

(19) **DANMARK**

(10) **DK/EP 3442093 T3**



Patent- og  
Varemærkestyrelsen

(12) Oversættelse af  
europæisk patentskrift

- 
- (51) Int.Cl.: **H 02 J 7/00 (2006.01)** **H 01 M 10/44 (2006.01)** **H 02 J 7/04 (2006.01)**
- (45) Oversættelsen bekendtgjort den: **2019-12-16**
- (80) Dato for Den Europæiske Patentmyndigheds bekendtgørelse om meddelelse af patentet: **2019-10-23**
- (86) Europæisk ansøgning nr.: **18198005.3**
- (86) Europæisk indleveringsdag: **2015-03-27**
- (87) Den europæiske ansøgnings publiceringsdag: **2019-02-13**
- (62) Stamansøgningsnr: **15886806.7**
- (84) Designerede stater: **AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**
- (73) Patenthaver: **GUANGDONG OPPO MOBILE TELECOMMUNICATIONS CORP., LTD., No.18, Haibin Road , Wusha , Chang'an, Dongguan, Guangdong 523860, Kina**
- (72) Opfinder: **ZHANG, Jialiang, c/o GUANGDONG OPPO MOBILE TELECOMMUNICATIONS, CORP., LTD., No. 18 Haibin Road, Wusha, Chang'an, Dongguan, Guangdong 523860, Kina**
- (74) Fuldmægtig i Danmark: **Novagraaf Brevets, Bâtiment O2, 2 rue Sarah Bernhardt CS90017, F-92665 Asnières-sur-Seine cedex, Frankrig**
- (54) Benævnelse: **OPLADNINGSSSTYREANORDNING OG STRØMADAPTER**
- (56) Fremdragne publikationer:  
**CN-U- 203 445 596**  
**US-A1- 2009 195 237**  
**US-A1- 2011 204 849**  
**US-A1- 2012 212 179**  
**US-B1- 8 981 731**



# DESCRIPTION

## TECHNICAL FIELD

**[0001]** The present disclosure relates to charging technology, and particularly to a charging control device and a power adapter.

## BACKGROUND

**[0002]** Electronic equipments such as mobile phones are usually equipped with a rechargeable battery that can be charged through a power adapter.

**[0003]** Upon charging, the power adapter converts alternating current (AC) to direct current (DC) with specified voltage and supplies DC to electronic equipments. In the power adapter and the electronic equipment, an electronic interface is typically provided respectively. Electrical connection with a charging cable can be achieved through the electronic interface, whereby the electronic equipment can be charged through the charging cable.

**[0004]** Electrical connection between electronic interfaces is achieved via contact of a metal contact sheet. Because of thermal effects of resistance, heat is generated at the metal contact sheet when charging current flows through. Too large charging current or charging voltage may cause high temperature of the electronic interface; in such a condition, device damage or even an explosion may occur, which seriously affect the security of charging.

US 8,981,731 B1 relates to a charger and electronic apparatus system, in which a charger cable of charging an electronic apparatus includes a charger main body having a power output unit which output charging power, a connection unit which is attached to the charger main body, which is configured to be connected to the electronic apparatus, and which is configured to supply the charging power from the power output unit to the electronic apparatus in a state that the connection unit is connected to the electronic apparatus, and a temperature sensor which is provided in the connection unit, and which is configured to detect a temperature in the vicinity of the connection unit.

## SUMMARY

**[0005]** In view of this, the present disclosure provides a charging control method, a charging control device, and a power adapter that can improve the security of charging.

**[0006]** According to a first aspect of the present disclosure, it is provided a charging control device. The charging control device is deployed in a power adapter used for charging of an electronic equipment through a charging cable, and includes: at least one first temperature

measuring unit, configured to measure a temperature of a first charging interface, the first charging interface is an interface of the power adapter for electrical connection with the charging cable; and a controlling unit, configured to control a charging process for the electronic equipment according to the temperature of the first charging interface. The charging control device further comprises at least one contact sheet. Each first temperature measuring component corresponds to one contact sheet. Each first temperature measuring component and the corresponding contact sheet thereof are arranged on the same thermal conductive substrate. Each first temperature measuring component and the corresponding contact sheet are spaced apart from each other by a predetermined interval.

**[0007]** Based on the first aspect, in a first implementation, the at least one contact sheet is configured to transmit charging current, and one first temperature measuring component is configured to measure a temperature of the corresponding contact sheet thereof.

**[0008]** Based on the first aspect and the above mentioned implementation, in a second implementation, the controlling unit is configured to determine an average temperature of the at least one contact sheet and use the average temperature as the temperature of the first charging interface.

**[0009]** Based on the first aspect and the above mentioned implementation, in a third implementation, the controlling unit is configured to determine the temperature of one contact sheet by averaging different temperatures of the contact sheet measured by one first temperature measuring component in at least two time periods.

**[0010]** Based on the first aspect and the above mentioned implementation, in a fourth implementation, the controlling unit is configured to determine the average temperature of the at least one contact sheet by averaging different temperatures of the at least one contact sheet measured by different first temperature measuring components.

**[0011]** Based on the second aspect and the above mentioned implementation, the controlling unit is configured to determine a maximum or minimum temperature of the at least one contact sheet and use the maximum or minimum temperature as the temperature of the first charging interface.

**[0012]** Based on the first aspect and the above mentioned implementation, in a fifth implementation, an insulating thermal conductive layer is arranged between the first temperature measuring component and the thermal conductive substrate; or, the insulating thermal conductive layer is arranged between the corresponding contact sheet of the first temperature measuring component and the thermal conductive substrate.

**[0013]** Based on the first aspect and the above mentioned implementation, in a sixth implementation, the device further comprises a second charging interface, the second charging interface being an interface of the charging cable for electrical connection with the power adapter. The controlling unit is further configured to receive first temperature indicating

information transmitted from the charging cable, wherein the first temperature indicating information is used to indicate a temperature of the second charging interface measured by a second temperature measuring component arranged in the second charging interface; determine the temperature of the second charging interface according to the first temperature indicating information; and control the charging process for the electronic equipment according to the temperature of the second charging interface.

**[0014]** Based on the first aspect and the above mentioned implementation, in a seventh implementation, the device further comprises a third charging interface, the third charging interface being an interface of the charging cable for electrical connection with the electronic equipment, the controlling unit is further configured to receive second temperature indicating information transmitted from the charging cable; the second temperature indicating information is used to indicate a temperature of the third charging interface measured by a third temperature measuring component arranged in the third charging interface; determine the temperature of the third charging interface according to the second temperature indicating information; control the charging process for the electronic equipment according to the temperature of the third charging interface.

