Description

Title of the invention: CHARGE/DISCHARGE DEVICE FOR SECONDARY BATTERIES

Technical Field

[0001] The present invention relates to a charge/discharge device for secondary batteries which performs charging/discharging for activation and quality inspection of secondary batteries that are used for IT equipment such as smartphones, electric vehicles, and the like, for example.

Background Art

[0002] Today, demand for secondary batteries that are used for IT equipment such as smartphones, electric vehicles, and the like is rapidly increasing.

In final processes of mass-production factories for those types of secondary batteries, a charge/discharge device that performs charging/discharging for activation and quality inspection of produced secondary batteries is widely used.

Use of such a charge/discharge device enables mechanization of activation and quality inspection of secondary batteries, which have been manually performed, and contributes to achievement of mass production of secondary batteries.

[0003] In this case, such a charge/discharge device as described above generally performs predetermined charging/discharging on secondary batteries to be inspected through a power supply unit including a plurality of power supply boards corresponding to a plurality of secondary batteries.

In a power supply unit of the charge/discharge device, a plurality of power supply boards which contact a large number of secondary batteries from above and execute charging/discharging are accommodated in a power supply case serving as a casing, and charge/discharge inspection is executed by contact pins on a bottom surface side of the power supply boards contact the secondary batteries from above.

[0004] The plurality of power supply boards accommodated in the power supply case are accommodated in an internal space of the power supply board when the charge/discharge device is manufactured and introduced, and are removable from the power supply case when maintenance is performed in accordance with subsequent use conditions, a use period, and the like, thereby enabling required inspection, repair, and the like to be performed.

As a technology relating to a power supply unit of such a charge/discharge device for secondary batteries, for example, a "multi-channel charge/discharge power supply having a contact function" as disclosed in Patent Literature 1 is known.

Citation List

Patent Literature

[0005] [PTL 1] JP 6470804 B1

Summary of Invention

Technical Problem

[0006] In such a related-art charge/discharge device for secondary batteries, there has been room for improvement particularly in workability of attachment/detachment and assembly at the time of maintenance and the like of a power supply board of a power supply unit.

[0007] The present invention has been proposed in order to solve the above-mentioned problem, and has an object to provide a charge/discharge device for secondary batteries, which enables easy, quick, and safe attachment/detachment and assembly of power supply boards of a power supply unit included in the charge/discharge device for secondary batteries, with which it is possible to greatly improve workability and safety of maintenance and the like, and which is suitable particularly for a power supply unit of a so-called cableless system, fixture-integrated type, or the like, in which contact pins of the power supply boards can be brought into direct contact with secondary batteries to be inspected.

Solution to Problem

[0008] In order to achieve the above-mentioned object, according to the present invention, there is provided a charge/discharge device for secondary batteries, including a power supply unit arranged above a battery container accommodating a plurality of secondary batteries to be inspected, the power supply unit being configured to execute predetermined charging/discharging on the secondary batteries. The power supply unit includes: a plurality of power supply boards configured to contact the respective secondary batteries in the battery container from above and execute the predetermined charging/discharging; a power supply case configured to accommodate the plurality of power supply boards in a suspended state at predetermined positions corresponding to the respective secondary batteries in the battery container; and guide structure for attachably and detachably guiding the plurality of power supply boards in the power supply case in a suspended state. The respective plurality of power supply boards are held by the guide structure in the power supply case in a suspended state attachably and detachably in a manner that prevents falling off.

Advantageous Effects of Invention

[0009] The charge/discharge device for secondary batteries according to the present invention enables easy, quick, and safe attachment/detachment and assembly of the power supply boards of the power supply unit included in the charge/discharge device for secondary batteries, and greatly improving workability and safety of maintenance and the like.

Accordingly, it is possible to provide the charge/discharge device for secondary batteries that is suitable particularly for the power supply unit of a so-called cableless system, fixture-integrated type, or the like, in which contact pins of the power supply boards can be brought into direct contact with the secondary batteries to be inspected.

Brief Description of Drawings

[0010] FIG. 1 is a schematic perspective view for schematically illustrating an overall configuration in an exploded state of a power supply case, a power supply board, and a battery container of a charge/discharge device for secondary batteries, which is a premise of the present invention.

FIGS. 2 are views for schematically illustrating an overall configuration of the power supply case and the power supply board of the charge/discharge device for secondary batteries illustrated in FIG. 1, in which FIG. 2(a) is a schematic perspective view in an assembled state, and FIG. 2(b) is a see-through view thereof.

FIGS. 3 are views for schematically illustrating an overall configuration of the power supply case, the power supply board, and the battery container of the charge/discharge device for secondary batteries illustrated in FIG. 1, in which FIG. 3(a) is a schematic perspective view in a state exhibited before the power supply boards contact batteries, and FIG. 3(b) is a schematic perspective view in a contact state thereof.

FIG. 4 is a schematic plan view and front view for schematically illustrating an overall configuration of a cylindrical battery serving as a secondary battery to be inspected in the present invention.

FIG. 5 is a schematic perspective view for schematically illustrating an assembly process of the power supply case and the power supply board of the charge/discharge device for secondary batteries illustrated in FIG. 1.

FIG. 6 is a schematic perspective view for schematically illustrating a state in which the power supply board falls off from the power supply case of the charge/discharge device for secondary batteries illustrated in FIG. 1.

FIG. 7 is a schematic perspective view for schematically illustrating an overall configuration of a power supply case and a power supply board of a charge/discharge device for secondary batteries according to one embodiment of the present invention.

