of the common charging mode; the method comprises:

conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface, such that the power adapter determines to charge the mobile terminal in the quick charging mode; and

receiving by the mobile terminal a charging current corresponding to the quick charging mode from the power adapter so as to charge a battery in the mobile terminal.

7. The method according to claim 6, wherein, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines to charge the mobile terminal in the quick charging mode comprises:

receiving by the mobile terminal a first instruction sent by the power adapter, wherein the first instruction is configured to ask the mobile terminal whether to start the quick charging mode; and

sending by the mobile terminal a replying instruction of the first instruction to the power adapter, wherein the replying instruction of the first instruction is configured to indicate that the mobile terminal agrees to start the quick charging mode.

8. The method according to claim 6 or 7, further comprising:

conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface, such that the power adapter determines a charging voltage corresponding to the quick charging mode.

9. The method according to claim 8, wherein, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines a charging voltage corresponding to the quick charging mode comprises:

receiving by the mobile terminal a second instruction sent by the power adapter, wherein the second instruction is configured to ask whether a current voltage of the power adapter is suitable as a charging voltage of the quick charging mode; and

sending by the mobile terminal a replying instruction of the second instruction to the power adapter, wherein the replying instruction of the second instruction is configured to indicate that the current voltage of the power adapter is suitable, high or low.

10. The method according to any of claims 6-9, further comprising:

conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface, such that the power adapter determines the charging current corresponding to the quick charging mode.

11. The method according to claim 10, wherein, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines the charging current corresponding to the quick charging mode comprises:

receiving by the mobile terminal a third instruction sent by the power adapter, wherein the third instruction is configured to inquire a maximum charging current supported currently by the mobile terminal; and

sending by the mobile terminal a replying instruction of the third instruction to the power adapter, wherein the replying instruction of the third instruction is configured to indicate the maximum charging current supported currently by the mobile terminal, such that the power adapter determines the charging current corresponding to the quick charging mode according to the maximum charging current.

12. The method according to any of claims 6-11, further comprising:

in a process that the power adapter charges the mobile terminal in the quick charging mode, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter adjusts the charging current of the power adapter continuously.

13. The method according to claim 12, wherein, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter adjusts the charging current of the power adapter continuously comprises:

receiving by the mobile terminal a fourth instruction sent by the power adapter, wherein the fourth instruction is configured to inquire a current voltage of a battery in the mobile terminal; and

sending by the mobile terminal a replying instruction of the fourth instruction to the power adapter, wherein the replying instruction of the fourth instruction is configured to indicate the current voltage of the battery in the mobile terminal, such that the power adapter adjusts the charging current of the power adapter continuously according to the current voltage of the battery.

14. The method according to any of claims 6-13, further comprising:

in a process that the power adapter charges the mobile terminal in the quick charging mode, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface, such that the power adapter determines whether a poor contact occurs in the USB interface.

15. The method according to claim 14, wherein, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB

interface, such that the mobile terminal determines whether a poor contact occurs in the USB interface comprises:

receiving by the mobile terminal a fourth instruction sent by the power adapter, wherein the fourth instruction is configured to inquire a current voltage of a battery in the mobile terminal; and

sending by the mobile terminal a replying instruction of the fourth instruction to the power adapter, wherein the replying instruction of the fourth instruction is configured to indicate the current voltage of the battery in the mobile terminal, such that the power adapter determines whether the poor contact occurs in the USB interface according to a charging voltage of the power adapter and the current voltage of the battery.

16. A power adapter, wherein, the power adapter is coupled to a mobile terminal through a universal serial bus (USB) interface, a power line in the USB interface is used by the power adapter to charge the mobile terminal, a data line in the USB interface is used by the power adapter to conduct a bidirectional communication with the mobile terminal, and the power adapter supports a common charging mode and a quick charging mode, in which a charging current of the quick charging mode is greater than that of the common charging mode; the power adapter comprises:

a communication unit, configured to conduct a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine to charge the mobile terminal in the quick charging mode; and

a current adjusting unit, configured to adjust a charging current to a charging current corresponding to the quick charging mode so as to charge the mobile terminal.

17. The power adapter according to claim 16, wherein, the communication unit is configured to send a first instruction to the mobile terminal, wherein the first instruction is configured to ask the mobile terminal whether to start the quick charging mode; and to receive a replying instruction of the first instruction from the mobile terminal, wherein the replying instruction of the first instruction is configured to indicate that the mobile terminal agrees to start the quick charging mode.

18. The power adapter according to claim 17, further comprising:

a power conversion unit, configured to perform a charging with the mobile terminal in the common charging mode;

wherein the communication unit is configured to send the first instruction to the mobile terminal after it is determined that a charging time of the common charging mode is larger than a preset threshold.

19. The power adapter according to any of claims 16-18, wherein, the communication unit is further configured to conduct a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine a charging voltage corresponding to the quick charging mode;

wherein the power adapter further comprises:

a voltage adjusting unit, configured to adjust a charging voltage to the charging voltage corresponding to the quick charging mode.

20. The power adapter according to claim 19, wherein, the communication unit is further configured to send a second instruction to the mobile terminal, wherein the second instruction is configured to ask whether a current voltage of the power adapter is suitable as a charging voltage of the quick charging mode; to receive a replying instruction of the second instruction sent by the mobile terminal, wherein the replying

instruction of the second instruction is configured to indicate that the current voltage of the power adapter is suitable, high or low; and the voltage adjusting unit is configured to determine the charging voltage of the quick charging mode according to the replying instruction of the second instruction.

21. The power adapter according to any of claims 16-20, wherein, the communication unit is configured to conduct a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine the charging current corresponding to the quick charging mode.

22. The power adapter according to claim 21, wherein, the communication unit is configured to send a third instruction to the mobile terminal, wherein the third instruction is configured to inquire a maximum charging current supported currently by the mobile terminal; to receive a replying instruction of the third instruction sent by the mobile terminal, wherein the replying instruction of the third instruction is configured to indicate the maximum charging current supported currently by the mobile terminal; and to determine the charging current of the quick charging mode according to the replying instruction of the third instruction.

23. The power adapter according to any of claims 16-22, wherein, the communication unit is further configured to conduct a bidirectional communication with the mobile terminal through the data line in the USB interface in a process that the power adapter charges the mobile terminal in the quick charging mode, so as to adjust the charging current of the power adapter continuously.

24. The power adapter according to claim 23, wherein, the communication unit is configured to send a fourth instruction to the mobile terminal, wherein the fourth instruction is configured to inquire a current voltage of a battery in the mobile terminal;

and to receive a replying instruction of the fourth instruction sent by the mobile terminal, wherein the replying instruction of the fourth instruction is configured to indicate the current voltage of the battery in the mobile terminal; and the current adjusting unit is configured to adjust the charging current of the power adapter according to the current voltage of the battery.

25. The power adapter according to any of claims 16-24, wherein, the communication unit is further configured to conduct a bidirectional communication with the mobile terminal through the data line in the USB interface in a process that the power adapter charges the mobile terminal in the quick charging mode, so as to determine whether a poor contact occurs in the USB interface; and to quit the quick charging mode if it is determined that the poor contact occurs in the USB interface.

26. The power adapter according to claim 25, wherein, the communication unit is configured to receive information for indicating a path impedance of the mobile terminal from the mobile terminal; to receive a replying instruction of the fourth instruction sent by the mobile terminal, wherein the replying instruction of the fourth instruction is configured to indicate a voltage of a battery in the mobile terminal; to determine a path impedance from the power adapter to the battery according to a charging voltage of the power adapter and the voltage of the battery; and to determine whether the poor contact occurs in the USB interface according to the path impedance from the power adapter to the battery, the path impedance of the mobile terminal and a path impedance of a charging circuit between the power adapter and the mobile terminal.

27. A mobile terminal, wherein, the mobile terminal is coupled to a power adapter through a universal serial bus (USB) interface, a power line in the USB interface is

configured to charge the mobile terminal, a data line in the USB interface is used by the mobile terminal to conduct a bidirectional communication with the power adapter, and the mobile terminal supports a common charging mode and a quick charging mode, in which a charging current of the quick charging mode is greater than that of the common charging mode; the mobile terminal comprises:

a communication unit, configured to conduct a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines to charge the mobile terminal in the quick charging mode; and

a charging unit, configured to receive a charging current corresponding to the quick charging mode from the power adapter so as to charge a battery in the mobile terminal.

28. The mobile terminal according to claim 27, wherein, the communication unit is further configured to conduct a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines a charging voltage corresponding to the quick charging mode.

29. The mobile terminal according to claim 27 or 28, wherein, the communication unit is further configured to conduct a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines the charging current corresponding to the quick charging mode.

30. The mobile terminal according to any of claims 27-29, wherein, the communication unit is further configured to conduct a bidirectional communication with the power adapter through the data line in the USB interface in a process that the power adapter charges the mobile terminal in the quick charging mode, such that the power adapter adjusts the charging current of the power adapter continuously.

# FAST CHARGING METHOD, POWER SOURCE ADAPTER AND MOBILE TERMINAL

## FIELD

The present disclosure relates to charging technical field, and more particularly, to a quick charging method, a power adapter and a mobile terminal.

## BACKGROUND

At present, a mobile terminal (such as a smart phone) has become increasingly popular among consumers, but the mobile terminal consumes a lot of electricity and needs to be charged frequently. With the increasing of battery capacity of the mobile terminal, the charging time becomes longer and longer. How to achieve quick charging has become a problem which needs to be solved.

In the related art, in order to achieve the quick charging, an output current of a power adapter is directly increased without considering the tolerance capacity of the mobile terminal, which may lead to a phenomenon of overheating or even burning out of the mobile terminal and decrease the life time of the mobile terminal.

## SUMMARY

Embodiments of the present disclosure provide a quick charging method, a power adapter and a mobile terminal, so as to improve the security in the quick charging process.

In a first aspect, a quick charging method is provided. The method is applied to a power adapter, the power adapter is coupled to a mobile terminal through a universal serial bus (USB) interface, a power line in the USB interface is used by the power adapter to charge the mobile terminal, a data line in the USB interface is used by the power adapter to conduct a bidirectional communication with the mobile terminal, and the power adapter supports a common charging mode and a quick charging mode, in which a charging current of the quick charging mode is greater than that of the common charging mode. The method includes: conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine to charge the mobile terminal in the quick charging mode; and adjusting by the power adapter a charging current to a charging current corresponding to the quick charging mode so as to charge the mobile terminal.