**[0015]** Based on the first aspect and the above mentioned implementation, in an eighth implementation, the device further comprises a fourth charging interface, the fourth charging interface being an interface of the electronic equipment for electrical connection with the charging cable, the controlling unit is further configured to receive third temperature indicating information transmitted from the electronic equipment via the charging cable, the third temperature indicating information is used to indicate a temperature of the fourth charging interface measured by a fourth temperature measuring component arranged in the fourth charging interface; determine the temperature of the fourth charging interface according to the third temperature indicating information; control the charging process for the electronic equipment according to the temperature of the fourth charging interface.

**[0016]** The controlling unit is configured to control the charging process for the electronic equipment according to a maximum temperature, an average temperature, or a minimum temperature of temperatures of multiple charging interfaces.

**[0017]** Based on the first aspect and the above mentioned implementation, in a ninth implementation, the controlling unit is configured to decrease current value or voltage value of charging current when the temperature of any charging interface is greater than or equal to a first temperature threshold; or, forbid the charging current to be output when the temperature of the charging interface is greater than or equal to a second temperature threshold.

**[0018]** According to a second aspect of the present disclosure, it is provided a power adapter, including the charging control device of any of the foregoing aspects and implementations.

**[0019]** According to a third aspect of the present disclosure, there is provided a charging control method performed in a power adapter configured to charge electronic equipment

through a charging cable. The method includes: measuring, with at least one temperature measuring component arranged in a charging interface of the power adapter for electrical connection with the charging cable, a temperature of the charging interface; and measuring, with at least one temperature measuring component arranged in a charging interface of the power adapter for electrical connection with the charging cable, a temperature of the charging interface. The charging interface is provided with at least one contact sheet and each first temperature measuring component corresponds to one contact sheet. Each first temperature measuring component and the corresponding contact sheet thereof are arranged on the same thermal conductive substrate. Each first temperature measuring component and the corresponding contact sheet are spaced apart from each other by a predetermined interval.

**[0020]** In one implementation, the method further includes: determining an average temperature, a maximum temperature, or a minimum temperature of at least one contact sheet and use the average temperature, the maximum temperature, or the minimum temperature as the temperature of the charging interface.

**[0021]** By means of the charging control method, the charging control device, and the power adapter according the present disclosure, temperature of the charging interface can be measured and then charging can be controlled based on the temperature of the charging interface; whereby components can be protected through adjusting charging current/voltage or even cutting off charging circuits if the temperature of the charging interface is greater than a safe temperature, and therefore, the security of charging can be improved.

## **BRIEF DESCRIPTION OF THE DRAWINGS**

**[0022]** In order to illustrate the technical solutions of the present disclosure or the related art more clearly, a brief description of the accompanying drawings used herein is given below. Obviously, the drawings listed below are only examples, and a person skilled in the art should be noted that, other drawings can also be obtained on the basis of these exemplary drawings without creative work.

FIG. 1 is a schematic flow chart illustrating a charging control method according to an embodiment of the present disclosure.

FIG. 2 is a schematic diagram illustrating the configuration relationship between temperature measuring components and an electronic interface.

FIG. 3 is a schematic structure diagram illustrating a charging control device according to an embodiment of the present disclosure.

FIG. 4 is a schematic structure diagram illustrating a power adapter according to an embodiment of the present disclosure.

**DETAILED DESCRIPTION OF ILLUSTRATED EMBODIMENTS**

**[0023]** The technical solutions of the embodiments of the present disclosure will be described clearly and completely taken in conjunction with the accompanying drawings; it will be apparent to one of ordinary skill in the art that, the embodiments described below are merely a part of the disclosure and other embodiments obtained out of them without creative work will fall into the protection range of the present disclosure either.

**[0024]** According to an embodiment of the present disclosure, it is provided a charging control method. FIG. 1 is a schematic flow chart illustrating a method 100. The method can be performed in a power adapter configured to charge electronic equipment through a charging cable; that is to say, the method can be performed by the power adapter. As shown in FIG. 1, the method includes followings.

**[0025]** S110, temperature of a charging interface is determined; wherein the charging interface includes at least one of the following interfaces: an interface of the power adapter used for electrical connection with the charging cable; an interface of the charging cable used for electrical connection with the power adapter; an interface of the charging cable used for electrical connection with the electronic equipment; and an interface of the electronic equipment used for electrical connection with the charging cable.

**[0026]** S120, charging of the electronic equipment can be controlled according to the temperature of the charging interface.

**[0027]** The method can be applied to a charging system in which charging can be achieved through electrical connection via a charging interface.

**[0028]** As one example, in the charging system, the power adapter, the charging cable, and the electronic equipment (such as mobile phone) can be independent of one another. In this circumstance, the charging interface can include interfaces illustrated below.

**[0029]** Interface A: an interface of the power adapter used for electrical connection with the charging cable.

**[0030]** Interface B: an interface of the charging cable used for electrical connection with the power adapter (to be specific, Interface A).

**[0031]** Interface C: an interface of the charging cable used for electrical connection with the electronic equipment.

**[0032]** Interface D: an interface of the electronic equipment used for electrical connection with the charging cable (to be specific, Interface C).

**[0033]** As another example, in the charging system, the charging cable and the electronic equipment can be set integrally. In this circumstance, the charging interface can include Interface A and Interface B.

**[0034]** As still another example, in the charging system, the power adapter and the charging cable can be set integrally. In this circumstance, the charging interface can include Interface C and Interface D.

**[0035]** Consequently, in the charging control method according to the present disclosure, in S110, the power adapter can determine temperature of at least one interface of Interface A~Interface D. Operations for determining the temperature of each interface will be described in detail below.

### **1. Operations for determining temperature of Interface A**

**[0036]** The charging interface includes Interface A, that is, an interface of the power adapter used for electrical connection with the charging cable.

**[0037]** The process of determining the temperature of the charging interface in S110 can be detailed as follows: the temperature of the charging interface is determined through temperature measuring component A arranged in Interface A.

**[0038]** Specifically, in Interface A, there can be a temperature measuring component (marked as temperature measuring component A or first temperature measuring component) configured to measure temperature of Interface A.

**[0039]** Therefore, the power adapter can measure the temperature of Interface A through temperature measuring component A.

**[0040]** Optionally, the process of determining the temperature of the charging interface through the first temperature measuring component can be specified as: temperature of at least one contact sheet arranged in Interface A can be measured by the power adapter through at least one temperature measuring component A; the at least one temperature measuring component A corresponds to the at least one contact sheet separately and the contact sheet is used to transfer charging current; and the temperature of the charging interface can be determined according to the temperature of the at least one contact sheet.