FIG. 8 is a schematic perspective view for schematically illustrating the power supply board of the charge/discharge device for secondary batteries according to the one embodiment of the present invention illustrated in FIG. 7.

FIG. 9 is a schematic front view for schematically illustrating the power supply case and the power supply board of the charge/discharge device for secondary batteries according to the one embodiment of the present invention illustrated in FIG. 7.

FIGS. 10 are views for schematically illustrating the power supply board of the charge/discharge device for secondary batteries according to the one embodiment of the present invention illustrated in FIG. 7, in which FIG. 10(a) is a schematic front view, and FIG. 10(b) is a schematic side view.

Description of Embodiments

[0011] Now, an embodiment that embodies a charge/discharge device for secondary batteries according to the present invention is described with reference to the drawings attached hereto, to thereby facilitate understanding of the present invention.

The charge/discharge device for secondary batteries according to the present invention is a charge/discharge device for secondary batteries which performs predetermined charge/discharge processing on produced secondary batteries in a final process and the like of a mass-production factory for the secondary batteries, for activation and quality inspection of secondary batteries that are used for IT equipment such as smartphones, electric vehicles, and the like, for example.

[0012] Specifically, the charge/discharge device for secondary batteries according to the one embodiment of the present invention is, for example, a device, which is used for activation and quality inspection of produced secondary batteries (test batteries: hereinafter also referred to simply as "batteries") such as lithium ion batteries, and serves to charge/discharge a plurality of secondary batteries at one time (simultaneously) in a plurality of test channels.

First, with reference to FIG. 1 to FIG. 6, the charge/discharge device for secondary batteries, which is a premise of the present invention, is described together with problems to be solved thereby.

[0013] In general, in a battery production factory, in order to activate initial batteries, there is a process of charging/discharging a current to/from batteries (charge/discharge inspection), and a device that is used therein is a charge/discharge device (charge/discharge inspection device).

In this case, the charge/discharge inspection is one of the most important processes that determines quality of lithium ion batteries through repetition of charging and discharging at a current, a voltage value, and a temperature determined in manufacture of lithium ion batteries, and is an advanced technology that simultaneously requires a highly accurate charge/discharge inspection function, excellent safety, and energy saving.

When such charge/discharge inspection is performed with high accuracy, charging and discharging are performed with high accuracy on cells, which are constituent materials of lithium ion batteries installed in a device in a charge/discharge inspection process, to thereby enable accumulation and analysis of data on battery performance and safety in each cell. Then, through classification of completed cells based on the analysis data, it is possible to provide safer and higher-performance lithium ion batteries to the market.

[0014] In this case, for the charge/discharge device for performing such charge/discharge inspection, a system in which an output end of a power supply circuit and a battery are electrically connected by a cable is generally common.

However, such a cable connection system charge/discharge device has had adverse effects of causing heat generation from a cable and an influence of noise due to routing of the cable as well as a power loss and the like accompanying an increase in resistance due to an increase in length of the cable.

In view of this, in order to suppress power consumption generated in such a cable, a system that does not use a cable or that shortens a cable as much as possible has been proposed. For example, there is a system in which current output pins are provided to a power supply circuit board (power supply board), and the pins are brought into direct contact with batteries. Such a system for a charge/discharge device is referred to as "cableless system" or "fixture-integrated type."

[0015] The charge/discharge device for secondary batteries according to the one embodiment of the present invention adopts such a structure and device in which electrode pins of the power supply unit for performing charging/discharging can be brought into direct contact with the batteries to be inspected, which is called "cableless system/fixture-integrated type."

FIG. 1 is a schematic perspective view for schematically illustrating an overall configuration in an exploded state of a power supply case, a power supply board, and a battery container that form the charge/discharge device for secondary batteries of the "cableless system/fixture-integrated type" (hereinafter also referred to simply as "integrated type"), which is a premise of the present invention.

FIGS. 2 are views for schematically illustrating an overall configuration of the power supply case and the power supply board illustrated in FIG. 1, in which FIG. 2(a) is a schematic perspective view in an assembled state, and FIG. 2(b) is a see-through view thereof.

FIGS. 3 are views for schematically illustrating an overall configuration of the power supply case, the power supply board, and the battery container as well, in which FIG. 3(a) is a schematic perspective view in a state exhibited before the power supply boards contact batteries, and FIG. 3(b) is a schematic perspective view in a contact state thereof.

[0016] The charge/discharge device for secondary batteries illustrated in those figures is used for activation and quality inspection of batteries (secondary batteries) 60 such as produced lithium ion batteries, and can charge/discharge a plurality of batteries 60 at one time.

Specifically, the charge/discharge device for secondary batteries according to this embodiment includes a power supply unit 1 arranged above a battery container 50 accommodating the plurality of batteries 60 to be inspected, and predetermined charging/discharging can be executed on the plurality of batteries 60 by the power supply unit 1.

[0017] [Power Supply Unit]

The power supply unit 1 includes: a plurality of power supply boards 20 that contact the respective batteries 60 in the battery container 50 from above and execute the predetermined charging/discharging; and a power supply case 10 that can accommodate the plurality of power supply boards 20 at predetermined positions corresponding to the respective batteries 60 in the battery container 50 in a suspended state. The power supply unit 1 forms the charge/discharge device of the "integrated type" in which electrode pins 21 of the power supply boards 20 can be brought into direct contact with electrodes (positive electrodes 61 and negative electrodes 62) of the batteries 60.