In combination with the first aspect, in an implementation of the first aspect, conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine to charge the mobile terminal in the quick charging mode includes: sending by the power adapter a first instruction to the mobile terminal, in which the first instruction is configured to ask the mobile terminal whether to start the quick charging mode; and receiving by the power adapter a replying instruction of the first instruction from the mobile terminal, in which the replying instruction of the first instruction is configured to indicate that the mobile terminal agrees to start the quick charging mode.

In combination with the first aspect or any one of above implementations, in another implementation of the first aspect, before sending by the power adapter a first instruction to the mobile terminal, the method further includes: performing a charging between the power adapter and the mobile terminal in the common charging mode; in which sending by the power adapter a first instruction to the mobile terminal, includes: after the power adapter determines that a charging time of the common charging mode is larger than a preset threshold, sending by the power adapter the first instruction to the mobile terminal.

In combination with the first aspect or any one of above implementations, in another implementation of the first aspect, before adjusting by the power adapter the charging current to the charging current corresponding to the quick charging mode so as to charge the mobile terminal, the method includes: conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine a charging voltage corresponding to the quick charging mode; and adjusting by the power adapter a charging voltage to the charging voltage corresponding to the quick charging mode.

In combination with the first aspect or any one of above implementations, in another implementation of the first aspect, conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine a charging voltage corresponding to the quick charging mode includes: sending by the power adapter a second instruction to the mobile terminal, in which the second instruction is configured to ask whether a current voltage of the power adapter is suitable as a charging voltage of the quick charging mode; receiving by the power adapter a replying instruction of the second instruction sent by the mobile terminal, in which the replying instruction of the second instruction is configured to indicate that the current voltage of the power adapter is suitable, high or low; and determining by

the power adapter the charging voltage of the quick charging mode according to the replying instruction of the second instruction.

In combination with the first aspect or any one of above implementations, in another implementation of the first aspect, before adjusting by the power adapter the charging current to the charging current corresponding to the quick charging mode so as to charge the mobile terminal, the method includes: conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine the charging current corresponding to the quick charging mode.

In combination with the first aspect or any one of above implementations, in another implementation of the first aspect, conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine the charging current corresponding to the quick charging mode, includes: sending by the power adapter a third instruction to the mobile terminal, in which the third instruction is configured to inquire a maximum charging current supported currently by the mobile terminal; receiving by the power adapter a replying instruction of the third instruction sent by the mobile terminal, in which the replying instruction of the third instruction is configured to indicate the maximum charging current supported currently by the mobile terminal; and determining by the power adapter the charging current of the quick charging mode according to the replying instruction of the third instruction.

In combination with the first aspect or any one of above implementations, in another implementation of the first aspect, the method further includes: in a process that the power adapter charges the mobile terminal in the quick charging mode, conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to adjust the charging current of the power adapter continuously.

In combination with the first aspect or any one of above implementations, in another implementation of the first aspect, conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to adjust the charging current of the power adapter continuously, includes: sending by the power adapter a fourth instruction to the mobile terminal, in which the fourth instruction is configured to inquire a current voltage of a battery in the mobile terminal; receiving by the power adapter a replying instruction of the fourth instruction sent by the mobile terminal, in which the replying instruction of the fourth instruction is configured to indicate the current voltage of the battery in the mobile terminal; and

adjusting by the power adapter the charging current according to the current voltage of the battery.

In combination with the first aspect or any one of above implementations, in another implementation of the first aspect, adjusting by the power adapter the charging current according to the current voltage of the battery, includes: adjusting by the power adapter the charging current of the power adapter to a charging current value corresponding to the current voltage of the battery according to the current voltage of the battery and preset correspondences between battery voltage values and charging current values.

In combination with the first aspect or any one of above implementations, in another implementation of the first aspect, the method also includes: in a process that the power adapter charges the mobile terminal in the quick charging mode, conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine whether a poor contact occurs in the USB interface; and if it is determined that the poor contact occurs in the USB interface, quitting by the power adapter the quick charging mode.

In combination with the first aspect or any one of above implementations, in another implementation of the first aspect, before conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine whether a poor contact occurs in the USB interface, the method further includes: receiving by the power adapter information for indicating a path impedance of the mobile terminal from the mobile terminal; in which conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine whether a poor contact occurs in the USB interface, includes: sending by the power adapter a fourth instruction to the mobile terminal, in which the fourth instruction is configured to inquire a voltage of a battery in the mobile terminal; receiving by the power adapter a replying instruction of the fourth instruction sent by the mobile terminal, in which the replying instruction of the fourth instruction is configured to indicate the voltage of the battery in the mobile terminal; determining by the power adapter a path impedance from the power adapter to the battery according to a charging voltage of the power adapter and the voltage of the battery; and determining by the power adapter whether the poor contact occurs in the USB interface according to the path impedance from the power adapter to the battery, the path impedance of the mobile terminal and a path impedance of a charging circuit between the power adapter and the mobile

terminal.

In combination with the first aspect or any one of above implementations, in another implementation of the first aspect, before quitting by the power adapter the quick charging mode, the method further includes: sending by the power adapter a fifth instruction to the mobile terminal, in which the fifth instruction is configured to indicate that the poor contact occurs in the USB interface.

In a second aspect, a quick charging method is provided. The method is applied to a mobile terminal, the mobile terminal is coupled to a power adapter through a universal serial bus (USB) interface, a power line in the USB interface is configured to charge the mobile terminal, a data line in the USB interface is used by the mobile terminal to conduct a bidirectional communication with the power adapter, and the mobile terminal supports a common charging mode and a quick charging mode, in which a charging current of the quick charging mode is greater than that of the common charging mode. The method includes: conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines to charge the mobile terminal in the quick charging mode; and receiving by the mobile terminal a charging current corresponding to the quick charging mode from the power adapter so as to charge a battery in the mobile terminal.

In combination with the second aspect, in an implementation of the second aspect, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines to charge the mobile terminal in the quick charging mode, includes: receiving by the mobile terminal a first instruction sent by the power adapter, in which the first instruction is configured to ask the mobile terminal whether to start the quick charging mode; and sending by the mobile terminal a replying instruction of the first instruction to the power adapter, in which the replying instruction of the first instruction is configured to indicate that the mobile terminal agrees to start the quick charging mode.

In combination with the second aspect or any one of above implementations, in another implementation of the second aspect, before receiving by the mobile terminal a first instruction sent by the power adapter, the method further includes: performing a charging between the mobile terminal and the power adapter in the common charging mode; in which receiving by the mobile terminal a first instruction sent by the power adapter, includes: after the power adapter determines that a charging time of the common charging mode is larger than a preset threshold, receiving by

the mobile terminal the first instruction sent by the power adapter.

In combination with the second aspect or any one of above implementations, in another implementation of the second aspect, before receiving by the mobile terminal a charging current corresponding to the quick charging mode from the power adapter so as to charge a battery in the mobile terminal, the method includes: conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines a charging voltage corresponding to the quick charging mode.

In combination with the second aspect or any one of above implementations, in another implementation of the second aspect, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines a charging voltage corresponding to the quick charging mode, includes: receiving by the mobile terminal a second instruction sent by the power adapter, in which the second instruction is configured to ask whether a current voltage of the power adapter is suitable as a charging voltage of the quick charging mode; and sending by the mobile terminal a replying instruction of the second instruction to the power adapter, in which the replying instruction of the second instruction is configured to indicate that the current voltage of the power adapter is suitable, high or low.

In combination with the second aspect or any one of above implementations, in another implementation of the second aspect, before receiving by the mobile terminal a charging current corresponding to the quick charging mode from the power adapter so as to charge a battery in the mobile terminal, the method includes: conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines the charging current corresponding to the quick charging mode.

In combination with the second aspect or any one of above implementations, in another implementation of the second aspect, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines the charging current corresponding to the quick charging mode, includes: receiving by the mobile terminal a third instruction sent by the power adapter, in which the third instruction is configured to inquire a maximum charging current supported currently by the mobile terminal; and sending by the mobile terminal a replying instruction of the third instruction to the power adapter, in which the replying instruction of the third instruction is configured to indicate

the maximum charging current supported currently by the mobile terminal, such that the power adapter determines the charging current corresponding to the quick charging mode according to the maximum charging current.

In combination with the second aspect or any one of above implementations, in another implementation of the second aspect, the method further includes: in a process that the power adapter charges the mobile terminal in the quick charging mode, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter adjusts the charging current of the power adapter continuously.

In combination with the second aspect or any one of above implementations, in another implementation of the second aspect, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter adjusts the charging current of the power adapter continuously, includes: receiving by the mobile terminal a fourth instruction sent by the power adapter, in which the fourth instruction is configured to inquire a current voltage of a battery in the mobile terminal; and sending by the mobile terminal a replying instruction of the fourth instruction to the power adapter, in which the replying instruction of the fourth instruction is configured to indicate the current voltage of the battery in the mobile terminal, such that the power adapter adjusts the charging current of the power adapter continuously according to the current voltage of the battery.

In combination with the second aspect or any one of above implementations, in another implementation of the second aspect, the method further includes: in a process that the power adapter charges the mobile terminal in the quick charging mode, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface, such that the power adapter determines whether a poor contact occurs in the USB interface.

In combination with the second aspect or any one of above implementations, in another implementation of the second aspect, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface, such that the mobile terminal determines whether a poor contact occurs in the USB interface, includes: receiving by the mobile terminal a fourth instruction sent by the power adapter, in which the fourth instruction is configured to inquire a current voltage of a battery in the mobile terminal; and

sending by the mobile terminal a replying instruction of the fourth instruction to the power adapter, in which the replying instruction of the fourth instruction is configured to indicate the current voltage of the battery in the mobile terminal, such that the power adapter determines whether the poor contact occurs in the USB interface according to a charging voltage of the power adapter and the current voltage of the battery.

In combination with the second aspect or any one of above implementations, in another implementation of the second aspect, the method further includes: receiving by the mobile terminal a fifth instruction sent by the power adapter, in which the fifth instruction is configured to indicate that the poor contact occurs in the USB interface.