**[0041]** FIG. 2 is a schematic diagram illustrating the configuration relationship between temperature measuring components and an electronic interface. As shown in FIG. 2, a plurality of metal contact sheets can be arranged in Interface A (for example, in the tab of Interface A). Although not shown in the figure, similarly, a plurality of metal contact sheets can be arranged in Interface B (for example, in the tab of Interface B). Typically, a plurality of metal contact

sheets in Interface A correspond to a plurality of metal contact sheets in Interface B separately, for example, corresponding in position. When Interface A is connected with Interface B, each contact sheet in Interface A and a corresponding contact sheet in Interface B will contact with each other; thus electrical connection between the power adapter and the charging cable can be achieved.

**[0042]** Since the contact sheet is a thermal source, temperature of the contact sheet in Interface A can be measured via temperature measuring component A. The temperature of Interface A can be determined based on the temperature of the contact sheet.

**[0043]** Temperature sensor to be used as temperature measuring component A can be chosen according to configuration space and the like of Interface A. For example, temperature measuring component A can be a thermistor.

**[0044]** As illustrated above, there can be one or more temperature measuring component A in Interface A, and there is no restriction. In order to ensure the accuracy of measurement, one temperature measuring component A corresponds to one contact sheet only; in other words, one temperature measuring component A is configured to measure temperature of one contact sheet only.

**[0045]** As one example, there are at least two temperature measuring components, which correspond to at least two contact sheets in Interface A separately.

**[0046]** Specifically, according to the embodiment of the present disclosure, the number of temperature measuring component A can be determined according to the number of contact sheets in Interface A, for example, these two numbers can be equal. Therefore, each temperature measuring component can measure temperature of a corresponding contact sheet thereof respectively, whereby temperatures of all contact sheets in Interface A can be obtained.

**[0047]** For example, as shown in FIG. 2, in Interface A, there are two contact sheets for transmitting current, that is, contact sheet A1 and contact sheet A2. Two temperature measuring components, that is, temperature measuring component A1 and temperature measuring component A2, are provided correspondingly. Temperature measuring component A1 corresponds to contact sheet A1 and is used to measure temperature of contact sheet A1. Temperature measuring component A2 corresponds to contact sheet A2 and is used to measure temperature of contact sheet A2.

**[0048]** Configuration relationship between temperature measuring component A and the contact sheet in Interface A will be described in detail below.

**[0049]** If more than one temperature measuring component A is provided, the configuration manner between each temperature measuring component and a corresponding contact sheet thereof can be the same or similar. The configuration manner between temperature measuring

component Al and contact sheet Al as illustrated in FIG. 2 will be described below as an example.

**[0050]** As one implementation, temperature measuring component Al can be laminated to the surface of contact sheet Al.

**[0051]** Alternatively, the first temperature measuring component and a corresponding contact sheet can be arranged on the same thermal conductive substrate, and there is a preset interval between the two.

**[0052]** Specifically, as shown in FIG. 2, temperature measuring component Al and a contact sheet Al can be arranged on the same thermal conductive substrate, therefore, heat of the temperature measuring component Al can be conducted to the contact sheet Al via the thermal conductive substrate, and there is a preset interval  $\alpha$  between the temperature measuring component Al and the contact sheet Al. Wherein the size of interval  $\alpha$  can be adjusted according to the size and configuration of Interface A. Therefore, with the aid of interval  $\alpha$ , influence of the current flowing through contact sheet Al on temperature measuring component Al caused by direct contact can be avoided.

**[0053]** Optionally, the thermal conductive substrate is metallic.

**[0054]** As to the thermal conductive substrate, in order to improve the thermal conductivity thereof, it can be metallic; that is to say, it can be made of metal materials such as copper foil, aluminum foil, and the like. Furthermore, the thickness of the thermal conductive substrate can be set as small as possible so as to further improve the thermal conductivity.

**[0055]** In addition, there can be an insulating thermal conductive layer between temperature measuring component A and the thermal conductive substrate; or, the insulating thermal conductive layer can be arranged between a corresponding contact sheet of temperature measuring component A and the thermal conductive substrate.

**[0056]** More specifically, upon charging for the electronic equipment, current will flow through contact sheet Al of Interface A illustrated in FIG.2. Thus, when adopting a metallic thermal conductive substrate, current can flow through the thermal conductive substrate from contact sheet Al to temperature measuring component Al. When adopting an electronic component such as a thermistor or an electronic temperature sensor as temperature measuring component Al, current flowing through the thermal conductive substrate from contact sheet Al may affect temperature measuring component Al. By arranging an insulation layer between temperature measuring component Al and the thermal conductive substrate, or, by arranging the insulation layer between contact sheet Al and the thermal conductive substrate, effects of external current on temperature measuring component Al can be avoided while conducting heat, and the safety and reliability of battery components of the present disclosure can be improved.

**[0057]** It should be understood, the material and shape of the thermal conductive substrate described above is only illustrative explanation, the present disclosure is not limited thereto; any type of thermal conductive substrate is possible as long as heat can be transmitted to the temperature measuring component via the contact sheet. For example, the thermal conductive substrate can be a printed circuit board (PCB) with a thermal conductive layer paved on the surface thereof.

**[0058]** Optionally, the process of determining the temperature of the charging interface can be specified as: use the first temperature measuring component to measure temperature of a corresponding contact sheet in at least two time period so as to obtain at least two temperature values; the at least two temperature values correspond to the at least two time period respectively; then the at least two temperature values are averaged so as to determine the temperature of the charging interface.

**[0059]** Specifically, each temperature measuring component (for ease of understanding, take temperature measuring component A1 as an example) can perform multiple measurements (that is, in at least two time period) on the temperature of contact sheet A1 in one period of temperature measurement. Thus, multiple temperature values of contact sheet A1 at different time points can be determined. The multiple temperature values referred to here can be the same or different, there is no restriction on this.

**[0060]** Thereafter, the multiple temperature values will be averaged, such as calculating the arithmetic mean thereof; the mean value thus obtained will be deemed as the temperature of contact sheet A1.

**[0061]** It should be noted that, the process for obtaining the mean value is illustrative only; the present disclosure is not limited thereto.