This embodiment is also characterized by including guide structure 30 for attachably and detachably guiding the plurality of power supply boards 20 in the power supply case 10 in a suspended state.

The guide structure is described later in detail with reference to FIG. 7 to FIGS. 10.

[0018] [Power Supply Case]

The power supply case 10 is a casing for accommodating and holding the plurality of power supply boards 20, and has a shape opened on a front side and a bottom side in this embodiment as illustrated in FIG. 1.

Thus, the plurality of power supply boards 20 can be inserted from the front side of the power supply case 10, the plurality of power supply boards 20 arranged in parallel are accommodated, and bottom surfaces of the respective power supply boards 20 are exposed from the bottom side of the power supply case 10.

In addition, in regard to each power supply board 20 inserted and accommodated in the power supply case 10, a connector 22 on a leading end side in an insertion direction is fitted and connected to a connector (not shown) located on a back end side of the power supply case 10, and a screw hole 23 at a trailing end in the insertion direction is subjected to screwing and fixing with a tapped hole 11 and a screw 12 on the front side of the power supply case 10.

[0019] Thus, the plurality of power supply boards 20 are accommodated at predetermined positions in the power supply case 10 in a suspended state, and can be removed in an attachable and detachable manner.

In this embodiment, as illustrated in FIG. 1 to FIGS. 3, eight power supply boards 20 are inserted into the power supply case 10 at predetermined positions with predetermined intervals, and are accommodated and held in a suspended state.

[0020] In addition, the power supply case 10 is opened also on the bottom side, and hence bottom surface sides of the respective plurality of power supply boards 20 accommodated and fixed in the power supply case 10 are exposed from the power supply case 10, and a plurality of electrode pins 21 provided on the bottom surface sides of the power supply boards 20 are exposed and protrude from the power supply case 10 on the bottom side.

Thus, the plurality of electrode pins 21 of the respective power supply boards 20 are brought into direct contact with, and are electrically connected to, the plurality of batteries 60 accommodated in the battery container 50 arranged below the power supply unit 1 at respective predetermined positions without intermediation of a cable or the like.

[0021] Other configurations, structures, and the like of the power supply case 10 are not particularly limited as long as the power supply case 10 includes a space that can accommodate a predetermined number of power supply boards 20, the power supply boards 20 can be inserted/removed and attached/detached from the front side, and the electrode pins 21 of the power supply boards 20 can be exposed and protrude on the bottom side.

Accordingly, the power supply case 10 is provided with configurations and structures required for the power supply unit 1, which include connectors (not shown) on the back end side of the case described above, in the same manner as in a normal charge/discharge device for secondary batteries.

[0022] [Power Supply Board]

The power supply board 20 is a power supply circuit board for contacting each battery 60 in the battery container 50 from above and executing the predetermined charging/discharging.

Specifically, as illustrated in FIG. 1 to FIGS. 3, the power supply board 20 is made from a substrate formed into a board shape or plate shape, and the respective power supply boards 20 are inserted into the above-mentioned power supply case 10 from the front side in a depth direction, and are accommodated and aligned in a state of being arranged in parallel.

[0023] As illustrated in FIG. 1 and FIGS. 2, each power supply board 20 includes the connector 22 on a leading

end side in a case insertion direction (back end side of the case). When each power supply board 20 is inserted and accommodated in the power supply case 10, the connector 22 is fitted and connected to the connector (not shown) located on the back end side of the power supply case 10, and the predetermined charge/discharge processing is executed under control of control means (charge/discharge controller) (not shown).

Although not particularly shown in FIG. 1 to FIGS. 3, it goes without saying that electronic components and battery circuits required for executing the predetermined charge/discharge processing on the batteries 60 are implemented on substrate surfaces (front surfaces and back surfaces) of the respective power supply boards 20.

[0024] In addition, each power supply board 20 is provided, on the trailing end side in the insertion direction, with the screw hole 23 protruding so as to face and abut against an upper edge of an opening on the front side of the power supply case 10, and the screw hole 23 is subjected to screwing and fixing to the tapped hole 11 on the front side of the power supply case 10 through the screw 12.

Thus, a predetermined number of power supply boards 20 are accommodated at predetermined positions in the power supply case 10 in a suspended state, and can be removed in an attachable and detachable manner.

In this embodiment, as illustrated in FIGS. 2, for example, eight power supply boards 20 are attachably and detachably accommodated and fixed at predetermined positions of the power supply case 10.

[0025] In addition, the power supply board 20 is provided, on the bottom surface side, with the plurality of electrode pins 21 capable of contacting batteries in the battery container 50.

The electrode pins 21 are formed as, for example, a pair of positive and negative contact pins or a plurality of (a plurality of pairs of) positive contact pins and negative contact pins, which are connected to the positive electrode 61 and the negative electrode 62 (see FIG. 4) of the batteries 60 accommodated in the battery container 50 described later. In this embodiment, as illustrated in FIG. 1 to FIGS. 3, in correspondence with the number of batteries 60 accommodated in the battery container 50, each power supply board 20 has seven (seven pairs of) electrode pins 21 protruding at predetermined positions with predetermined intervals along the case insertion direction.

[0026] Such a plurality of electrode pins 21 are exposed and protrude downward from an opening on the bottom side of the power supply case 10 under a state in which the respective power supply boards 20 are accommodated and fixed in the power supply case 10, and the plurality of electrode pins 21 of the respective power supply boards 20 can be brought into direct contact with, and electrically connected to, the plurality of batteries 60, which are accommodated in the battery container 50 arranged below the power supply unit 1, at respective predetermined positions.