In a third aspect, a power adapter is provided. The power adapter is coupled to a mobile terminal through a universal serial bus (USB) interface, a power line in the USB interface is used by the power adapter to charge the mobile terminal, a data line in the USB interface is used by the power adapter to conduct a bidirectional communication with the mobile terminal, and the power adapter supports a common charging mode and a quick charging mode, in which a charging current of the quick charging mode is greater than that of the common charging mode. The power adapter includes: a communication unit, configured to conduct a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine to charge the mobile terminal in the quick charging mode; and a current adjusting unit, configured to adjust a charging current to a charging current corresponding to the quick charging mode so as to charge the mobile terminal.

In combination with the third aspect, in an implementation of the third aspect, the communication unit is specifically configured to send a first instruction to the mobile terminal, in which the first instruction is configured to ask the mobile terminal whether to start the quick charging mode; and to receive a replying instruction of the first instruction from the mobile terminal, in which the replying instruction of the first instruction is configured to indicate that the mobile terminal agrees to start the quick charging mode.

In combination with the third aspect or any one of above implementations, in another implementation of the third aspect, the power adapter further includes: a power conversion unit, configured to perform a charging with the mobile terminal in the common charging mode; in which the communication unit is specifically configured to send the first instruction to the mobile terminal after it is determined that a charging time of the common charging mode is larger than a

preset threshold.

In combination with the third aspect or any one of above implementations, in another implementation of the third aspect, the communication unit is further configured to conduct a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine a charging voltage corresponding to the quick charging mode; in which the power adapter further includes: a voltage adjusting unit, configured to adjust a charging voltage to the charging voltage corresponding to the quick charging mode.

In combination with the third aspect or any one of above implementations, in another implementation of the third aspect, the communication unit is further configured to: send a second instruction to the mobile terminal, in which the second instruction is configured to ask whether a current voltage of the power adapter is suitable as a charging voltage of the quick charging mode; receive a replying instruction of the second instruction sent by the mobile terminal, in which the replying instruction of the second instruction is configured to indicate that the current voltage of the power adapter is suitable, high or low; and the power adjusting unit is specifically configured to determine the charging voltage of the quick charging mode according to the replying instruction of the second instruction.

In combination with the third aspect or any one of above implementations, in another implementation of the third aspect, the communication unit is specifically configured to conduct a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine the charging current corresponding to the quick charging mode.

In combination with the third aspect or any one of above implementations, in another implementation of the third aspect, the communication unit is specifically configured to send a third instruction to the mobile terminal, in which the third instruction is configured to inquire a maximum charging current supported currently by the mobile terminal; to receive a replying instruction of the third instruction sent by the mobile terminal, in which the replying instruction of the third instruction is configured to indicate the maximum charging current supported currently by the mobile terminal; and to determine the charging current of the quick charging mode according to the replying instruction of the third instruction.

In combination with the third aspect or any one of above implementations, in another implementation of the third aspect, the communication unit is further configured to conduct a bidirectional communication with the mobile terminal through the data line in the USB interface in

a process that the power adapter charges the mobile terminal in the quick charging mode, so as to adjust the charging current of the power adapter continuously.

In combination with the third aspect or any one of above implementations, in another implementation of the third aspect, the communication unit is specifically configured to send a fourth instruction to the mobile terminal, in which the fourth instruction is configured to inquire a current voltage of a battery in the mobile terminal; and to receive a replying instruction of the fourth instruction sent by the mobile terminal, in which the replying instruction of the fourth instruction is configured to indicate the current voltage of the battery in the mobile terminal; and the current adjusting unit is configured to adjust the charging current of the power adapter according to the current voltage of the battery.

In combination with the third aspect or any one of above implementations, in another implementation of the third aspect, the current adjusting unit is specifically configured to adjust the charging current of the power adapter to a charging current value corresponding to the current voltage of the battery according to the current voltage of the battery and preset correspondences between battery voltage values and charging current values.

In combination with the third aspect or any one of above implementations, in another implementation of the third aspect, the communication unit is further configured to conduct a bidirectional communication with the mobile terminal through the data line in the USB interface in a process that the power adapter charges the mobile terminal in the quick charging mode, so as to determine whether a poor contact occurs in the USB interface; and to quit the quick charging mode if it is determined that the poor contact occurs in the USB interface.

In combination with the third aspect or any one of above implementations, in another implementation of the third aspect, the communication unit is specifically configured to receive information for indicating a path impedance of the mobile terminal from the mobile terminal; to receive a replying instruction of the fourth instruction sent by the mobile terminal, in which the replying instruction of the fourth instruction is configured to indicate a voltage of a battery in the mobile terminal; to determine a path impedance from the power adapter to the battery according to a charging voltage of the power adapter and the voltage of the battery; and to determine whether the poor contact occurs in the USB interface according to the path impedance from the power adapter to the battery, the path impedance of the mobile terminal and a path impedance of a charging circuit between the power adapter and the mobile terminal.

In combination with the third aspect or any one of above implementations, in another implementation of the third aspect, the communication unit is further configured to send a fifth instruction to the mobile terminal, in which the fifth instruction is configured to indicate that the poor contact occurs in the USB interface.

In a fourth aspect, a mobile terminal is provided. The mobile terminal is coupled to a power adapter through a universal serial bus (USB) interface, a power line in the USB interface is configured to charge the mobile terminal, a data line in the USB interface is used by the mobile terminal to conduct a bidirectional communication with the power adapter, and the mobile terminal supports a common charging mode and a quick charging mode, in which a charging current of the quick charging mode is greater than that of the common charging mode. The mobile terminal includes: a communication unit, configured to conduct a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines to charge the mobile terminal in the quick charging mode; and a charging unit, configured to receive a charging current corresponding to the quick charging mode from the power adapter so as to charge a battery in the mobile terminal.

In combination with the fourth aspect, in an implementation of the fourth aspect, the communication unit is specifically configured to receive a first instruction sent by the power adapter, in which the first instruction is configured to ask the mobile terminal whether to start the quick charging mode; and to send a replying instruction of the first instruction to the power adapter, in which the replying instruction of the first instruction is configured to indicate that the mobile terminal agrees to start the quick charging mode.

In combination with the fourth aspect or any one of above implementations, in another implementation of the fourth aspect, the charging unit is further configured to perform a charging with the power adapter in the common charging mode; and the communication unit is specifically configured to receive the first instruction sent by the power adapter after the power adapter determines that a charging time of the common charging mode is larger than a preset threshold.

In combination with the fourth aspect or any one of above implementations, in another implementation of the fourth aspect, the communication unit is further configured to conduct a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines a charging voltage corresponding to the quick charging mode.

In combination with the fourth aspect or any one of above implementations, in another implementation of the fourth aspect, the communication unit is specifically configured to receive a second instruction from the power adapter, in which the second instruction is configured to ask whether a current voltage of the power adapter is suitable as a charging voltage of the quick charging mode; and to send a replying instruction of the second instruction to the power adapter, in which the replying instruction of the second instruction is configured to indicate that the current voltage of the power adapter is suitable, high or low.

In combination with the fourth aspect or any one of above implementations, in another implementation of the fourth aspect, the communication unit is further configured to conduct a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines the charging current corresponding to the quick charging mode.

In combination with the fourth aspect or any one of above implementations, in another implementation of the fourth aspect, the communication unit is specifically configured to receive a third instruction sent by the power adapter, in which the third instruction is configured to inquire a maximum charging current supported currently by the mobile terminal; and to send a replying instruction of the third instruction to the power adapter, in which the replying instruction of the third instruction is configured to indicate the maximum charging current supported currently by the mobile terminal, such that the power adapter determines the charging current of the quick charging mode according to the maximum charging current.

In combination with the fourth aspect or any one of above implementations, in another implementation of the fourth aspect, the communication unit is further configured to conduct a bidirectional communication with the power adapter through the data line in the USB interface in a process that the power adapter charges the mobile terminal in the quick charging mode, such that the power adapter adjusts the charging current of the power adapter continuously.

In combination with the fourth aspect or any one of above implementations, in another implementation of the fourth aspect, the communication unit is specifically configured to receive a fourth instruction sent by the power adapter, in which the fourth instruction is configured to inquire a current voltage of a battery in the mobile terminal; and to send a replying instruction of the fourth instruction to the power adapter, in which the replying instruction of the fourth instruction is configured to indicate the current voltage of the battery in the mobile terminal, such

that the power adapter adjusts the charging current of the power adapter continuously according to the current voltage of the battery.

In combination with the fourth aspect or any one of above implementations, in another implementation of the fourth aspect, the communication unit is further configured to conduct a bidirectional communication with the power adapter through the data line in the USB interface in a process that the power adapter charges the mobile terminal in the quick charging mode, such that the power adapter determines whether a poor contact occurs in the USB interface.

In combination with the fourth aspect or any one of above implementations, in another implementation of the fourth aspect, the communication unit is specifically configured to receive a fourth instruction sent by the power adapter, in which the fourth instruction is configured to inquire a current voltage of a battery in the mobile terminal; to send a replying instruction of the fourth instruction to the power adapter, in which the replying instruction of the fourth instruction is configured to indicate the current voltage of the battery in the mobile terminal, such that the power adapter determines whether the poor contact occurs in the USB interface according to a charging voltage of the power adapter and the current voltage of the battery.

In combination with the fourth aspect or any one of above implementations, in another implementation of the fourth aspect, the communication unit is further configured to receive a fifth instruction sent by the power adapter, in which the fifth instruction is configured to indicate that the poor contact occurs in the USB interface.

In embodiments of the present disclosure, the power adapter needs to conduct a bidirectional communication with the mobile terminal and negotiates whether a quick charging mode may be adopted, instead of blindly increasing the output current for performing a quick charging. Compared to the related art, the security in the quick charging process is improved.

## BRIEF DESCRIPTION OF THE DRAWINGS

In order to make the technical solutions of embodiments of the present invention more clearly, the accompanying drawings used in the description of embodiments of the present invention are briefly described hereunder. Obviously, the described drawings are merely some embodiments of present invention. For persons skilled in the art, other drawings may be obtained based on these drawings without any creative work.

Fig. 1 is a schematic flow chart of a quick charging method according to an embodiment of

the present disclosure;

Fig. 2 is a schematic flow chart of a quick charging method according to an embodiment of the present disclosure;

Fig. 3 is a schematic diagram of a process of starting the quick charging according to an embodiment of the present disclosure;

Fig. 4 is a schematic diagram of a quick charging process according to an embodiment of the present disclosure;

Fig. 5 is a schematic block diagram of a power adapter according to an embodiment of the present disclosure; and

Fig. 6 is a schematic block diagram of a mobile terminal according to an embodiment of the present disclosure.