**[0062]** Operations for determining the temperature of the contact sheet of interface A described above is for illustrative explanation only, and the present disclosure is not limited thereto. For example, only one piece of temperature information transmitted by temperature measuring component A is required to be obtained, and the unique temperature value thus obtained will be the temperature of the contact sheet of interface A. As another implementation, the maximum temperature value among multiple temperature information transmitted by temperature measuring component A will be the temperature of the contact sheet of interface A.

**[0063]** Optionally, the process of determining the temperature of the charging interface can be specified as: use at least two temperature measuring components (that is, temperature measuring A) to obtain at least two temperature values; the at least two temperature values are averaged so as to determine the temperature of the charging interface, wherein the at least two temperature measuring components correspond to the at least two temperature values respectively.

**[0064]** Specifically, in this example, a plurality of temperature measuring components is arranged, and temperature values of contact sheets measured by each corresponding temperature measuring component respectively can be averaged. The mean temperature obtained will be the temperature of the contact sheet of the charging interface.

**[0065]** In the examples described above, the temperature of the contact sheet can be processed properly after obtained in order to obtain the temperature of Interface A. For example, a preset value can be subtracted from the temperature of the contact sheet, and the temperature after subtraction will be the temperature of Interface A. Any method being used to obtain the temperature of the charging interface based on the temperature of the contact sheet shall fall into the scope of protection of the present disclosure.

**[0066]** In addition, the configuration and measurement object of temperature measuring component A is illustrative explanation only, and the present disclosure is not limited thereto. For example, temperature measuring component A can be arranged on the case of Interface A so as to measure the temperature thereof; the temperature of the case will be the temperature of Interface A.

## **2. Operations for determining temperature of Interface B**

**[0067]** The charging interface includes Interface B, that is, an interface of the charging cable used for electrical connection with the power adapter.

**[0068]** The process of determining the temperature of the charging interface includes: first temperature indicating information is received from the charging cable, wherein the first temperature indicating information is used to indicate the temperature of the charging interface measured by a second temperature measuring component arranged in Interface B; and the temperature of the charging interface is determined according to the first temperature indicating information.

**[0069]** Specifically, a temperature measuring component (that is, the second temperature measuring component) for measuring temperature of Interface B is arranged in the charging cable. In order to facilitate description, in the following, the second temperature measuring component will be represented as temperature measuring component B.

**[0070]** Thus, the temperature of Interface B can be measured by the charging cable via temperature measuring component B.

**[0071]** In this implementation, the configuration and measurement object of temperature measuring component B in Interface B is similar to that of temperature measuring component A in Interface A, detailed description will be omitted to avoid redundancy.

**[0072]** Thereafter, the charging cable can transmit the first temperature indicating information

used to indicate the temperature of Interface B to the power adapter; and then the power adapter can determine the temperature of Interface B according to the first temperature indicating information.

### **3. Operations for determining temperature of Interface C**

**[0073]** The charging interface includes Interface C, that is, an interface of the charging cable used for electrical connection with the electronic equipment.

**[0074]** The process of determining the temperature of the charging cable includes: second temperature indicating information used to indicate the temperature of the charging interface measured through a third temperature measuring component arranged in Interface C is received from the charging cable. Then the temperature of the charging interface can be determined according to the second temperature indicating information.

**[0075]** Specifically, a temperature measuring component (that is, the third temperature measuring component) for measuring temperature of Interface C is arranged in the charging cable. In order to facilitate description, in the following, the third temperature measuring component will be represented as temperature measuring component C.

**[0076]** Thus, the temperature of Interface C can be measured by the charging cable via temperature measuring component C. In this implementation, the configuration and measurement object of temperature measuring component C in Interface C is similar to that of temperature measuring component A in Interface A, detailed description will be omitted to avoid redundancy.

**[0077]** Thereafter, the charging cable can transmit the second temperature indicating information used to indicate the temperature of Interface C to the power adapter; and then the power adapter can determine the temperature of Interface C according to the second temperature indicating information.

### **4. Operations for determining temperature of Interface D**

**[0078]** The charging interface includes Interface D, that is, an interface of the electronic equipment used for electrical connection with the charging cable.

**[0079]** The process of determining the temperature of the charging interface includes: third temperature indicating information used to indicate the temperature of the charging interface measured by a fourth temperature measuring component arranged in Interface D is received from the electronic equipment via the charging cable; and the temperature of the charging interface is determined according to the third temperature indicating information.

**[0080]** Specifically, a temperature measuring component (that is, the fourth temperature measuring component) for measuring temperature of Interface D is arranged in the electronic equipment. In order to facilitate description, in the following, the fourth temperature measuring component will be represented as temperature measuring component D.

**[0081]** Thus, the temperature of Interface D can be measured by the electronic equipment via temperature measuring component D. In this implementation, the configuration and measurement object of temperature measuring component D in Interface D is similar to that of temperature measuring component A in Interface A, detailed description will be omitted to avoid redundancy.

**[0082]** Thereafter, the electronic equipment can transmit the third temperature indicating information used to indicate the temperature of Interface D to the power adapter via the charging cable; and then the power adapter can determine the temperature of Interface D according to the third temperature indicating information.

**[0083]** To be concluded, by means of the technical schemes described above, the power adapter can determine the temperature of at least one interface among Interface A ~ Interface D in S110, and in S120, charging control is performed according to the temperature determined in S110, which will be described in detail below.

**[0084]** Operations for charging control performed in S120 includes: the current value or voltage value of charging current will be decreased if the temperature of the charging interface is greater than or equal to a first temperature threshold; or, the charging current will be forbidden to be output if the temperature of the charging interface is greater than or equal to a second temperature threshold; wherein the second temperature threshold is greater than the first temperature threshold.

**[0085]** Specifically, if temperature of one interface of Interface A-Interface D can be determined by the power adapter, charging control can be performed according to the temperature of the interface.

**[0086]** If multiple temperatures of multiple interfaces of Interface A-Interface D can be determined by the power adapter, the temperature used for charging control can be the maximum temperature, the minimum temperature, or the average temperature of multiple temperatures corresponding to multiple interfaces among Interface A ~ Interface D.

**[0087]** In the following, the temperature based on which charging control is performed will be expressed as "charging interface temperature".

**[0088]** Specifically, if the charging interface temperature is greater than or equal to the first temperature threshold, it is indicated that there are security risks in charging system; the power adapter can decrease charging current or charging voltage so as to reduce the quantity of heat generated by the charging interface. The first temperature threshold can be a safe

temperature threshold for fast-charging (for example, high current charging or high voltage charging), for example, it can be arbitrary temperature in the range of 15 °C ~45 °C.