When both electrodes (positive electrode and negative electrode) of the battery 60 are not provided on an upper surface of the battery, for example, when one of the electrodes of the electrode 60 is provided on a lower surface side of the battery, one of the electrode pins 21 of the power supply board 20 can be brought into contact with and connected to the electrode (positive electrode or negative electrode) on the lower surface side of the battery 60, for example, through a cable, a harness, or the like so as to be capable of contacting the electrode of

the battery 60.

Accordingly, the number, configuration, mode, and the like of the electrode pins 21 can be appropriately caused to correspond to the arrangement and configuration of the electrodes of the batteries 60 to be connected.

[0027] [Battery Container and Battery]

The battery container 50 is a container, which accommodates the plurality of batteries 60 to be inspected in the charge/discharge device for secondary batteries, and is also called a tray, a pallet, or the like.

Specifically, the battery container 50 is formed as a container having an accommodation space opened on an upper surface side, and a predetermined number of batteries 60 can be arranged in a plurality of rows and columns in a planar manner.

In this embodiment, as illustrated in FIG. 1, cylindrical-type secondary batteries (cylindrical batteries) serving as the batteries 60 can be arranged at predetermined intervals in (eight rows in a vertical direction (depth direction in the figure))×(seven columns in a horizontal direction (left-right direction in the figure))=(56 batteries in total).

[0028] The batteries 60 accommodated in the battery container 50 are secondary batteries (lithium ion batteries) to be inspected by the charge/discharge device for secondary batteries, and the predetermined charging/discharging is performed when the batteries 60 contact the electrodes 21 of the power supply boards 20 of the power supply unit 1.

Specifically, the charge/discharge device for secondary batteries is provided with raising/lowering means or a raising/lowering mechanism (not shown) called a so-called mechanical unit, into which the battery container 50 accommodating the batteries 60 is inserted and placed. Through a raising/lowering operation of the raising/lowering means, the battery container 50 placed thereon moves upward or rises, contacts the electrodes 21 of the power supply boards 20 at a predetermined position, and charge/discharge processing is executed.

After completion of the charge/discharge processing, through the raising/lowering operation of the raising/lowering means, the battery container moves downward or descends, contact with the electrodes 21 of the power supply boards 20 is released, the battery container 50 can be pulled out from a placement position of the raising/lowering means, and the batteries 60 for which the charging/discharging has been completed can be taken out from the battery container 50.

[0029] FIG. 3(a) shows a state in which the battery container 50 accommodating the batteries 60 is installed and arranged at a predetermined position of the raising/lowering means (not shown) below the power supply case 10, and moves upward and downward, or is raised and lowered, through movable operation of the raising/lowering means.

FIG. 3(b) shows a state in which the battery container 50 has risen upward to be combined with the power supply unit 1. In this state, the electrode pins 21 of the power supply board 20 are brought into direct contact with the electrodes (the positive electrodes 61 and the negative electrodes 62) of the batteries 60, thereby enabling current transmission from the power supply board 20 to the batteries.

[0030] FIG. 4 shows an example of such a battery 60 accommodated in the battery container 50 as described

above.

The battery 60 illustrated in the figure is an example of a cylindrical-type battery (cylindrical battery), in which a protruding portion at a center of the upper surface of the battery is the positive electrode 61, and substantially the entire other part of the surface (upper surface) is the negative electrode 62.

With respect to such a battery 60, the electrode pins 21 of the power supply board 20 of the battery unit 1 located thereabove respectively contact the positive electrode 61 and the negative electrode 62 of the battery 60, and are electrically connected thereto, and hence the predetermined charge/discharge processing is executed on the battery 60.

As described above, the electrode pins 21 of the power supply board 20 are formed of, for example, a pair of positive and negative contact pins, a plurality of (a plurality of pairs of) positive contact pins and negative contact pins, or a plurality of contact pins having different numbers between positive and negative contact pins, and can be set and formed in correspondence with electrodes on the to-be-inspected battery 60 side.

[0031] In this case, as batteries to be inspected by the power supply unit 1 (charge/discharge device for secondary batteries) in this embodiment, there are a plurality of types (forms/structures), including the cylindrical-type battery 60 illustrated in FIG. 4, and in general, there are cylindrical-type, prismatic-type, and laminated-type batteries as described below.

In this embodiment, the cylindrical-type battery 60 is described with reference to the illustration thereof, but the form and structure of the battery are not particularly limited, and it goes without saying that even batteries having other forms (of the prismatic-type and the laminated-type) can be applied as the batteries to be inspected by the charge/discharge device for secondary batteries according to the present invention.

[0032] [Cylindrical Type]

The cylindrical type indicates a cylindrical-shaped battery represented by, for example, 18650 and 21700 batteries, and is most suitable for the power supply unit 1 of the "integrated type" as also illustrated in FIG. 1. A contact between the power supply board 20 (electrode pin 21) and the battery 60 is generally a probe pin.

[Prismatic Type]

The prismatic type indicates a rectangular parallelepiped-shaped battery, and can be supported also by the power supply unit 1 of the "integrated type." However, the battery differs in shape depending on an application, a use target, and the like of the battery, and hence support on the power supply unit 1 side is required in some cases. A contact between the power supply board 20 and the battery 60 is generally a probe pin, and depending on the battery, for example, a pressure restraint mechanism, a jig, or the like for reliably bringing the battery into contact with the probe pin is required in some cases.