## DETAILED DESCRIPTION

The technical solutions in embodiments of the present invention are hereinafter described clearly and completely with reference to accompanying drawings in embodiments of the present invention. Apparently, embodiments described are a part of embodiments of the present invention, but not all embodiments. All other embodiments obtained by those skilled in the art based on the embodiments in the present invention without creative labor shall fall in the protection scope of the present invention.

Fig. 1 is a schematic flow chart of a quick charging method according to an embodiment of the present disclosure. The method shown in Fig. 1 is applied to a power adapter. The power adapter is coupled to a mobile terminal through a Universal Serial Bus (USB) interface, the USB interface may be a common USB interface or a micro USB interface. A power line in the USB interface is used by the power adapter to charge the mobile terminal, in which the power line in the USB interface may be a VBus line and/or a ground line in the USB interface. A data line in the USB interface is used by the power adapter to conduct a bidirectional communication with the mobile terminal, in which the data line may be a D+ line and/or a D- line in the USB interface, and the bidirectional communication may refer to an information interaction between the power adapter and the mobile terminal. The power adapter supports a common charging mode and a quick charging mode, in which a charging current of the quick charging mode is greater than that of the common charging mode. For example, the charging current of the common charging mode

is generally less than 2.5A, and the charging current of the quick charging mode may be greater than 3A.

The method shown in Fig. 1 includes following acts.

At block 110, the power adapter conducts a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine to charge the mobile terminal in the quick charging mode.

It should be noted that, in a process that the power adapter and the mobile terminal negotiate whether the quick charging mode is adopted for charging the mobile terminal, the power adapter may only keep being coupled to the mobile terminal without performing a charging, or may charge the mobile terminal in the common charging mode, or may charge the mobile terminal with a low current, which is not limited in the present disclosure.

At block 120, the power adapter adjusts charging current to a charging current corresponding to the quick charging mode to charge the mobile terminal.

After determining to charge the mobile terminal in the quick charging mode, the power adapter may adjust the charging current to the charging current corresponding to the quick charging mode directly, or may negotiate with the mobile terminal about the charging current of the quick charging mode. For example, the charging current corresponding to the quick charging mode may be determined according to a current electric quantity of a battery in the mobile terminal.

In an embodiment of the present disclosure, the power adapter needs to conduct a bidirectional communication with the mobile terminal and negotiates whether a quick charging mode may be adopted, instead of blindly increasing the output current for performing a quick charging. Compared to the related art, the security in the quick charging process is improved.

Alternatively, as an embodiment, the act at block 110 may include: sending by the power adapter a first instruction to the mobile terminal, in which the first instruction is configured to ask the mobile terminal whether to start the quick charging mode; receiving by the power adapter a replying instruction of the first instruction from the mobile terminal, in which the replying instruction of the first instruction is configured to indicate that the mobile terminal agrees to start the quick charging mode.

Alternatively, as an embodiment, before the power adapter sends the first instruction to the mobile terminal, the method further includes: performing a charging between the power adapter

and the mobile terminal in the common charging mode. Sending by the power adapter the first instruction to the mobile terminal, includes: after the power adapter determines that a charging time of the common charging mode is larger than a preset threshold, sending by the power adapter the first instruction to the mobile terminal.

It should be understood that, after the power adapter determines that the charging time of the common charging mode is larger than the preset threshold, the power adapter can consider that the mobile terminal has recognized it as a power adapter, and a quick charging inquiry communication can be started.

Alternatively, as an embodiment, sending by the power adapter the first instruction to the mobile terminal, includes: after the power adapter determines that the charging is performed for a preset time period with a charging current larger than or equal to a preset current threshold, sending by the power adapter the first instruction to the mobile terminal.

Alternatively, as an embodiment, before the act at block 120, the method shown in Fig. 1 further includes: conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine a charging voltage corresponding to the quick charging mode; adjusting by the power adapter a charging voltage to the charging voltage corresponding to the quick charging mode.

Alternatively, as an embodiment, the act at block 110 may include: sending by the power adapter a second instruction to the mobile terminal, in which the second instruction is configured to ask whether a current voltage of the power adapter is suitable as a charging voltage of the quick charging mode; receiving by the power adapter a replying instruction of the second instruction sent by the mobile terminal, in which the replying instruction of the second instruction is configured to indicate that the current voltage of the power adapter is suitable, high or low; and determining by the power adapter the charging voltage of the quick charging mode according to the replying instruction of the second instruction.

Alternatively, as an embodiment, before the act at block 120, the method shown in Fig. 1 may further include: conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine the charging current corresponding to the quick charging mode.

Alternatively, as an embodiment, conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to

determine the charging current corresponding to the quick charging mode, may include: sending by the power adapter a third instruction to the mobile terminal, in which the third instruction is configured to inquire a maximum charging current supported currently by the mobile terminal; receiving by the power adapter a replying instruction of the third instruction sent by the mobile terminal, in which the replying instruction of the third instruction is configured to indicate the maximum charging current supported currently by the mobile terminal; and determining by the power adapter the charging current of the quick charging mode according to the replying instruction of the third instruction.

The power adapter may determine the maximum charging current as the charging current of the quick charging mode directly, or set a current which is smaller than the maximum charging current as the charging current.

Alternatively, as an embodiment, the method shown in Fig. 1 may further include: in a process that the power adapter charges the mobile terminal in the quick charging mode, conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface to adjust the charging current of the power adapter continuously.

The power adapter may inquire a current working state of the mobile terminal continually so as to adjust the charging current continuously. For example, the power adapter may inquire a voltage, an electric quantity of the battery, or other information in the mobile terminal.

Alternatively, as an embodiment, conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to adjust the charging current of the power adapter continuously, may include: sending by the power adapter a fourth instruction to the mobile terminal, in which the fourth instruction is configured to inquire a current voltage of a battery in the mobile terminal; receiving by the power adapter a replying instruction of the fourth instruction sent by the mobile terminal, in which the replying instruction of the fourth instruction is configured to indicate the current voltage of the battery in the mobile terminal; adjusting by the power adapter the charging current of the power adapter according to the current voltage of the battery.

Alternatively, as an embodiment, adjusting by the power adapter the charging current of the power adapter according to the current voltage of the battery, includes: adjusting by the power adapter the charging current of the power adapter to a charging current value corresponding to the current voltage of the battery according to the current voltage of the battery and preset

correspondences between battery voltage values and charging current values.

Specifically, the power adapter may pre-store the correspondences between battery voltage values and charging current values.

Alternatively, as an embodiment, the method shown in Fig. 1 may further include: in a process that the power adapter charges the mobile terminal in the quick charging mode, conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine whether a poor contact occurs in the USB interface; if it is determined that the poor contact occurs in the USB interface, quitting by the power adapter the quick charging mode.

Alternatively, as an embodiment, before the power adapter conducts a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine whether the poor contact occurs in the USB interface, the method shown in Fig. 1 may further include: receiving by the power adapter information for indicating a path impedance of the mobile terminal from the mobile terminal. Conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine whether a poor contact occurs in the USB interface, includes: sending by the power adapter a fourth instruction to the mobile terminal, in which the fourth instruction is configured to inquire a voltage of a battery in the mobile terminal; receiving by the power adapter a replying instruction of the fourth instruction sent by the mobile terminal, in which the replying instruction of the fourth instruction is configured to indicate the voltage of the battery in the mobile terminal; determining by the power adapter a path impedance from the power adapter to the battery according to a charging voltage of the power adapter and the voltage of the battery; and determining by the power adapter whether the poor contact occurs in the USB interface according to the path impedance from the power adapter to the battery, the path impedance of the mobile terminal and a path impedance of a charging circuit between the power adapter and the mobile terminal.

The power adapter may pre-record the path impedance 1 of the mobile terminal, for example, since the structures of mobile terminals with a same model number are the same, the path impedances of the mobile terminals may be set as the same value when configuring the factory settings. Similarly, the power adapter may pre-record the path impedance 2 of the charging circuit. When the power adapter acquires the voltage between two ends of the battery in the mobile

terminal, the path impedance 3 of the whole path may be determined according to the voltage drop from the power adapter to each of the two ends of the battery. If path impedance 3 > path impedance 1 + path impedance 2, or path impedance 3 – (path impedance 1 + path impedance 2) > impedance threshold, then it may be considered that a poor contact occurs in the USB interface.

Alternatively, as an embodiment, before the power adapter quits the quick charging mode, the method shown in Fig. 1 may further include: sending by the power adapter a fifth instruction to the mobile terminal, in which the fifth instruction is configured to indicate that a poor contact occurs in the USB interface.

After the fifth instruction is sent, the power adapter quits the quick charging mode or is reset.

Hereinbefore, by referring to Fig. 1, the quick charging method according to embodiments of the present disclosure is described in detail from the aspect of a power adapter. In the following, the quick charging method according to embodiments of the present disclosure will be described from the aspect of a mobile terminal by referring to Fig. 2.

It should be understood that, the interaction between a power adapter and a mobile terminal, related features and functionality described from the mobile terminal side corresponds to the description from the power adapter side. For the sake of simplicity, repetitive description may be omitted properly.

Fig. 2 is a schematic flow chart of a quick charging method according to an embodiment of the present disclosure. The method shown in Fig. 2 is applied to a mobile terminal, the mobile terminal is coupled to a power adapter through a USB interface, a power line in the USB interface is configured to charge the mobile terminal, a data line in the USB interface is used by the mobile terminal to conduct a bidirectional communication with the power adapter, and the mobile terminal supports a common charging mode and a quick charging mode, in which a charging current of the quick charging mode is greater than that of the common charging mode. The method shown in Fig. 2 includes following acts.

At block 210, the mobile terminal conducts a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines to charge the mobile terminal in the quick charging mode.

At block 220, the mobile terminal receives a charging current corresponding to the quick charging mode from the power adapter so as to charge a battery in the mobile terminal.

In embodiments of the present disclosure, the power adapter needs to conduct a bidirectional

communication with the mobile terminal and negotiates whether a quick charging mode may be adopted, instead of blindly increasing the output current for performing a quick charging. Compared to the related art, the security in the quick charging process is improved.