**[0089]** Furthermore, if the charging interface temperature is greater than or equal to the second temperature threshold which is greater than the first temperature threshold, it is indicated that the charging system is no longer suitable to continue working; the power adapter can cut off the charging circuit. The second temperature threshold can be a safe temperature threshold for charging, for example, it can be 50°C.

**[0090]** Specific numerical examples are given to illustrate the temperature thresholds; the present disclosure is not limited thereto. Each temperature threshold can be determined according to a safe working temperature and/or maximum permissible temperature of various components (such as the power adapter, the charging cable, and the electronic equipment) of the charging system; or, can be determined according to values (for example, numerical values set according to degree of tolerance to heat) preset by the user.

**[0091]** In the above description, charging control according to charging interface temperature is performed by the power adapter. The present disclosure is not limited thereto. In the circumstance where the charging cable or the electronic equipment has charging control function, the power adapter can transmit information indicating the temperature of Interface A to the charging cable or the electronic equipment. Charging control can be performed by the charging cable or the electronic equipment according to the information. The method and process of the charging cable or the electronic equipment is similar to that of the power adapter. Details will be omitted to avoid redundancy.

**[0092]** Wherein Interface A ~ Interface D referred to in the present disclosure can be achieved by existing USB interface; information transmission among the power adapter, the charging cable, and the electronic equipment can be performed via data transmission circuits in the USB interface.

**[0093]** By means of the charging control method according to the embodiment of the present disclosure, the temperature of the charging interface can be determined, and charging control can be performed according to the temperature of the charging interface, whereby components can be protected by adjusting charging current or charging voltage or even cutting off charging circuit, and safety of charging can be improved.

**[0094]** The charging control method of the present disclosure has been described with refer to FIG.1 and FIG.2. A charging control device according to embodiments of the present disclosure will be described with refer to FIG. 3.

**[0095]** FIG. 3 is a schematic structure diagram illustrating the device. As shown in FIG. 3, a charging control device 200, which is deployed in a power adapter used for charging of electronic equipment through a charging cable, includes a determining unit 210 and a controlling unit 220.

**[0096]** The determining unit 210 is configured to determine temperature of a charging interface; wherein the charging interface includes at least one of the following interfaces: an interface of the power adapter used for electrical connection with the charging cable; an interface of the charging cable used for electrical connection with the power adapter; an interface of the charging cable used for electrical connection with the electronic equipment; and an interface of the electronic equipment used for electrical connection with the charging cable. The controlling unit 220 is configured to control charging for the electronic equipment according to the temperature of the charging interface.

**[0097]** Optionally, the charging interface includes the interface of the power adapter used for electrical connection with the charging cable.

**[0098]** The determining unit 210 is configured to determine the temperature of the charging interface through a first temperature measuring component arranged in the interface of the power adapter.

**[0099]** Optionally, the determining unit is configured to measure temperature of at least one contact sheet arranged in the interface of the power adapter through at least one first temperature measuring component arranged in the interface of the power adapter. The at least one temperature measuring component corresponds to the at least one contact sheet respectively, and the contact sheet is configured to transmit charging current. The determining unit is configured to determine the temperature of the charging interface according to the temperature of the at least one contact sheet.

**[0100]** Optionally, each first temperature measuring component and a corresponding contact sheet thereof can be arranged on the same thermal conductive substrate; and there is a preset interval between each first temperature measuring component and the corresponding contact sheet.

**[0101]** Optionally, the thermal conductive substrate is metallic.

**[0102]** Optionally, an insulating thermal conductive layer is arranged between the first temperature measuring component and the thermal conductive substrate; or, the insulating thermal conductive layer is arranged between a corresponding contact sheet of the first temperature measuring component and the thermal conductive substrate.

**[0103]** The charging interface includes the interface of the charging cable used for electrical connection with the power adapter.

**[0104]** The charging control device further includes: a receiving unit, configured to receive first temperature indicating information transmitted from the charging cable, the first temperature indicating information is used to indicate the temperature of the charging interface measured by a second temperature measuring component arranged in the interface of the charging

cable used for electrical connection with the power adapter. The determining unit is further configured to determine the temperature of the charging interface according to the first temperature indicating information.

**[0105]** The charging interface includes the interface of the charging cable used for electrical connection with the electronic equipment.

**[0106]** The charging control device further includes: a receiving unit, configured to receive second temperature indicating information transmitted from the charging cable; the second temperature indicating information is used to indicate the temperature of the charging interface measured by a third temperature measuring component arranged in the interface of the charging cable used for electrical connection with the electronic equipment. The determining unit is further configured to determine the temperature of the charging interface according to the second temperature indicating information.

**[0107]** The charging interface includes the interface of the electronic equipment used for electrical connection with the charging cable.

**[0108]** The charging control device further includes: a receiving unit, configured to receive third temperature indicating information transmitted from the electronic equipment via the charging cable; the third temperature indicating information is used to indicate the temperature of the charging interface measured by a fourth temperature measuring component arranged in the interface of the electronic equipment used for electrical connection with the charging cable. The determining unit is further configured to determine the temperature of the charging interface according to the third temperature indicating information.

**[0109]** Optionally, the controlling unit is configured to decrease the current value or voltage value of charging current if the temperature of the charging interface is greater than or equal to a first temperature threshold; or, configured to forbid the charging current to be output if the temperature of the charging interface is greater than or equal to a second temperature threshold; wherein the second temperature threshold is greater than the first temperature threshold.

**[0110]** The charging control device 200 according to the embodiment of the present disclosure corresponds to the implementing subject (such as the power adapter or functional components disposed in the power adapter) of the charging control method described above; in addition, respective unit or module and/or other operation or function of the charging control device 200 can achieve corresponding process of the charging control method 100 as shown in FIG. 1, and will not go into much detail here.

**[0111]** By means of the charging control device, the temperature of the charging interface can be determined, and charging control can be performed according to the temperature of the charging interface, whereby components can be protected by adjusting charging current or charging voltage or even cutting off charging circuit, and safety of charging can be improved.

**[0112]** The charging control method of the present disclosure has been described with refer to FIG. 1 and FIG. 2. The power adapter according to embodiments of the present disclosure will be described with refer to FIG 4.

**[0113]** FIG. 4 is schematic structure diagram illustrating the power adapter. As shown in FIG. 4, a power adapter 300 includes an adapter main body 310, an interface 320, and a processor 330.