[Laminated Type]

The laminated type indicates a pouch-shaped battery, and unlike the cylindrical-type battery, does not allow connection, as it is, to the power supply unit 1 of the "integrated type," thus requires a harness or the like, but can be supported through improvement, development, and the like. A contact between the power supply board 20 and the battery 60 is generally a dedicated clip, and there are cost increase factors such as an increase in the

amount of wiring, as compared to the prismatic type and the cylindrical type.

[0033] [Attachment/Detachment and Assembly Procedure]

In the charge/discharge device for secondary batteries of the "integrated type" having such a configuration as described above, work processes exhibited when the power supply board 20 is attached/detached and mounted to the power supply case 10 in the power supply unit 1 illustrated in FIG. 1, which is a premise of the present invention, and problems at that time are described with reference to FIG. 5 to FIG. 6.

First, the respective plurality of power supply boards 20 are mounted to the power supply case 10.

As illustrated in FIG. 5, in a mounting method, the power supply board 20 is inserted from the front side of the power supply case 10, the connector 22 on the leading end side of the power supply board 20 in the insertion direction is fitted and connected to the connector on the back end side of the power supply case 10, and in that state, the power supply board 20 is screw-fixed to an upper portion on the front side of the power supply case 10.

[0034] Specifically, each power supply board 20 is provided, on the trailing end side in the insertion direction, with the screw hole 23 protruding so as to face and abut against the upper edge of the opening on the front side of the power supply case 10, and the screw hole 23 is subjected to screwing and fixing to the tapped hole 11 on the front side of the power supply case 10 through the screw 12.

This mounting work is sequentially performed for a predetermined number of (in this embodiment, eight) power supply boards 20.

[0035] However, such work of mounting and screw-fixing the power supply board 20 to the power supply case 10 requires a worker to grip the power supply board 20 by hand and always hold the power supply board 20 under a state in which the power supply board 20 is suspended in midair. However, holding the power supply board 20 in such a manner is extremely difficult operation and work in consideration of the weight, structure, and the like of the power supply board 20, and not only imposes a large burden on the worker, but also has had a possibility of causing the power supply board 20 to fall off or drop in a worst case.

As described above, the charge/discharge device for secondary batteries of the "integrated type" requires a lower portion of the power supply case 10 forming the power supply unit 1 to have the electrode pins 21 of the power supply board 20 exposed in order to directly connect to the batteries 60 located below without a cable.

For that reason, the power supply board 20 of the power supply unit 1 has a structure in which no support or receiver is present at a lower portion (see FIG. 5).

[0036] In such a state, when attachment/detachment work from the power supply case 10 is to be performed on the power supply board 20 for, for example, maintenance or the like, there occur difficulty in work of holding the power supply board 20 and a risk such as falling off or dropping thereof, as have been described above.

Specifically, the maintenance of the power supply board 20 is a process and work in which the power supply board 20 is removed from the power supply case 10, required inspection, component replacement, or the like is performed thereon, and after completion thereof, the power supply board 20 is returned to an original position in the power supply case 10 again, and is accommodated and fixed.

Then, in order to attach/detach the power supply board 20 to/from the power supply case 10, as illustrated in FIG. 5, it is required to remove or tighten the screw 12 on an upper front surface of a top plate of the power supply case 10, which is fixing the power supply board 20, but at that time, the power supply board 20 is open on a lower side, and is in a state having no support.

[0037] For that reason, when the worker removes the screw 12 without supporting the power supply board 20, as illustrated in FIG. 6, the power supply board 20 falls downward merely by doing so.

When the power supply board 20 is dropped, the power supply board 20 itself is damaged, the worker is injured, or when the battery container 50 is present below, the batteries 60 are subjected to breakage, damage, and the like, and there is also a risk of leading to ignition or fire.

In order to prevent such a situation, the worker is required to perform work of attachment/detachment and screwing of the screw 12 at the same time while, for example, supporting the power supply board 20 with one hand, performing work by a plurality of workers, or performing any other means or method in some suitable manner so as to prevent the power supply board 20 from falling downward.

[0038] In addition, such problems occur not only when the power supply board 20 is removed but also when the power supply board 20 for which the maintenance or the like has been completed is mounted to the power supply case 10 side, in exactly the same manner.

In particular, recent power supply boards have become extremely heavier due to integration of a large number of components, and hence maintenance work is extremely difficult and dangerous work, which has been a significant problem.

In view of this, in this embodiment, the following structure and configuration of the guide structure 30 is provided in order to prevent the power supply board 20 from dropping when the worker attaches/detaches the power supply board 20 to/from the power supply case 10 even without supporting a lower portion and the like of the power supply board 20 with one hand.

[0039] [Guide structure]

FIG. 7 is a schematic perspective view for schematically illustrating an overall configuration of the power supply case 10 and the power supply board 20 including the guide structure 30 in this embodiment.

FIG. 8 is a schematic perspective view for schematically illustrating the power supply board 20 including the guide structure 30 illustrated in FIG. 7.

FIG. 9 is a schematic front view of the power supply case 10 and the power supply board 20 including the guide structure 30 as well.

FIGS. 10 are views for schematically illustrating the power supply board 20 including the guide structure 30 as well, in which FIG. 10(a) is a schematic front view, and FIG. 10(b) is a schematic side view.

[0040] As illustrated in those figures, the guide structure 30 is means or a mechanism for attachably and detachably guiding the plurality of power supply boards 20 in the power supply case 10 in a suspended state.