Alternatively, as an embodiment, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines to charge the mobile terminal in the quick charging mode, includes: receiving by the mobile terminal a first instruction sent by the power adapter, in which the first instruction is configured to ask the mobile terminal whether to start the quick charging mode; sending by the mobile terminal a replying instruction of the first instruction to the power adapter, in which the replying instruction of the first instruction is configured to indicate that the mobile terminal agrees to start the quick charging mode.

Alternatively, as an embodiment, before the mobile terminal receives the first instruction sent by the power adapter, the method further includes: performing a charging between the mobile terminal and the power adapter in the common charging mode. Receiving by the mobile terminal a first instruction sent by the power adapter, includes: after the power adapter determines that a charging time of the common charging mode is larger than a preset threshold, receiving by the mobile terminal the first instruction sent by the power adapter.

Alternatively, as an embodiment, before the mobile terminal receives the charging current corresponding to the quick charging mode from the power adapter so as to charge the battery in the mobile terminal, the method includes: conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines a charging voltage corresponding to the quick charging mode.

Alternatively, as an embodiment, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines a charging voltage corresponding to the quick charging mode, includes: receiving by the mobile terminal a second instruction sent by the power adapter, in which the second instruction is configured to ask whether a current voltage of the power adapter is suitable as the charging voltage of the quick charging mode; sending by the mobile terminal a replying instruction of the second instruction to the power adapter, in which the replying instruction of the second instruction is configured to indicate that the current voltage of the power adapter is suitable, high or low.

Alternatively, as an embodiment, before the mobile terminal receives the charging current corresponding to the quick charging mode from the power adapter so as to charge the battery in the mobile terminal, the method includes: conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines the charging current corresponding to the quick charging mode.

Alternatively, as an embodiment, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines the charging current corresponding to the quick charging mode, includes: receiving by the mobile terminal a third instruction sent by the power adapter, in which the third instruction is configured to inquire a maximum charging current supported currently by the mobile terminal; sending by the mobile terminal a replying instruction of the third instruction to the power adapter, in which the replying instruction of the third instruction is configured to indicate the maximum charging current supported currently by the mobile terminal, such that the power adapter determines the charging current corresponding to the quick charging mode according to the maximum charging current.

Alternatively, as an embodiment, the method further includes: in a process that the power adapter charges the mobile terminal in the quick charging mode, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter adjusts the charging current of the power adapter continuously.

Alternatively, as an embodiment, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter adjusts the charging current of the power adapter continuously, includes: receiving by the mobile terminal a fourth instruction sent by the power adapter, in which the fourth instruction is configured to inquire a current voltage of a battery in the mobile terminal; sending by the mobile terminal a replying instruction of the fourth instruction to the power adapter, in which the replying instruction of the fourth instruction is configured to indicate the current voltage of the battery in the mobile terminal, such that the power adapter adjusts the charging current of the power adapter continuously according to the current voltage of the battery.

Alternatively, as an embodiment, the method further includes: in a process that the power adapter charges the mobile terminal in the quick charging mode, conducting by the mobile

terminal a bidirectional communication with the power adapter through the data line in the USB interface, such that the power adapter determines whether a poor contact occurs in the USB interface.

Alternatively, as an embodiment, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface, such that the mobile terminal determines whether a poor contact occurs in the USB interface, includes: receiving by the mobile terminal a fourth instruction sent by the power adapter, in which the fourth instruction is configured to inquire a current voltage of a battery in the mobile terminal; sending by the mobile terminal a replying instruction of the fourth instruction to the power adapter, in which the replying instruction of the fourth instruction is configured to indicate the current voltage of the battery in the mobile terminal, such that the power adapter determines whether the poor contact occurs in the USB interface according to a charging voltage of the power adapter and the current voltage of the battery.

Alternatively, as an embodiment, the method further includes: receiving by the mobile terminal a fifth instruction sent by the power adapter, in which the fifth instruction is configured to indicate that the poor contact occurs in the USB interface.

In combination with specific examples, embodiments of the present disclosure will be described below in more detail. It should be noted that, examples shown in Fig. 3 to Fig. 4 merely help those skilled in the arts for understanding embodiments of the present disclosure, instead of limiting the embodiments of the present disclosure to illustrated specific values or scenarios. Obviously, various equivalent modifications and changes may be made according to the examples shown in Fig. 3 to Fig. 4 by those skilled in the arts, and the modifications or changes shall fall in the protection scope of the present invention.

Fig. 3 is a schematic diagram of a starting process of the quick charging according to an embodiment of the present disclosure.

As illustrated in Fig. 3, the process of starting a flash charging includes five stages.

Stage 1

If the power adapter detects that the output current in a continuous time period T1 is larger than or equal to I2, it is considered that the type recognition of the power adapter performed by the mobile terminal is finished (i.e. a device charging the mobile terminal is recognized as the power adapter, rather than other electric appliances such as a computer, etc.), the communication is

started and instruction 1 is sent to ask the mobile terminal whether to start the quick charging (or flash charging), by the power adapter. If the power adapter receives a reply indicating that the mobile terminal disagrees with the flash charging, the current may be detected repeatedly. If the current is still larger than or equal to I2, the request may be sent again by the power adapter, and that cycle repeats until the mobile terminal provides a reply indicating the mobile terminal agrees to perform the quick charging or until the current no longer satisfies the condition of that the current is larger than or equal to I2. After the mobile terminal agrees to perform the flash charging, the process goes to stage 2.

Stage 2

The power adapter sends instruction 2 to ask the mobile terminal whether the voltage of the power adapter is suitable. If the mobile terminal provides a reply indicating that the voltage is high or low, the voltage is adjusted correspondingly and the mobile terminal is again asked by the power adapter whether the voltage of the power adapter is suitable, and that cycle repeats until the mobile terminal provides a reply indicating the voltage is at a suitable position. And then, the process goes to stage 3.

Stage 3

After the power adapter receives a reply indicating that the voltage of the power adapter is suitable from the mobile terminal, the power adapter sends instruction 3 for inquiring the maximum charging current supported currently by the mobile terminal. And then, the process goes to stage 4.

Stage 4, 5

The power adapter sets the output current with specified values according to the current value replied by the mobile terminal and the process goes to a constant current stage. At the same time, the power adapter sends instruction 4 at regular intervals for inquiring the battery voltage of the mobile terminal, and then it is judged according to the battery voltage whether the USB interface contacts well and whether it is required to decrease the charging current. If the power adapter judges that a poor contact occurs in the USB interface, instruction 5 is sent and a reset operation is performed thereafter.

It should be noted that: 1) in stage 1, when the mobile terminal provides the reply to the instruction 1, a path impedance of terminal may be attached in data of the reply, the path impedance of terminal may be used in stage 5 to judge the connection situation of the USB

interface. 2) In stage 2, a time period from when the power adapter agrees to perform the quick charging to when the voltage of the power adapter is adjusted to a suitable value may be controlled within a certain range, so as to prevent the mobile terminal from being judged as abnormal and stopping the quick charging. 3) In stage 2, when the voltage of the power adapter is adjusted to a value higher than the battery voltage ΔV, the terminal can provide the reply indicating that the voltage is suitable (ΔV may be set as 200~500mA). 4) In stage 4, an increasing speed of the output current may be controlled within a certain range, so as to avoid an abnormal interrupt of the flash charging due to an over-quick increasing speed. 5) In stage 5, the control precision of the current in the constant current mode may be controlled within 5% to the greatest extent. 6) In stage 5, the power adapter detects the path impedance in real time, the impedance of the whole path for the quick charging may be computed by measuring the voltage of the power adapter, the current charging current and the read battery voltage. If the detected path impedance > path impedance of the terminal + impedance of the data line for flash charging, it is considered that a poor contact occurs in the USB interface and the quick charging may be stopped. 7) After starting the quick charging, each interval between communications may be controlled within a certain range, so as to avoid an abnormal interrupt of the quick charging. 8) The termination of the quick charging may be divided into a recoverable type and a non-recoverable type. 1. If the mobile terminal detects that the battery is fully charged or a poor contact occurs in the USB interface during the quick charging stage, the flash charging is stopped and the power adapter may not start the flash charging any more. 2. If there is an abnormal communication between the power adapter and the mobile terminal, the power adapter may stop the quick charging, but the power adapter may re-start the quick charging process thereafter. 3. If the power adapter detects that the battery is abnormal, the quick charging may be stopped, and the quick charging process may be re-started until the battery returns to normal.

Fig. 4 illustrates an example of a quick charging process. The whole process illustrated in Fig. 4 substantially corresponds to the process illustrated in Fig. 3.

As illustrated in Fig. 4, the power adapter is in a DCP mode at beginning, that is, the power adapter is in a D+, D- short circuit mode, and the mobile terminal is charged in a common charging mode. Before sending the first instruction, the power adapter may judge whether the data line is a quick charging data line, which may be implemented in various ways. For example, an identification circuit may be added to the data line, and the power adapter may identify whether

the data line is a quick charging data line by conducting an information interaction with the identification circuit. Additionally, it should be noted that, when there is an abnormal communication or abnormal impedance in the whole quick charging process, the power adapter may quit the quick charging process or be reset.

Hereinbefore, by referring to Fig. 1 to Fig. 4, the quick charging method according to an embodiment of the present disclosure is described in detail. In the following, the power adapter and the mobile terminal according to embodiments of the present disclosure will be described in detail hereinafter with reference to Fig. 5 to Fig. 8.

Fig. 5 is a schematic block diagram of a power adapter according to an embodiment of the present disclosure. The power adapter 500 shown in Fig. 5 can achieve respective act executed by the power adapter in Fig. 1 to Fig. 4, which is not described herein in order to avoid repetition.

Specifically, the power adapter 500 is coupled to a mobile terminal through a USB interface, a power line in the USB interface is used by the power adapter 500 to charge the mobile terminal, a data line in the USB interface is used by the power adapter 500 to conduct a bidirectional communication with the mobile terminal, and the power adapter 500 supports a common charging mode and a quick charging mode, in which a charging current of the quick charging mode is greater than that of the common charging mode. The power adapter 500 includes a communication circuit 510 and a current adjusting circuit 520.

The communication circuit 510 is configured to conduct a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine to charge the mobile terminal in the quick charging mode.

The current adjusting circuit 520 is configured to adjust a charging current to a charging current corresponding to the quick charging mode so as to charge the mobile terminal.