**[0114]** Specifically, the adapter main body 310 is configured to obtain alternating current from a power supply and convert the alternating current to direct current with specified voltage. The interface 320 is configured to electronically connect to a charging cable, obtain the direct current from the adapter main body 310, and then provide the direct current to an electronic equipment through the charging cable. The processor 330 is configured to determine temperature of a charging interface, and control the adapter main body or the interface of the power adapter according to the temperature of the charging interface so as to control the direct current provided to the electronic equipment. The charging interface includes at least one of the following interfaces: the interface of the power adapter; an interface of the charging cable used for electrical connection with the power adapter; an interface of the charging cable used for electrical connection with the electronic equipment; and an interface of the electronic equipment used for electrical connection with the charging cable.

**[0115]** Optionally, the charging interface includes the interface of the power adapter.

**[0116]** The device further includes: a first temperature measuring component, arranged in the interface of the power adapter and configured to determine temperature of the interface of the power adapter. The processor is further configured to determine the temperature of the charging interface according to the temperature of the interface of the power adapter measured by the first temperature measuring component.

**[0117]** Optionally, there is at least one first temperature measuring component. The at least one first temperature measuring component corresponds to the at least one contact sheet separately, and each first temperature measuring component is configured to measure temperature of the at least one contact sheet respectively. The contact sheet is configured to transmit charging current.

**[0118]** The processor is configured to determine the temperature of the charging interface according to the temperature of the at least one contact sheet.

**[0119]** Optionally, each first temperature measuring component and a corresponding contact sheet thereof can be arranged on the same thermal conductive substrate; and there is a preset interval between each first temperature measuring component and the corresponding contact sheet.

**[0120]** Optionally, the thermal conductive substrate is metallic.

**[0121]** Optionally, an insulating thermal conductive layer is arranged between the first temperature measuring component and the thermal conductive substrate; or, the insulating thermal conductive layer is arranged between a corresponding contact sheet of the first temperature measuring component and the thermal conductive substrate.

**[0122]** Optionally, the charging interface includes the interface of the charging cable used for electrical connection with the power adapter.

**[0123]** The power adapter further includes: a receiver, configured to receive first temperature indicating information transmitted from the charging cable. The first temperature indicating information is used to indicate the temperature of the charging cable measured by a second temperature measuring component arranged in the interface of the charging cable used for electrical connection with the power adapter. The processor is further configured to determine the temperature of the charging interface according to the first temperature indicating information.

**[0124]** Optionally, the charging interface includes the interface of the charging cable used for electrical connection with the electronic equipment.

**[0125]** The power adapter further includes: a receiver, configured to receive second temperature indicating information transmitted from the charging cable. The second temperature indicating information is used to indicate the temperature of the charging interface measured by a third temperature measuring component arranged in the interface of the charging cable used for electrical connection with the electronic equipment. The processor is further configured to determine the temperature of the charging interface according to the second temperature indicating information.

**[0126]** Optionally, the charging interface includes the interface of the electronic equipment used for electrical connection with the charging cable.

**[0127]** The power adapter further includes: a receiving unit, configured to receive third temperature indicating information transmitted from the electronic equipment via the charging cable. The third temperature indicating information is used to indicate the temperature of the charging interface measured by a fourth temperature measuring component arranged in the interface of the electronic equipment used for electrical connection with the charging cable. The processor is further configured to determine the temperature of the charging interface according to the third temperature indicating information.

**[0128]** Optionally, the processor is further configured to decrease the current value or voltage value of direct current if the temperature of the charging interface is greater than or equal to a first temperature threshold; or, configured to forbid the adapter main body to operate or forbid direct current to be output from the interface of the power adapter if the temperature of the

charging interface is greater than or equal to a second temperature threshold; wherein the second temperature threshold is greater than the first temperature threshold.

**[0129]** In the following, the processor will be described in detail. The processor can perform or achieve each step and logic block diagram illustrated according to embodiments of the present disclosure. General-purpose processor can be a microprocessor, or, the processor can be any conventional processor or decoder. Steps of the methods of the present disclosure can be performed by a hardware processor, or can be performed via a combination of a hardware and software module in a decoding processor. The software module can be located in Read Only Memory (ROM), flash, Random Access Memory (RAM), programmable read-only memory or electrically erasable programmable memory, register, or any other known storage medium in the art.

**[0130]** The processor can be a Central Processing Unit (CPU). The processor can also be other general-purpose processors, Digital signal processor (DSP), Special integrated circuit (ASIC), Field Programmable Gate Array (FPGA) or other programmable logic devices, discrete gate or transistor logic device, discrete hardware component. General-purpose processor can be a microprocessor or any conventional processor.

**[0131]** Memory includes ROM and RAM and can provide instructions and data to the processor. A part of the memory can include non-volatile RAM. For example, the memory can store information about device types.

**[0132]** During implementation, steps of the methods according to embodiments of the present disclosure can be achieved via integrated logic circuit of hardware or instructions in the form of software in the processor. Steps of the methods of the present disclosure can be performed by a hardware processor, or can be performed via a combination of hardware and software module in a decoding processor. The software module can be located in Read Only Memory (ROM), Random Access Memory (RAM), flash, programmable read-only memory or electrically erasable programmable memory, register, or any other known storage medium in the art. Storage medium is located in a memory; the processor can read information from the memory and achieve the steps of the methods described above with the aid of its own hardware. It will not go into much detail in order to avoid redundancy.

**[0133]** The power adapter 300 according to the embodiment of the present disclosure can correspond to the implementing subject of the charging control method described above either; in addition, respective unit or module and/or other operation or function of the power adapter 300 can achieve corresponding process of the charging control method 100 as shown in FIG. 1, and will not go into much detail here.

**[0134]** By means of the power adapter according to the embodiment of the present disclosure, the temperature of the charging interface can be measured, and charging control can be performed based on the temperature; whereby components can be protected through adjusting charging current/voltage or even cutting off charging circuits if the temperature of the

charging interface is greater than a safe temperature, and the security of charging can be improved.

**[0135]** In the embodiments described above, the order of execution of operations or steps should be determined based on function and internal logic, and the order of description should not be construed as a restriction on the order of execution.

**[0136]** A person skilled in the art will understand, exemplary units or algorithm steps described in any of the embodiments can be achieved via an electronic hardware or a combination of electronic hardware and computer software. Whether a hardware or software should be adopted depends on design constraints and specific application of technical schemes. Respective specific application can use different methods or manners to achieve the function described in the embodiments, which will fall into the protection scope of the present disclosure.

**[0137]** Specific operations of the device, system, and the unit or module can refer to corresponding description of the charging control method according to the embodiment.

