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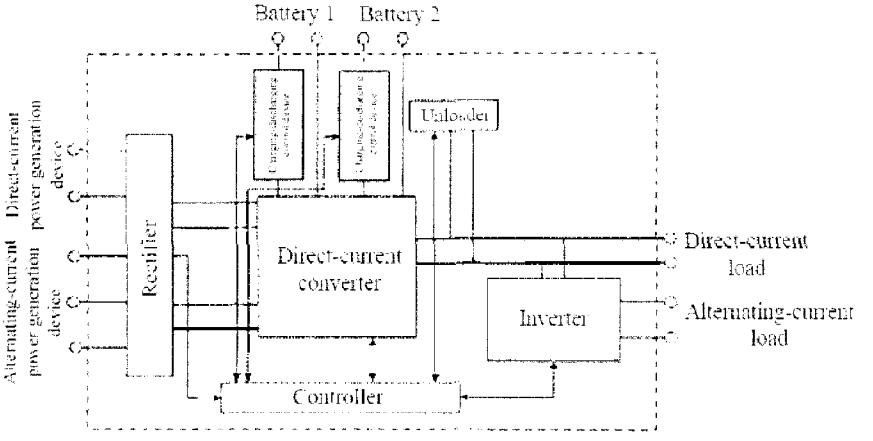
(54) Title: POWER SUPPLY CONNECTION DEVICE, AND CHARGING-DISCHARGING CONTROL METHOD FOR SAME



(57) Abrégé/Abstract:
Provided in the present invention is a power supply connection device, used to connect to a power generation unit and an energy storage unit, and supply power to a load. The power supply connection device comprises a current regulator, a DC converter, a dump load, an inverter, and a controller. The current regulator is used to regulate an input from the power generation unit. The DC converter is used to step up the voltage of an input from the energy storage unit, an input from the power generation unit, or the regulated input of the power generation unit. The dump load is used to release excessive energy. The inverter is used to perform DC to AC conversion. The power supply connection device further comprises a charging-discharging control device used to control the energy storage unit to charge or discharge. The controller controls the charging-discharging control device. Also provided in the present invention is a charging-discharging control method for a power supply connection device. By modifying a connection mode of an energy storage unit, the power supply connection device provided in the present invention reduces the number of times of charging and discharging the energy storage unit, thus increasing the service life of the energy storage unit, decreasing an operating cost of a micro-grid system comprising the power supply connection device, and ensuring stable and reliable power supply of the micro-grid system.

Abstract

Provided in the present invention is a power supply connection device, used to connect to a power generation unit and an energy storage unit, and supply power to a load. The power supply connection device comprises a current regulator, a DC converter, a dump load, an inverter, and a controller. The current regulator is used to regulate an input from the power generation unit. The DC converter is used to step up the voltage of an input from the energy storage unit, an input from the power generation unit, or the regulated input of the power generation unit. The dump load is used to release excessive energy. The inverter is used to perform DC to AC conversion. The power supply connection device further comprises a charging-discharging control device used to control the energy storage unit to charge or discharge. The controller controls the charging-discharging control device. Also provided in the present invention is a charging-discharging control method for a power supply connection device. By modifying a connection mode of an energy storage unit, the power supply connection device provided in the present invention reduces the number of times of charging and discharging the energy storage unit, thus increasing the service life of the energy storage unit, decreasing an operating cost of a micro-grid system comprising the power supply connection device, and ensuring stable and reliable power supply of the micro-grid system.

POWER SUPPLY CONNECTION DEVICE, AND CHARGING-DISCHARGING CONTROL METHOD FOR SAME

[0001] The present application claims the priority of Chinese patent applications CN201610343620.4, CN201620472328.8, CN201610339975.6, and CN201620467454.4 with the filing date of 20 May 2016.

Field of invention

[0002] The present invention relates to the field of electrical control, and in particular to a power supply access device and a charging-discharging control method for same.

Prior arts

[0003] The rapid expansion of semiconductor power devices, the maturity of modern control theory, and the intelligent development of power systems have brought about an opportunity for the development of micro-grid apparatuses in a micro-grid system.