In embodiments of the present disclosure, the power adapter needs to conduct a bidirectional communication with the mobile terminal and negotiates whether a quick charging mode may be adopted, instead of blindly increasing the output current for performing a quick charging. Compared to the related art, the security in the quick charging process is improved.

Alternatively, as an embodiment, the communication circuit 510 is specifically configured to send a first instruction to the mobile terminal, in which the first instruction is configured to ask the mobile terminal whether to start the quick charging mode; and to receive a replying instruction of the first instruction from the mobile terminal, in which the replying instruction of the first

instruction is configured to indicate that the mobile terminal agrees to start the quick charging mode.

Alternatively, as an embodiment, the power adapter 500 further includes a power conversion circuit configured to perform a charging with the mobile terminal in the common charging mode. The communication circuit 510 is specifically configured to send the first instruction to the mobile terminal after determining that a charging time of the common charging mode is larger than a preset threshold.

Alternatively, as an embodiment, the communication circuit 510 is further configured to conduct a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine a charging voltage corresponding to the quick charging mode. The power adapter 500 further includes a voltage adjusting circuit configured to adjust charging voltage to a charging voltage corresponding to the quick charging mode.

Alternatively, as an embodiment, the communication circuit 510 is further configured to send a second instruction to the mobile terminal, in which the second instruction is configured to ask whether a current voltage of the power adapter 500 is suitable as a charging voltage of the quick charging mode; and receive a replying instruction of the second instruction sent by the mobile terminal, in which the replying instruction of the second instruction is configured to indicate that the current voltage of the power adapter 500 is suitable, high or low. The power adjusting circuit is specifically configured to determine the charging voltage of the quick charging mode according to the replying instruction of the second instruction.

Alternatively, as an embodiment, the communication circuit 510 is specifically configured to conduct a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine a charging current corresponding to the quick charging mode.

Alternatively, as an embodiment, the communication circuit 510 is specifically configured to send a third instruction to the mobile terminal, in which the third instruction is configured to inquire the maximum charging current supported currently by the mobile terminal; to receive a replying instruction of the third instruction sent by the mobile terminal, in which the replying instruction of the third instruction is configured to indicate the maximum charging current supported currently by the mobile terminal; and to determine the charging current of the quick charging mode according to the replying instruction of the third instruction.

Alternatively, as an embodiment, the communication circuit 510 is further configured to

conduct a bidirectional communication with the mobile terminal through the data line in the USB interface in a process that the power adapter 500 charges the mobile terminal in the quick charging mode, so as to adjust the charging current of the power adapter 500 continuously.

Alternatively, as an embodiment, the communication circuit 510 is specifically configured to send a fourth instruction to the mobile terminal, in which the fourth instruction is configured to inquire a current voltage of the battery in the mobile terminal; and to receive a replying instruction of the fourth instruction sent by the mobile terminal, in which the replying instruction of the fourth instruction is configured to indicate the current voltage of the battery in the mobile terminal. The current adjusting circuit 520 is configured to adjust the charging current of the power adapter according to the current voltage of the battery.

Alternatively, as an embodiment, the current adjusting circuit 520 is specifically configured to adjust the charging current of the power adapter 500 to a charging current value corresponding to the current voltage of the battery according to the current voltage of the battery and preset correspondences between battery voltage values and charging current values.

Alternatively, as an embodiment, the communication circuit 510 is specifically configured to conduct a bidirectional communication with the mobile terminal through the data line in the USB interface in a process that the power adapter charges the mobile terminal in the quick charging mode, so as to determine whether a poor contact occurs in the USB interface; and to quit the quick charging mode if it is determined that the poor contact occurs in the USB interface.

Alternatively, as an embodiment, the communication circuit 510 is specifically configured to receive information for indicating a path impedance of the mobile terminal from the mobile terminal; to receive a replying instruction of the fourth instruction sent by the mobile terminal, in which the replying instruction of the fourth instruction is configured to indicate the voltage of the battery in the mobile terminal; to determine a path impedance from the power adapter 500 to the battery according to the charging voltage of the power adapter 500 and the voltage of the battery; and to determine whether the poor contact occurs in the USB interface according to the path impedance from the power adapter 500 to the battery, the path impedance of the mobile terminal and a path impedance of a charging line between the power adapter 500 and the mobile terminal.

Alternatively, as an embodiment, the communication circuit 510 is further configured to send a fifth instruction to the mobile terminal, in which the fifth instruction is configured to indicate that the poor contact occurs in the USB interface.

Fig. 6 is a schematic block diagram of a mobile terminal according to an embodiment of the present disclosure. The mobile terminal 600 illustrated in Fig. 6 is coupled to a power adapter through a USB interface, a power line in the USB interface is configured to charge the mobile terminal 600, a data line in the USB interface is used by the mobile terminal 600 to conduct a bidirectional communication with the power adapter, and the mobile terminal 600 supports a common charging mode and a quick charging mode, in which a charging current of the quick charging mode is greater than that of the common charging mode. The mobile terminal 600 includes a communication circuit 610 and a charging circuit 620.

The communication circuit 610 is configured to conduct a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines to charge the mobile terminal 600 in the quick charging mode.

The charging circuit 620 is configured to receive a charging current corresponding to the quick charging mode from the power adapter so as to charge a battery in the mobile terminal 600.

In embodiments of the present disclosure, the power adapter needs to conduct a bidirectional communication with the mobile terminal and negotiates whether a quick charging mode may be adopted, instead of blindly increasing the output current for conducting a quick charging. Compared to the related art, the security in the quick charging process is improved.

Alternatively, as an embodiment, the communication circuit 610 is specifically configured to receive a first instruction sent by the power adapter, in which the first instruction is configured to ask the mobile terminal 600 whether to start the quick charging mode; and to send a replying instruction of the first instruction to the power adapter, in which the replying instruction of the first instruction is configured to indicate that the mobile terminal 600 agrees to start the quick charging mode.

Alternatively, as an embodiment, the charging circuit 620 is further configured to perform a charging with the power adapter in the common charging mode. The communication circuit 610 is specifically configured to receive the first instruction sent by the power adapter after the power adapter determines that a charging time of the common charging mode is larger than a preset threshold.

Alternatively, as an embodiment, the communication circuit 610 is further configured to conduct a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines a charging voltage corresponding to the quick

charging mode.

Alternatively, as an embodiment, the communication circuit 610 is specifically configured to receive a second instruction sent by the power adapter, in which the second instruction is configured to ask whether a current voltage of the power adapter is suitable as a charging voltage of the quick charging mode; and to send a replying instruction of the second instruction to the power adapter, in which the replying instruction of the second instruction is configured to indicate that the current voltage of the power adapter is suitable, high or low.

Alternatively, as an embodiment, the communication circuit 610 is further configured to conduct a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines the charging current corresponding to the quick charging mode.

Alternatively, as an embodiment, the communication circuit 610 is specifically configured to receive a third instruction sent by the power adapter, in which the third instruction is configured to inquire a maximum charging current supported currently by the mobile terminal 600; and to send a replying instruction of the third instruction to the power adapter, in which the replying instruction of the third instruction is configured to indicate the maximum charging current supported currently by the mobile terminal 600, such that the power adapter determines the charging current corresponding to the quick charging mode according to the maximum charging current.

Alternatively, as an embodiment, the communication circuit 610 is further configured to conduct a bidirectional communication with the power adapter through the data line in the USB interface in a process that the power adapter charges the mobile terminal 600 in the quick charging mode, such that the power adapter adjusts the charging current of the power adapter continuously.

Alternatively, as an embodiment, the communication circuit 610 is specifically configured to receive a fourth instruction sent by the power adapter, in which the fourth instruction is configured to inquire a current voltage of a battery in the mobile terminal 600; and to send a replying instruction of the fourth instruction to the power adapter, in which the replying instruction of the fourth instruction is configured to indicate the current voltage of the battery in the mobile terminal 600, such that the power adapter adjusts the charging current of the power adapter continuously according to the current voltage of the battery.

Alternatively, as an embodiment, the communication circuit 610 is further configured to conduct a bidirectional communication with the power adapter through the data line in the USB

interface in a process that the power adapter charges the mobile terminal 600 in the quick charging mode, such that the power adapter determines whether a poor contact occurs in the USB interface.

Alternatively, as an embodiment, the communication circuit 610 is specifically configured to receive a fourth instruction sent by the power adapter, in which the fourth instruction is configured to inquire a current voltage of a battery in the mobile terminal 600; to send a replying instruction of the fourth instruction to the power adapter, in which the replying instruction of the fourth instruction is configured to indicate the current voltage of the battery in the mobile terminal 600, such that the power adapter determines whether the poor contact occurs in the USB interface according to the charging voltage of the power adapter and the current voltage of the battery.

Alternatively, as an embodiment, the communication circuit 610 is further configured to receive a fifth instruction sent by the power adapter, in which the fifth instruction is configured to indicate that the poor contact occurs in the USB interface.

Those skilled in the art can be aware that, units and algorithm steps in respective examples described with reference to embodiments disclosed in the present disclosure can be realized by electronic hardware or combination of computer software and electronic hardware. Executing these functions in hardware or software depends on particular applications and design constraint conditions of the technical solutions. Technology professionals can use different methods to realize the described functions for each particular application, which should be regarded as being within the scope of the present disclosure.

Those skilled in the art can understand clearly that, for convenience and simplicity of description, specific working process of the above system, devices and units may refer to corresponding process in the above method embodiments, which will not be elaborated herein.

It should be understood that, the system, devices and method disclosed in several embodiments provided by the present disclosure can be realized in any other manner. For example, the device embodiments described above can be merely exemplary, for example, the units are just divided according to logic functions. In practical implementation, the units can be divided in other manners, for example, multiple units or components can be combined or integrated into another system, or some features can be omitted or not executed. In addition, the mutual coupling or direct coupling or communication connection described or discussed can be via some interfaces, and indirect coupling or communication connection between devices or units may be electrical, mechanical or of other forms.

The units illustrated as separate components can be or not be separated physically, and

components described as units can be or not be physical units, i.e., can be located at one place, or can be distributed onto multiple network units. It is possible to select some or all of the units according to actual needs, for realizing the objective of embodiments of the present disclosure.

In addition, respective functional units in respective embodiments of the present disclosure can be integrated into one processing unit, or can be present as separate physical entities. It is also possible that two or more than two units are integrated into one unit.