Providing the guide structure 30 causes each of the plurality of power supply boards 20 to be held in the power supply case 10 in a suspended state attachably and detachably in a manner that prevents falling off.

Accordingly, in maintenance or the like of the power supply unit 1, when the power supply board 20 is attached/detached, there is no risk of causing the power supply board 20 to fall off or drop, and the worker can freely use both hands, thereby enabling workability and safety of the attachment/detachment and assembly to be greatly improved.

[0041] As illustrated in FIG. 7, the guide structure 30 includes engagement structures, which are provided on upper edge sides of the respective plurality of power supply boards 20 and on an inner side of the power supply case 10 in correspondence with the respective plurality of power supply boards 20, and which are engageable with each other.

Specifically, as illustrated in FIG. 8 to FIGS. 10, the engagement structures forming the guide structure 30 include a protruding portion 31 and a rail portion 32 that are engageable with each other.

[0042] The protruding portion 31 is a member extending along a longitudinal direction on the upper edge side of each of the plurality of power supply boards 20 and protruding on both sides of the power supply board 20.

The protruding portion 31 can be formed of, for example, a pair of L-shaped longitudinal members, which are fixed on both sides of the upper edge of the power supply board 20 along a board longitudinal direction, and form a T-shape in a front view (see FIG. 9) together with a front portion of the power supply board 20.

The rail portion 32 is a rail member, which is provided on a ceiling surface on the inner side of the power supply case 10, and is engageable with the protruding portion 31.

The rail portion 32 can be formed of, for example, a pair of L-shaped rail members, which are fixed on an inner side of a top surface of the power supply case 10 along a case longitudinal direction, and form a downward C-shape in the front view (see FIG. 9) together with a top surface portion of the power supply case 10.

[0043] In this case, the protruding portion 31 is preferred to have a predetermined length, which is shorter than the total length of the power supply board 20 in the longitudinal direction at the upper edge of the power supply board 20, with both end portions terminating on an inner side of the power supply board 20 in the longitudinal direction.

Further, the rail portion 32 is preferred to have a predetermined length, which is slightly shorter than the total length of the power supply case 10 in the longitudinal direction on the inner side of the top surface of the power supply case 10, with both end portions terminating on the inner side of the power supply case 10 in the longitudinal direction.

In addition, an end portion of the protruding portion 31 on the leading end side in the insertion direction is preferred to be subjected to rounded R processing or taper processing that provides a tapered shape.

With this configuration, through insertion of the power supply board 20 from the front of the power supply case 10, the leading end portion of the protruding portion 31 in the insertion direction can be easily installed and engaged with an end portion of the rail portion 32, and after that, the power supply board 20 can be inserted and accommodated in the power supply case 10 by only slidingly moving the power supply board 20 to the back side of the power supply case 10.

[0044] In addition, the engagement structures forming the guide structure 30 described above can include

positioning structure by which the respective plurality of power supply boards 20 are held in a suspended state at predetermined positions in the power supply case 10.

The positioning structure can be formed of, for example, protrusions, which are provided to the respective plurality of power supply boards 20, and abut against the rail portions 32 at predetermined positions in the power supply case 10.

Specifically, for example, protrusions such as bolts, which restrict insertion and sliding movement of the power supply boards 20 by abutting against end portions of the rail portions 32 at accommodation positions of the power supply boards 20, can be provided on trailing end portion sides of the power supply boards 20 in the insertion direction. Thus, the power supply boards 20 can be positioned at predetermined positions in the insertion direction (horizontal direction) in the power supply case 10.

[0045] Further, for example, protrusions such as bolts, which abut against and clamp the rail portion 32 from above and below together with the protruding portion 31, can be provided on a leading end portion side of the power supply board 20 in the insertion direction. Thus, the power supply board 20 can be positioned at a predetermined position in a height direction (vertical direction) in the power supply case 10.

Providing the positioning structure as described above enables an insertion operation of the power supply board 20 into the power supply case 10 to be performed more easily and smoothly. In addition, the power supply board 20 can be stopped and positioned at a predetermined position in the power supply case 10 by only slidingly moving the power supply board 20 to the back side of the power supply case 10, thereby enabling insertion/removal and attachment/detachment work for the power supply board 20 to be further facilitated and more efficiently performed.

[0046] As described above, as illustrated in FIG. 7 to FIGS. 10, the guide structure 30 provided in the power supply unit 1 in this embodiment is configured based on imagery of a kind of "suspended monorail," which enables the power supply board 20 to be suspended and slid forward and backward, by providing, at a lower portion of the top plate of the power supply case 10 and an upper portion of the power supply board 20, such rail mechanisms (engagement structures) that engage with each other.

In this embodiment, the rail mechanism includes, as a specific example thereof, a (downward) C-shaped rail (see FIG. 9) at the lower portion of the top plate of the power supply case 10 and a T-shaped rail (see FIG. 8 and FIGS. 10) at the upper portion of the power supply board 20.

In FIG. 8 to FIGS. 10, the engagement structures (protruding portion 31 and rail portion 32) are exaggeratedly drawn so that structures of the engagement structures are easy to understand.

[0047] Providing the protruding portion 31 and the rail portion 32 as described above enables the power supply board 20 to be attached to and detached from the power supply case 10 by only sliding the power supply board 20, and eliminates a fear that the power supply board 20 may drop.