[0004] In a typical intelligent micro-grid system, in order to securely and efficiently access and make full use of distributed energy, including a rectifier, an inverter, a direct- current converter, an unloader and an energy storage unit, as shown in Fig. 1, electric energy generated by a fan and a photovoltaic assembly charges the energy storage unit, and the energy storage unit is discharged to supply power to a direct-current or alternating-current load.

[0005] By means of such a structure, during a power supply process of the micro-grid, the energy storage unit is continuously charged and discharged, and since the number of times of charging and discharging of the energy storage unit is limited, the energy storage unit will be scrapped after having been used for a period of time, and must be replaced, resulting in a relatively high running cost of the micro-grid system.

[0006] In addition, the inverter, the direct-current converter and the unloader are often each configured with a separate controller for control, and the various devices in the system are relatively dispersed, such that the micro-grid system occupies a larger space and the running cost is further increased.

Content of the present invention

[0007] In view of the problems existing in the prior art, the object of the present invention is to provide a power supply access device, which reduces the number of times of charging and discharging of an energy storage unit by changing a connection mode of the energy storage unit, thus prolonging the service life of the energy storage unit, decreasing running costs of a micro-grid system constituted by the power supply access device, and ensuring stable and reliable supplying of power to the micro-grid system.

CA 3019619 2020-03-20

[0008] The present invention provides a power supply access device for accessing a power generation unit and an energy storage unit and supplying power to a load. The power supply access device comprises a rectifier, a direct-current converter, an unloader, and an inverter. The rectifier is used to rectify an input from the power generation unit. The direct-current converter is used to boost an input from the energy storage unit, the input from the power generation unit, or the rectified input from the power generation unit. The unloader is used to release excess energy. The inverter is used to convert direct current into alternating current. The power supply access device further comprises a charging-discharging control device and a controller, wherein the charging-discharging control device is used to control the discharging or charging of the energy storage unit. The controller controls the charging-discharging control device.

[0009] Further, the controller is connected to the direct-current converter, the unloader and the inverter; the controller is used to control the direct-current converter, the unloader and the inverter; the unloader is connected to the direct-current converter and the inverter; and the unloader is mounted on a high-voltage bus between the direct-current converter and the inverter.

[0010] Further, the charging-discharging control device is arranged between the energy storage unit and the high-voltage bus.

[0011] Further, the direct-current converter is a BOOST circuit.

[0012] Further, a positive electrode of the energy storage unit is connected to the charging-discharging control device via an inductor of the BOOST circuit, and then connected to the high-voltage bus via the charging-discharging control device.

[0013] Further, the direct-current converter is a bidirectional BUCK-BOOST circuit.

[0014] Further, the positive electrode of the energy storage unit is connected to a first terminal of an inductor of the bidirectional BUCK-BOOST circuit via a parallel circuit of a second controllable switch and an unidirectionally-conducted diode, the other terminal of the inductor is grounded, and the charging-discharging control device is connected between the first terminal of the inductor and the high-voltage bus.

[0015] Further, the second controllable switch is used to control whether to access the energy storage unit.

[0016] Further, controlling whether to access the energy storage unit comprises:

[0017] when the power of electricity generated by the power generation unit is greater than a product of a load power and a first coefficient, if the energy storage unit is not fully charged, charging the energy storage unit, and if the energy storage unit is fully charged, switching out the energy storage unit, and activating the unloader;

[0018] when the power of the electricity generated by the power generation unit is less than a product of the load power and a second coefficient, switching in the energy storage unit, so that the energy storage unit is discharged, and the energy storage unit supplies power to the load together with the power generation unit; and

[0019] when the power of the electricity generated by the power generation unit is greater than or equal to the product of the load power and the second coefficient and less than or equal to the product of the load power and the first coefficient, switching out the energy storage unit.

[0020] Further, the charging-discharging control device comprises a unidirectional channel and a controllable channel connected in parallel, wherein when the controllable channel is disconnected, the energy storage unit is discharged via the unidirectional channel, and when the controllable channel is conducted, the energy storage unit is charged via the controllable channel.

[0021] Further, the controllable channel is provided with a first controllable switch, and the unidirectional channel is provided with a diode for unidirectional conduction.

[0022] Further, the power supply access device comprises one or more sets of energy storage unit access terminals.