If the functions are realized in form of functional software units and are sold or used as separate products, they can be stored in a computer readable storage medium. Based on this understanding, the parts of the technical solutions or the essential parts of the technical solutions (i.e. the parts making a contribution to the related art) can be embodied in form of software product, which is stored in a storage medium, and includes several instruction used for causing a computer device (for example, a personal computer, a server or a network device) to execute all or part of steps in the methods described in respective embodiments of the present disclosure. The above storage medium may be any medium capable of storing program codes, including a USB flash disk, a mobile hard disk, a Read-Only Memory (ROM), a Random Access Memory (RAM), a disc, or a light disk.

The forgoing description is only directed to preferred embodiments of the present disclosure, but not used to limit the present disclosure. All modifications, equivalents, variants and improvements made within the spirit and principle of the present disclosure shall fall within the protection scope of the present disclosure. Thus, the protection scope of the present disclosure shall be limited by the protection scope of the claims.

**WHAT IS CLAIMED IS:**

1. A quick charging method, being characterized at that, the method is applied to a power adapter, the power adapter is coupled to a mobile terminal through a universal serial bus (USB) interface, a power line in the USB interface is used by the power adapter to charge the mobile terminal, a data line in the USB interface is used by the power adapter to conduct a bidirectional communication with the mobile terminal, and the power adapter supports a common charging mode and a quick charging mode, wherein a charging current of the quick charging mode is greater than that of the common charging mode; the method comprises:

conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine to charge the mobile terminal in the quick charging mode; and

adjusting by the power adapter a charging current to a charging current corresponding to the quick charging mode so as to charge the mobile terminal.

2. The method according to claim 1, being characterized at that, conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine to charge the mobile terminal in the quick charging mode comprises:

sending by the power adapter a first instruction to the mobile terminal, wherein the first instruction is configured to ask the mobile terminal whether to start the quick charging mode; and

receiving by the power adapter a replying instruction of the first instruction from the mobile terminal, wherein the replying instruction of the first instruction is configured to indicate that the mobile terminal agrees to start the quick charging mode.

3. The method according to claim 2, being characterized at that, before sending by the power adapter a first instruction to the mobile terminal, the method further comprises:

performing a charging between the power adapter and the mobile terminal in the common charging mode;

wherein sending by the power adapter a first instruction to the mobile terminal, comprises:

after the power adapter determines that a charging time of the common charging mode is larger than a preset threshold, sending by the power adapter the first instruction to the mobile terminal.

4. The method according to any of claims 1-3, being characterized at that, before adjusting by the power adapter the charging current to the charging current corresponding to the quick charging mode so as to charge the mobile terminal, the method comprises:

conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine a charging voltage corresponding to the quick charging mode; and

adjusting by the power adapter a charging voltage to the charging voltage corresponding to the quick charging mode.

5. The method according to claim 4, being characterized at that, conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine a charging voltage corresponding to the quick charging mode comprises:

sending by the power adapter a second instruction to the mobile terminal, wherein the second instruction is configured to ask whether a current voltage of the power adapter is suitable as a charging voltage of the quick charging mode;

receiving by the power adapter a replying instruction of the second instruction sent by the mobile terminal, wherein the replying instruction of the second instruction is configured to indicate that the current voltage of the power adapter is suitable, high or low; and

determining by the power adapter the charging voltage of the quick charging mode according to the replying instruction of the second instruction.

6. The method according to any of claims 1-5, being characterized at that, before adjusting by the power adapter the charging current to the charging current corresponding to the quick charging mode so as to charge the mobile terminal, the method comprises:

conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine the charging current corresponding to the quick charging mode.

7. The method according to claim 6, being characterized at that, conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine the charging current corresponding to the quick charging mode comprises:

sending by the power adapter a third instruction to the mobile terminal, wherein the third

instruction is configured to inquire a maximum charging current supported currently by the mobile terminal;

receiving by the power adapter a replying instruction of the third instruction sent by the mobile terminal, wherein the replying instruction of the third instruction is configured to indicate the maximum charging current supported currently by the mobile terminal; and

determining by the power adapter the charging current of the quick charging mode according to the replying instruction of the third instruction.

8. The method according to any of claims 1-7, being characterized at, further comprising:

in a process that the power adapter charges the mobile terminal in the quick charging mode, conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to adjust the charging current of the power adapter continuously.

9. The method according to claim 8, being characterized at that, conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to adjust the charging current of the power adapter continuously comprises:

sending by the power adapter a fourth instruction to the mobile terminal, wherein the fourth instruction is configured to inquire a current voltage of a battery in the mobile terminal;

receiving by the power adapter a replying instruction of the fourth instruction sent by the mobile terminal, wherein the replying instruction of the fourth instruction is configured to indicate the current voltage of the battery in the mobile terminal; and

adjusting by the power adapter the charging current according to the current voltage of the battery.

10. The method according to claim 9, being characterized at that, adjusting by the power adapter the charging current according to the current voltage of the battery comprises:

adjusting by the power adapter the charging current of the power adapter to a charging current value corresponding to the current voltage of the battery according to the current voltage of the battery and preset correspondences between battery voltage values and charging current values.

11. The method according to any of claims 1-10, being characterized at, further comprising:

in a process that the power adapter charges the mobile terminal in the quick charging mode, conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine whether a poor contact occurs in the USB

interface; and

if it is determined that the poor contact occurs in the USB interface, quitting by the power adapter the quick charging mode.

12. The method according to claim 11, being characterized at that, before conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine whether a poor contact occurs in the USB interface, the method further comprises:

receiving by the power adapter information for indicating a path impedance of the mobile terminal from the mobile terminal;

wherein conducting by the power adapter a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine whether a poor contact occurs in the USB interface, comprises:

sending by the power adapter a fourth instruction to the mobile terminal, wherein the fourth instruction is configured to inquire a voltage of a battery in the mobile terminal;

receiving by the power adapter a replying instruction of the fourth instruction sent by the mobile terminal, wherein the replying instruction of the fourth instruction is configured to indicate the voltage of the battery in the mobile terminal;

determining by the power adapter a path impedance from the power adapter to the battery according to a charging voltage of the power adapter and the voltage of the battery; and

determining by the power adapter whether the poor contact occurs in the USB interface according to the path impedance from the power adapter to the battery, the path impedance of the mobile terminal and a path impedance of a charging circuit between the power adapter and the mobile terminal.

13. The method according to claim 11 or 12, being characterized at that, before quitting by the power adapter the quick charging mode, the method further comprises:

sending by the power adapter a fifth instruction to the mobile terminal, wherein the fifth instruction is configured to indicate that the poor contact occurs in the USB interface.

14. A quick charging method, being characterized at that, the method is applied to a mobile terminal, the mobile terminal is coupled to a power adapter through a universal serial bus (USB) interface, a power line in the USB interface is configured to charge the mobile terminal, a data line in the USB interface is used by the mobile terminal to conduct a bidirectional communication with

the power adapter, and the mobile terminal supports a common charging mode and a quick charging mode, in which a charging current of the quick charging mode is greater than that of the common charging mode; the method comprises:

conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface, such that the power adapter determines to charge the mobile terminal in the quick charging mode; and

receiving by the mobile terminal a charging current corresponding to the quick charging mode from the power adapter so as to charge a battery in the mobile terminal.

15. The method according to claim 14, being characterized at that, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines to charge the mobile terminal in the quick charging mode comprises:

receiving by the mobile terminal a first instruction sent by the power adapter, wherein the first instruction is configured to ask the mobile terminal whether to start the quick charging mode; and

sending by the mobile terminal a replying instruction of the first instruction to the power adapter, wherein the replying instruction of the first instruction is configured to indicate that the mobile terminal agrees to start the quick charging mode.

16. The method according to claim 15, being characterized at that, before receiving by the mobile terminal a first instruction sent by the power adapter, the method further comprises:

performing a charging between the mobile terminal and the power adapter in the common charging mode;

wherein receiving by the mobile terminal a first instruction sent by the power adapter, comprises:

after the power adapter determines that a charging time of the common charging mode is larger than a preset threshold, receiving by the mobile terminal the first instruction sent by the power adapter.

17. The method according to any of claims 14-16, being characterized at that, before receiving by the mobile terminal a charging current corresponding to the quick charging mode from the power adapter so as to charge a battery in the mobile terminal, the method comprises:

conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface, such that the power adapter determines a charging

voltage corresponding to the quick charging mode.

18. The method according to claim 17, being characterized at that, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines a charging voltage corresponding to the quick charging mode comprises:

receiving by the mobile terminal a second instruction sent by the power adapter, wherein the second instruction is configured to ask whether a current voltage of the power adapter is suitable as a charging voltage of the quick charging mode; and

sending by the mobile terminal a replying instruction of the second instruction to the power adapter, wherein the replying instruction of the second instruction is configured to indicate that the current voltage of the power adapter is suitable, high or low.

19. The method according to any of claims 14-18, being characterized at that, before receiving by the mobile terminal a charging current corresponding to the quick charging mode from the power adapter so as to charge a battery in the mobile terminal, the method comprises:

conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface, such that the power adapter determines the charging current corresponding to the quick charging mode.

20. The method according to claim 19, being characterized at that, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines the charging current corresponding to the quick charging mode comprises:

receiving by the mobile terminal a third instruction sent by the power adapter, wherein the third instruction is configured to inquire a maximum charging current supported currently by the mobile terminal; and

sending by the mobile terminal a replying instruction of the third instruction to the power adapter, wherein the replying instruction of the third instruction is configured to indicate the maximum charging current supported currently by the mobile terminal, such that the power adapter determines the charging current corresponding to the quick charging mode according to the maximum charging current.

21. The method according to any of claims 14-20, being characterized at, further comprising:

in a process that the power adapter charges the mobile terminal in the quick charging mode,

conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter adjusts the charging current of the power adapter continuously.

22. The method according to claim 21, being characterized at that, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter adjusts the charging current of the power adapter continuously comprises:

receiving by the mobile terminal a fourth instruction sent by the power adapter, wherein the fourth instruction is configured to inquire a current voltage of a battery in the mobile terminal; and

sending by the mobile terminal a replying instruction of the fourth instruction to the power adapter, wherein the replying instruction of the fourth instruction is configured to indicate the current voltage of the battery in the mobile terminal, such that the power adapter adjusts the charging current of the power adapter continuously according to the current voltage of the battery.