After the power supply board 20 is slidingly inserted into the power supply case 10, in the same manner as in the related-art charge/discharge device for secondary batteries described above (see FIG. 5), the screw 12 is screwed into the screw hole 23 of each power supply board 20 and the tapped hole 11 on the front side of the

power supply case 10, and hence the power supply board 20 is fixed to the power supply case 10.

In addition, when the power supply board 20 is removed from the power supply case 10, the power supply board 20 can be easily removed from the power supply case 10 by only releasing the screw 12 fixing the power supply board 20 and then slidingly moving the power supply board 20 to the front side of the power supply case 10.

[0048] The guide structure 30 in this embodiment is not limited to the above-mentioned engagement structures and rail shape, and may have other forms or the like as long as the guide structure 30 has a structure or mechanism capable of holding and sliding the power supply board 20 in the power supply case 10.

For example, in the guide structure 30 described above, both the protruding portion 31 on the power supply board 20 side and the rail portion 32 on the power supply case 10 side are formed in a continuous linear shape having no break, but in addition thereto, for example, the protruding portion 31 can also be formed as a discontinuous protruding portion or protrusion having a break. With this configuration, the material of the protruding portion 31 can be saved, thereby enabling reduction in cost and suppression of an increase in weight of the power supply board 20.

[0049] Further, in the guide structure 30 described above, the protruding portion 31 protruding on both sides of the power supply board 20 is provided as the engagement structure that engages with the rail portion 32 on the power supply case 10 side, but in addition thereto, for example, a groove portion with which the rail portion 32 is engageable can be formed in the upper edge of the power supply board 20, to thereby form the engagement structure.

That is, as the guide structure in the present invention, any shapes or forms, such as any recess-protrusion structures, can be configured as the guide structure as long as the guide structure has engagement structures, which are provided on the upper edge sides of the power supply boards 20 and on the inner side of the power supply case 10 in correspondence with the power supply boards 20, and which are engageable with each other.

[0050] As described above, with the charge/discharge device for secondary batteries according to the one embodiment of the present invention, a large number of power supply boards 20 accommodated in the power supply case 10 of the power supply unit 1 are held in the power supply case 10 in a suspended state through the guide structure 30 attachably and detachably in a manner that prevents falling off.

Thus, in the maintenance or the like of the power supply unit 1, when the power supply board 20 is attached/detached, there is no risk of carelessly causing the power supply board 20 to fall off or drop, and the worker can use both hands, thereby greatly improving the workability of the attachment/detachment and assembly.

[0051] In the related-art power supply unit 1, the power supply board 20 has been only fixed and held to the power supply case 10 by screw-fixing. Accordingly, the worker performing the attachment/detachment work has been required to simultaneously perform work of loosening (or tightening) a screw fixing the power supply board 20 while supporting the power supply board 20 with an available hand, holding the power supply board 20 by a plurality of persons, or taking any other means and paying attention in some suitable manner so as to prevent the

power supply board 20 from dropping from the power supply case 10.

For that reason, it has been required to always pay close attention to causing the power supply board 20 to fall off or drop, the attachment/detachment itself of the power supply board 20 has been difficult and time-consuming work, there has been a problem of significantly impairing the workability and efficiency of the entire maintenance of the power supply unit 1, and there has also been a fear that the worker may suffer injury or the like.

[0052] Meanwhile, in the charge/discharge device for secondary batteries of the present invention, the guide structure 30 enables the respective plurality of power supply boards 20 to be held and accommodated in the power supply case 10 in a suspended state attachably and detachably in a manner that prevents falling off, and the power supply boards 20 can be held by the power supply case 10 without falling off or dropping even when the worker releases the hands from the power supply boards 20, thereby allowing the worker to freely use both hands.

Accordingly, according to the present invention, the attachment/detachment and assembly of the plurality of power supply boards 20 can be easily, quickly, and safely performed, and it is possible to greatly improve the workability and safety of the maintenance or the like of the charge/discharge device for secondary batteries and the power supply unit 1.

[0053] The charge/discharge device for secondary batteries according to this embodiment described above is provided with a physical electric circuit (not shown) or a computer that executes predetermined processing, means, and functions in accordance with instructions of a program (software) instead of the physical electric circuit, as the control means (charge/discharge controller) for executing and controlling the predetermined charge/discharge processing by the power supply unit 1. The program can send commands to respective components of the computer and cause the power supply unit 1 to perform the predetermined charge/discharge processing, functions, and the like in the present invention.

Accordingly, each processing, means, and functions of the power supply unit 1 in the present invention can be implemented by specific means in which the program and the computer cooperate.

[0054] In this case, the entirety or a part of the program is provided by, for example, a magnetic disk, an optical disk, a semiconductor memory, or any other computer-readable recording medium, and the program read out from the recording medium is installed in the computer and executed. The program can also be executed by being directly loaded into the computer through a communication line without intermediation of the recording medium.

Further, the computer that controls the power supply unit 1 in the present invention can be formed of a single information processing device (for example, one personal computer), or can be formed of a plurality of information processing devices (for example, a group of a plurality of server computers).