**[0138]** Besides, the device, system, and method described herein can be achieved in other manners. Configuration of the device according to the embodiment described above is only exemplary; the division of units in the device is a kind of division according to logical function, therefore there can be other divisions in practice. For example, multiple units or components can be combined or integrated into another system; or, some features can be ignored while some units need not to be executed. In addition, "connection", "connecting", "coupling", or "coupled to" can be direct connection or communication connection via one or more interface; or, can be electrical or mechanical indirect connection via one or more intermediate part.

**[0139]** On the other hand, units or components illustrated as separated components can be physically separate, components illustrated as units can be or not be physical units, that is, they can be located in one place, or can be dispersed in multiple network units or systems. All or a part of the units or components illustrated above can be chosen to achieve the purpose of the present disclosure.

**[0140]** On the other hand, various function units can be integrated into one processing unit; two or more than two units can be integrated into one unit; or, each unit is physically separate.

**[0141]** Operations or functions of technical schemes according to embodiments of the present disclosure, which are achieved in the form of software functional units and can be sold or used as an independent product, can be stored in a computer readable storage medium. According to this, all or a part of the technical schemes of the present disclosure can be realized in the form of software products which can be stored in a storage medium. The storage medium includes USB disk, Read Only Memory (ROM), Random Access Memory (RAM), magnetic disk, CD, and any other medium that can be configured to store computer-readable program code or instructions. The computer-readable program code, when executed on a data-

processing apparatus (can be personal computer, server, or network equipment), adapted to perform the all or a part of the methods as described in the above-mentioned embodiments.

**[0142]** The foregoing descriptions are merely exemplary embodiments of the present disclosure, and should not be interpreted as any restriction. Various modifications and alterations may be made to the present disclosure for those skilled in the art.

**[0143]** The invention is defined by the features of the independent claims 1 and 14. Preferred embodiments are defined in the dependent claims.

## **REFERENCES CITED IN THE DESCRIPTION**

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

### **Patent documents cited in the description**

- US8981731B1 [0004]

## Patentkrav

1. En opladningsstyreanordning (200), der anvendes i en strømadapter, der bruges til at lade elektronisk udstyr op via et opladningskabel, som omfatter:

5

mindst én første temperaturmålingskomponent, der er konfigureret til at måle en temperatur på en første ladeegrænseflade, den første ladeegrænseflade er en grænseflade på strømadapteren til elektrisk forbindelse med opladningskablet, og en styreenhed (220), der er konfigureret til at styre en ladeproces for det elektroniske

10 udstyr i henhold til temperaturen af den første ladeegrænseflade; **kendetegnet ved, at:** hvor opladningsstyreanordningen desuden omfatter mindst én kontaktplade, hvori hver første temperaturmålekomponent svarer til én kontaktplade, hvori hver første temperaturmålingskomponent og den dertil hørende kontaktplade er arrangeret på et samme termisk ledende substrat, og hvori hver første temperaturmålingskomponent  
15 og den tilhørende kontaktplade er placeret i en afstand fra hinanden med et forudbestemt interval.

2. Anordningen (200) i krav 1, hvori mindst én kontaktplade er konfigureret til at transmittere ladestrøm, og en første temperaturmålingskomponent er konfigureret til  
20 at måle en temperatur af den tilsvarende kontaktplade deraf.

3. Anordningen (200) i krav 2, hvori styreenheden (220) er konfigureret til at bestemme en gennemsnitstemperatur af mindst én kontaktplade og bruge gennemsnitstemperaturen som temperaturen af den første ladeegrænseflade.

25

4. Anordningen (200) i krav 3, hvori styreenheden (220) er konfigureret til at bestemme temperaturen af én kontaktplade ved at udregne gennemsnittet af de forskellige temperaturer af kontaktpladen, som er målt af én første temperaturmålingskomponent i mindst to tidsperioder.

30

5. Anordningen (200) i krav 3, hvori styreenheden (220) er konfigureret til at bestemme gennemsnitstemperaturen af mindst én kontaktplade ved at udregne gennemsnittet af forskellige temperaturer af mindst én kontaktplade, der er målt med forskellige første temperaturmålingskomponenter.

5

6. Anordningen (200) i krav 2, hvori styreenheden (220) er konfigureret til at bestemme en maksimal eller minimal temperatur af mindst én kontaktplade og bruge den maksimale eller minimale temperatur som temperaturen af den første ladeegrænseflade.

10

7. Anordningen (200) i krav 1, hvori et isolerende termisk ledende lag er arrangeret mellem den første temperaturmålingskomponent og det termisk ledende substrat; eller, det isolerende termisk ledende lag er arrangeret mellem den tilsvarende kontaktplade på den første temperaturmålingskomponent og det termisk ledende substrat.

15

8. Anordningen (200) i ethvert af kravene 1 til 7, hvori anordningen desuden omfatter en anden ladeegrænseflade, den anden ladeegrænseflade er en grænseflade på opladningskablet til elektrisk forbindelse med strømadapteren:

20 hvori styreenheden (220) desuden er konfigureret til at:

modtage første temperaturvisende oplysninger, der er transmitteret fra ladekablet, hvori de første temperaturvisende oplysninger bruges til at angive en temperatur af den anden ladeegrænseflade målt med en anden temperaturmålingskomponent, der er arrangeret i den anden ladeegrænseflade; bestemme temperaturen af den anden ladeegrænseflade i henhold til de første temperaturvisende oplysninger; og kontrollere ladeprocessen for det elektroniske udstyr i henhold til temperaturen af den anden ladeegrænseflade.

25

**9.** Anordningen (200) i ethvert af kravene 1 til 8, hvori anordningen desuden omfatter en tredje ladegrænseflade, den tredje ladegrænseflade er en grænseflade på opladningskablet til elektrisk forbindelse med det elektroniske udstyr:

5    hvori styreenheden (220) desuden er konfigureret til at:

modtage andre temperaturvisende oplysninger, der er transmitteret fra ladekablet, hvori de andre temperaturvisende oplysninger bruges til at angive en temperatur af den tredje ladegrænseflade målt med en tredje temperaturmålingskomponent, der er  
10    arrangeret i den tredje ladegrænseflade; bestemme temperaturen af den tredje ladegrænseflade i henhold til de andre temperaturvisende oplysninger; og kontrollere ladeprocessen for det elektroniske udstyr i henhold til temperaturen af den tredje ladegrænseflade.