23. The method according to any of claims 14-22, being characterized at, further comprising:

in a process that the power adapter charges the mobile terminal in the quick charging mode, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface, such that the power adapter determines whether a poor contact occurs in the USB interface.

24. The method according to claim 23, being characterized at that, conducting by the mobile terminal a bidirectional communication with the power adapter through the data line in the USB interface, such that the mobile terminal determines whether a poor contact occurs in the USB interface comprises:

receiving by the mobile terminal a fourth instruction sent by the power adapter, wherein the fourth instruction is configured to inquire a current voltage of a battery in the mobile terminal; and

sending by the mobile terminal a replying instruction of the fourth instruction to the power adapter, wherein the replying instruction of the fourth instruction is configured to indicate the current voltage of the battery in the mobile terminal, such that the power adapter determines whether the poor contact occurs in the USB interface according to a charging voltage of the power adapter and the current voltage of the battery.

25. The method according to claim 24, being characterized at, further comprising:

receiving by the mobile terminal a fifth instruction sent by the power adapter, wherein the

fifth instruction is configured to indicate that the poor contact occurs in the USB interface.

26. A power adapter, being characterized at that, the power adapter is coupled to a mobile terminal through a universal serial bus (USB) interface, a power line in the USB interface is used by the power adapter to charge the mobile terminal, a data line in the USB interface is used by the power adapter to conduct a bidirectional communication with the mobile terminal, and the power adapter supports a common charging mode and a quick charging mode, in which a charging current of the quick charging mode is greater than that of the common charging mode; the power adapter comprises:

a communication unit, configured to conduct a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine to charge the mobile terminal in the quick charging mode; and

a current adjusting unit, configured to adjust a charging current to a charging current corresponding to the quick charging mode so as to charge the mobile terminal.

27. The power adapter according to claim 26, being characterized at that, the communication unit is specifically configured to send a first instruction to the mobile terminal, wherein the first instruction is configured to ask the mobile terminal whether to start the quick charging mode; and to receive a replying instruction of the first instruction from the mobile terminal, wherein the replying instruction of the first instruction is configured to indicate that the mobile terminal agrees to start the quick charging mode.

28. The power adapter according to claim 27, being characterized at, further comprising:

a power conversion unit, configured to perform a charging with the mobile terminal in the common charging mode;

wherein the communication unit is specifically configured to send the first instruction to the mobile terminal after it is determined that a charging time of the common charging mode is larger than a preset threshold.

29. The power adapter according to any of claims 26-28, being characterized at that, the communication unit is further configured to conduct a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine a charging voltage corresponding to the quick charging mode;

wherein the power adapter further comprises:

a voltage adjusting unit, configured to adjust a charging voltage to the charging voltage

corresponding to the quick charging mode.

30. The power adapter according to claim 29, being characterized at that, the communication unit is further configured to send a second instruction to the mobile terminal, wherein the second instruction is configured to ask whether a current voltage of the power adapter is suitable as a charging voltage of the quick charging mode; to receive a replying instruction of the second instruction sent by the mobile terminal, wherein the replying instruction of the second instruction is configured to indicate that the current voltage of the power adapter is suitable, high or low; and the power adjusting unit is specifically configured to determine the charging voltage of the quick charging mode according to the replying instruction of the second instruction.

31. The power adapter according to any of claims 26-30, being characterized at that, the communication unit is specifically configured to conduct a bidirectional communication with the mobile terminal through the data line in the USB interface so as to determine the charging current corresponding to the quick charging mode.

32. The power adapter according to claim 31, being characterized at that, the communication unit is specifically configured to send a third instruction to the mobile terminal, wherein the third instruction is configured to inquire a maximum charging current supported currently by the mobile terminal; to receive a replying instruction of the third instruction sent by the mobile terminal, wherein the replying instruction of the third instruction is configured to indicate the maximum charging current supported currently by the mobile terminal; and to determine the charging current of the quick charging mode according to the replying instruction of the third instruction.

33. The power adapter according to any of claims 26-32, being characterized at that, the communication unit is further configured to conduct a bidirectional communication with the mobile terminal through the data line in the USB interface in a process that the power adapter charges the mobile terminal in the quick charging mode, so as to adjust the charging current of the power adapter continuously.

34. The power adapter according to claim 33, being characterized at that, the communication unit is specifically configured to send a fourth instruction to the mobile terminal, wherein the fourth instruction is configured to inquire a current voltage of a battery in the mobile terminal; and to receive a replying instruction of the fourth instruction sent by the mobile terminal, wherein the replying instruction of the fourth instruction is configured to indicate the current voltage of the battery in the mobile terminal; and the current adjusting unit is configured to adjust the charging

current of the power adapter according to the current voltage of the battery.

35. The power adapter according to claim 34, being characterized at that, the current adjusting unit is specifically configured to adjust the charging current of the power adapter to a charging current value corresponding to the current voltage of the battery according to the current voltage of the battery and preset correspondences between battery voltage values and charging current values.

36. The power adapter according to any of claims 26-35, being characterized at that, the communication unit is further configured to conduct a bidirectional communication with the mobile terminal through the data line in the USB interface in a process that the power adapter charges the mobile terminal in the quick charging mode, so as to determine whether a poor contact occurs in the USB interface; and to quit the quick charging mode if it is determined that the poor contact occurs in the USB interface.

37. The power adapter according to claim 36, being characterized at that, the communication unit is specifically configured to receive information for indicating a path impedance of the mobile terminal from the mobile terminal; to receive a replying instruction of the fourth instruction sent by the mobile terminal, wherein the replying instruction of the fourth instruction is configured to indicate a voltage of a battery in the mobile terminal; to determine a path impedance from the power adapter to the battery according to a charging voltage of the power adapter and the voltage of the battery; and to determine whether the poor contact occurs in the USB interface according to the path impedance from the power adapter to the battery, the path impedance of the mobile terminal and a path impedance of a charging circuit between the power adapter and the mobile terminal.

38. The power adapter according to claim 36 or 37, being characterized at that, the communication unit is further configured to send a fifth instruction to the mobile terminal, wherein the fifth instruction is configured to indicate that the poor contact occurs in the USB interface.

39. A mobile terminal, being characterized at that, the mobile terminal is coupled to a power adapter through a universal serial bus (USB) interface, a power line in the USB interface is configured to charge the mobile terminal, a data line in the USB interface is used by the mobile terminal to conduct a bidirectional communication with the power adapter, and the mobile terminal supports a common charging mode and a quick charging mode, in which a charging current of the quick charging mode is greater than that of the common charging mode; the mobile terminal comprises:

a communication unit, configured to conduct a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines to charge the mobile terminal in the quick charging mode; and

a charging unit, configured to receive a charging current corresponding to the quick charging mode from the power adapter so as to charge a battery in the mobile terminal.

40. The mobile terminal according to claim 39, being characterized at that, the communication unit is specifically configured to receive a first instruction sent by the power adapter, wherein the first instruction is configured to ask the mobile terminal whether to start the quick charging mode; and to send a replying instruction of the first instruction to the power adapter, wherein the replying instruction of the first instruction is configured to indicate that the mobile terminal agrees to start the quick charging mode.

41. The mobile terminal according to claim 40, being characterized at that, the charging unit is further configured to perform a charging with the power adapter in the common charging mode;

and the communication unit is specifically configured to receive the first instruction sent by the power adapter after the power adapter determines that a charging time of the common charging mode is larger than a preset threshold.

42. The mobile terminal according to any of claims 39-41, being characterized at that, the communication unit is further configured to conduct a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines a charging voltage corresponding to the quick charging mode.

43. The mobile terminal according to claim 42, being characterized at that, the communication unit is specifically configured to receive a second instruction sent by the power adapter, wherein the second instruction is configured to ask whether a current voltage of the power adapter is suitable as a charging voltage of the quick charging mode; and to send a replying instruction of the second instruction to the power adapter, wherein the replying instruction of the second instruction is configured to indicate that the current voltage of the power adapter is suitable, high or low.

44. The mobile terminal according to any of claims 39-43, being characterized at that, the communication unit is further configured to conduct a bidirectional communication with the power adapter through the data line in the USB interface such that the power adapter determines the charging current corresponding to the quick charging mode.

45. The mobile terminal according to claim 44, being characterized at that, the communication unit is specifically configured to receive a third instruction sent by the power adapter, wherein the third instruction is configured to inquire a maximum charging current supported currently by the mobile terminal; and to send a replying instruction of the third instruction to the power adapter, wherein the replying instruction of the third instruction is configured to indicate the maximum charging current supported currently by the mobile terminal, such that the power adapter determines the charging current of the quick charging mode according to the maximum charging current.

46. The mobile terminal according to any of claims 39-45, being characterized at that, the communication unit is further configured to conduct a bidirectional communication with the power adapter through the data line in the USB interface in a process that the power adapter charges the mobile terminal in the quick charging mode, such that the power adapter adjusts the charging current of the power adapter continuously.

47. The mobile terminal according to claim 46, being characterized at that, the communication unit is specifically configured to receive a fourth instruction sent by the power adapter, wherein the fourth instruction is configured to inquire a current voltage of a battery in the mobile terminal; and to send a replying instruction of the fourth instruction to the power adapter, wherein the replying instruction of the fourth instruction is configured to indicate the current voltage of the battery in the mobile terminal, such that the power adapter adjusts the charging current of the power adapter continuously according to the current voltage of the battery.

48. The mobile terminal according to any of claims 39-47, being characterized at that, the communication unit is further configured to conduct a bidirectional communication with the power adapter through the data line in the USB interface in a process that the power adapter charges the mobile terminal in the quick charging mode, such that the power adapter determines whether a poor contact occurs in the USB interface.

49. The mobile terminal according to claim 48, being characterized at that, the communication unit is specifically configured to receive a fourth instruction sent by the power adapter, wherein the fourth instruction is configured to inquire a current voltage of a battery in the mobile terminal; to send a replying instruction of the fourth instruction to the power adapter, wherein the replying instruction of the fourth instruction is configured to indicate the current voltage of the battery in the mobile terminal, such that the power adapter determines whether the

poor contact occurs in the USB interface according to a charging voltage of the power adapter and the current voltage of the battery.

50. The mobile terminal according to claim 49, being characterized at that, the communication unit is further configured to receive a fifth instruction sent by the power adapter, wherein the fifth instruction is configured to indicate that the poor contact occurs in the USB interface.