[0055] Specifically, the information processing device forming electric power control means (charge/discharge controller) in the present invention is formed of, for example, hardware including a CPU, a RAM, a ROM, an HDD, an input device, a display device (display), a communication IF, and the like. Those components are connected to each other by a system bus, and data is exchanged via the system bus. The central processing unit (CPU) is

also called a central processor, is a part of a computer that performs central processing, and controls each device and calculates or processes data. The random access memory (RAM) is one type of memory device that can erase or rewrite data. The read only memory (ROM) is one type of memory device using a semiconductor or the like, and can only read out recorded data at the time of usage, the data being written only once at the time of manufacture. The hard disk drive (HDD) is an auxiliary storage device that records and reads out information through use of properties of a magnetic body. The input device is used by the user to give an operation instruction to the computer or to input characters and the like, and specifically, is formed of a keyboard, a mouse, and the like. The display device is formed of, for example, a liquid crystal display. Each device in this system may include a device having a touch panel function in which the input device and the display device are integrated. In addition, a communication function (communication IF) that enables communication to/from another terminal, information processing device, and the like can also be included. The communication interface (IF) is a device for communicating to/from another device in accordance with a predetermined communication standard, and includes, for example, a network interface card (NIC).

[0056] The preferred embodiment of the present invention has been shown and described above, but the present invention is not limited to the embodiment described above. Needless to say, various modifications may be made within the scope of the present invention.

For example, in the above-mentioned embodiment, as the configuration of the charge/discharge device for secondary batteries, the case of the "cableless system/fixture-integrated type" in which the electrode pins 21 of the power supply board 20 of the power supply unit 1 are brought into direct contact with the electrodes (positive electrodes 61 and negative electrodes 62) of batteries 60 to be inspected has been described as an example. However, the present invention is not particularly limited to a connection structure between the power supply unit and the batteries, and the like, as long as the power supply board is arranged and accommodated in the power supply unit in a suspended state.

Accordingly, the present invention can also be suitably applied to a charge/discharge device of a (normal) system in which an output end of a power supply circuit and a battery are electrically connected by a cable when the power supply board is held in a suspended state attachably and detachably in a manner that prevents falling off.

[0057] Further, in regard to the guide structure 30 described in the above-mentioned embodiment, the configuration of the rail portion 32 provided on the power supply case 10 side can be provided to, for example, a rack or stand for temporary storage of the power supply board 20.

As described above, at the time of the maintenance or the like of the power supply unit 1, required inspection, repair, or the like is performed under a state in which the power supply board 20 has been removed from the power supply case 10. In a manufacturing process for the power supply board 20 as well, required work is performed under the state in which the power supply board 20 has been removed from the power supply case 10.

In such a case, the power supply board 20 may be mounted to, for example, the rack or stand for

temporary storage until the power supply board 20 is finally accommodated in the power supply case 10, and it is desired that such a rack or stand be capable of holding and temporarily storing the power supply board 20 in a suspended state in the same manner as in the power supply case 10 described above.

[0058] In view of this, as such a rack or stand for temporary storage, in the same manner as in the power supply case 10 described above, it is possible to use a rack or stand including an engagement structure similar to the rail portion 32 that can attachably and detachably guide, in a suspended state, the power supply board 20 including the protruding portion 31 and the positioning structure of the guide structure 30 in the present invention and can hold the power supply board 20 in a manner that prevents falling off.

Through use of such a rack or stand including a configuration similar to that of the guide structure 30 and the engagement structure, temporary storage work for the power supply board 20 can be easily, safely, and quickly performed, and maintenance work for the power supply unit 1 can be more efficiently performed.

Industrial Applicability

[0059] The present invention can be suitably used as a charge/discharge device for secondary batteries which performs charging/discharging for activation and quality inspection of secondary batteries that are used, for example, for IT equipment such as smartphones, and electric vehicles.

Reference Signs List

[0060]
1 power supply unit (charge/discharge device for secondary batteries)
10 power supply case
11 tapped hole
20 power supply board
21 electrode pin
22 connector
23 screw hole
30 guide structure
31 protruding portion
32 rail portion
50 battery container
60 battery (cylindrical battery)
61 positive electrode
62 negative electrode

Claims

[Claim 1] A charge/discharge device for secondary batteries, comprising a power supply unit arranged above a battery container accommodating a plurality of secondary batteries to be inspected, the power supply unit being configured to execute predetermined charging/discharging on the secondary batteries,

wherein the power supply unit includes:

a plurality of power supply boards configured to contact the respective secondary batteries in the battery container from above and execute the predetermined charging/discharging;

a power supply case configured to accommodate the plurality of power supply boards in a suspended state at predetermined positions corresponding to the respective secondary batteries in the battery container; and

guide structure for attachably and detachably guiding the plurality of power supply boards in the power supply case in a suspended state, and

wherein the respective plurality of power supply boards are held by the guide structure in the power supply case in a suspended state attachably and detachably in a manner that prevents falling off.

[Claim 2] The charge/discharge device for secondary batteries according to claim 1, wherein the guide structure includes engagement structures, which are provided on upper edge sides of the respective plurality of power supply boards and on an inner side of the power supply case in correspondence with the respective plurality of power supply boards, and are engageable with each other.

[Claim 3] The charge/discharge device for secondary batteries according to claim 2, wherein the engagement structures include:

a protruding portion extending along a longitudinal direction on an upper edge side of each of the plurality of power supply boards and protruding on both sides of the each of the plurality of power supply boards; and

a rail portion, which is provided on a ceiling surface on the inner side of the power supply case, and is engageable with the protruding portion.

[Claim 4] The charge/discharge device for secondary batteries according to claim 3, wherein the engagement structures include positioning structure by which each of the plurality of power supply boards is held in a suspended state at a predetermined position in the power supply case.

[Claim 5] The charge/discharge device for secondary batteries according to claim 4, wherein the positioning structure includes a protrusion, which is provided to each of the plurality of power supply boards, and which is configured to abut against the rail portion at a predetermined position in the power supply case.