15    **10.** Anordningen (200) i ethvert af kravene 1 til 10, hvori anordningen desuden omfatter en fjerde ladegrænseflade, den fjerde ladegrænseflade er en grænseflade på det elektriske udstyr til elektrisk forbindelse med ladekablet:

hvor styreenheden (220) desuden er konfigureret til at:

20    modtage tredje temperaturvisende oplysninger, der transmitteres fra det elektroniske udstyr via ladekablet, hvori de tredje temperaturvisende oplysninger bruges til at angive en temperatur af den fjerde ladegrænseflade målt af en fjerde temperaturmålingskomponent, der er arrangeret i den fjerde ladegrænseflade;  
bestemme temperaturen af den fjerde ladegrænseflade i henhold til de tredje  
25    temperaturvisende oplysninger; og styre ladeprocessen for det elektroniske udstyr i henhold til temperaturen af den fjerde ladegrænseflade.

**11.** Anordningen (200) i ethvert af kravene 8 til 10, hvori styreenheden (220) er konfigureret til at kontrollere ladeprocessen for det elektroniske udstyr i henhold til en

maksimumtemperatur, en gennemsnitstemperatur eller en minimumstemperatur af temperaturer af flere ladegrænseflader.

**12.** Anordningen (200) i ethvert af kravene 1 til 11, hvori styreenheden er konfigureret til at reducere strømværdien eller spændingsværdien for ladestrømmen, når temperaturen af enhver ladegrænseflade er større end eller lig med en første temperaturgrænse; eller forbyde udgang af ladestrømmen, når temperaturen af enhver ladegrænseflade er større end eller lig med en anden temperaturgrænse.

**13.** En strømadapter (300), der omfatter opladningsstyreanordningen i ethvert af kravene 1 til 12.

**14.** En opladningsstyremetode, der anvendes i en strømadapter, der bruges til at lade elektronisk udstyr op via et opladningskabel, som omfatter:

måling, med mindst én temperaturmålingskomponent, der er arrangeret i en ladegrænseflade på strømadapteren til elektrisk forbindelse med ladekablet, en temperatur af ladegrænsefladen, og kontrol af opladning for det elektroniske udstyr i henhold til temperaturen af ladegrænsefladen;

hvor ladegrænsefladen er udstyret med mindst én kontaktplade, og hver første temperaturmålekomponent svarer til én kontaktplade, hvori hver første temperaturmålingskomponent og den dertil hørende kontaktplade er arrangeret på et samme termisk ledende substrat, og hvori hver første temperaturmålingskomponent og den tilhørende kontaktplade er placeret i en afstand fra hinanden med et forudbestemt interval.

**15.** Opladningskontrolmetoden i krav 14, hvori metoden desuden omfatter:

bestemmelse af en gennemsnitstemperatur, en maksimumtemperatur eller en minimumstemperatur på mindst én kontaktplade og brug af

gennemsnitstemperaturen, maksimumtemperaturen eller minimumtemperaturen som temperaturen af ladegrænsefladen.

# DRAWINGS

100

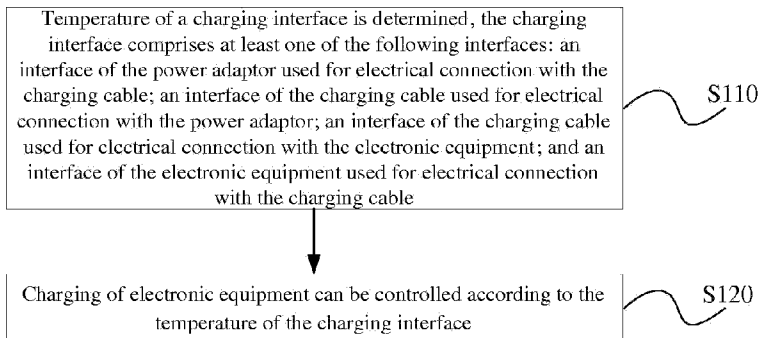


FIG. 1

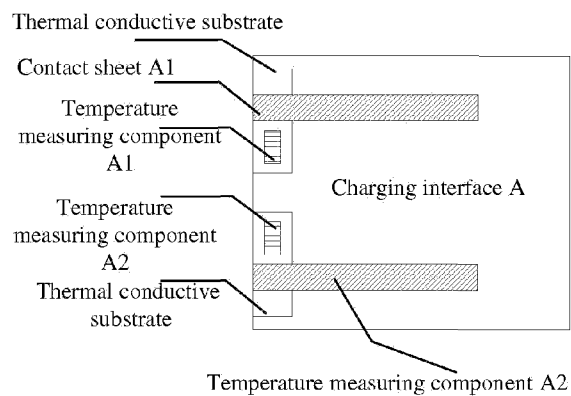


FIG. 2

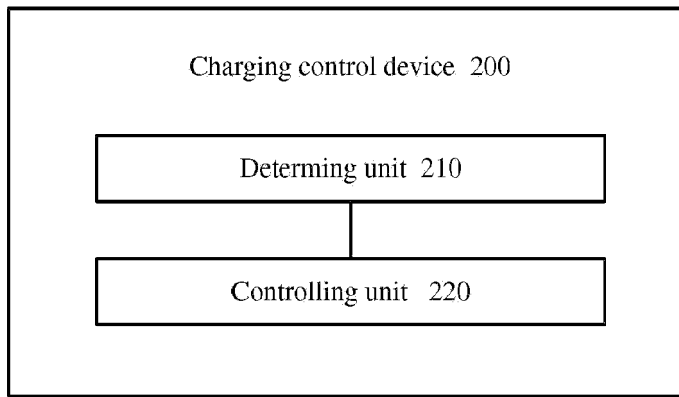


FIG. 3

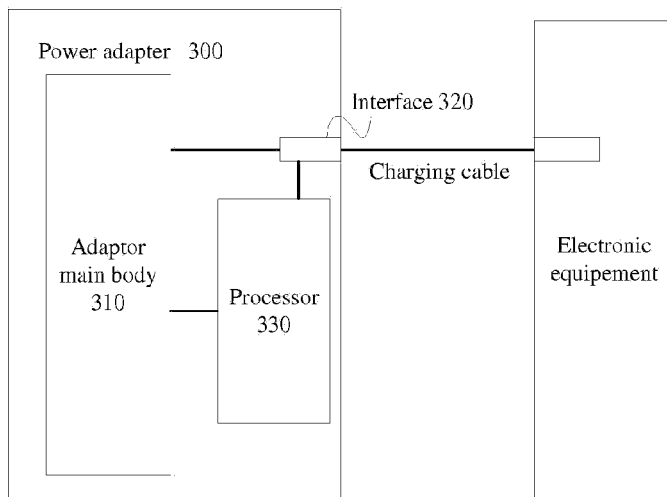


FIG. 4