[0023] Further, the energy storage unit access terminals are used to access energy storage units having the same charging and discharging properties.

[0024] Further, the energy storage unit access terminals are used to access energy storage units having different charging and discharging properties, and the controller discharges the energy storage unit with different priorities or at different frequencies.

[0025] Further, the controller has a battery management function.

[0026] Further, the battery management function comprises:

[0027] estimating a state of charge of the energy storage unit; and

[0028] collecting terminal voltages as well as charging and discharging current in real time during charging and discharging processes of the energy storage unit.

[0029] Further, some or all of the rectifier, the direct-current converter, the unloader and the inverter are arranged on the same PCB board.

[0030] The present invention further provides a charging-discharging control method for the power supply access device, comprising the steps of:

[0031] (a) when the power of electricity generated by the power generation unit is greater than the product of the load power and the first coefficient, if the energy storage unit is not fully charged, controlling the charging of the energy storage unit, and if the energy storage unit is fully charged, switching out the energy storage unit, and activating the unloader;

[0032] (b) when the power of the electricity generated by the power generation unit is less than the product of the load power and the second coefficient, controlling the discharging of the energy storage unit, so that the energy storage unit supplies power to the load together with the power generation unit; and

[0033] (c) when the power of the electric power generated by the power generation unit is greater than or equal to the product of the load power and the second coefficient and less than or equal to the product of the load power and the first coefficient, switching out the energy storage unit.

[0034] Further, the first coefficient is greater than or equal to the second coefficient.

[0035] Compared with the prior art, the power supply access device and the charging-discharging control method for same provided in the present invention have the following beneficial effects: reducing the number of times of charging and discharging of an energy storage unit by changing a connection mode of the energy storage unit, thus prolonging the service life of the energy storage unit, decreasing a running cost of a micro-grid system constituted by the power supply access device, and ensuring stable and reliable supplying of power to the micro-grid system. In addition, by sharing a controller with the direct-current converter, the unloader and the inverter, and arranging some or all of the rectifier, the direct-current converter, the unloader and the inverter on the same PCB board, the present invention further reduces redundant components, space and costs.

Brief description of the drawings

[0036] Fig. 1 is a schematic structural diagram of a power supply access device in the prior art;

[0037] Fig. 2 is a schematic structural diagram of a power supply access device of an embodiment of the present invention;

[0038] Fig. 3 is a circuit diagram of a bidirectional BUCK-BOOST circuit and a charging-discharging control device;

[0039] Fig. 4 is one circuit diagram of a BOOST circuit and a charging-discharging control device;

[0040] Fig. 5 is another circuit diagram of a BOOST circuit and a charging-discharging control device; and

[0041] Fig. 6 is a schematic structural diagram of a power supply access device of a still further embodiment of the present invention.

Detailed description of the preferred embodiment

[0042] As shown in Fig. 2, a power supply access device of an embodiment of the present invention is used to access a power generation unit and an energy storage unit, and supply power to a load. The power supply access device comprises a rectifier, a direct-current converter, an unloader, an inverter and a controller. The rectifier is used to rectify an input from the power generation unit. The direct-current converter is used to boost an input from the energy storage unit, the input from the power generation unit, or the rectified input from the power generation unit. The unloader is used to release excess energy. The inverter is used to convert direct current into alternating current. The

power supply access device further comprises a charging-discharging control device for controlling the charging or discharging of the energy storage unit. The controller controls the charging-discharging control device.

[0043] The power generation unit may be a direct-current power generation device and/or an alternating-current power generation device.

[0044] There may be one or more power generation units.

[0045] In this embodiment, there are two power generation units, and the power generation unit comprises a direct-current power generation device and an alternating-current power generation device, wherein the direct-current power generation device is a photovoltaic assembly, and the alternating-current power generation device is a fan. Of course, the alternating-current power generation device may also be a diesel generator, and of course, may also only comprise a fan, or only comprise the photovoltaic assembly, which is not limited in the present invention.

[0046] In this embodiment, the energy storage unit is a lead-acid battery. The energy storage unit may also be a battery, such as a lead-acid battery, a lithium battery, a liquid flow battery or a sodium-sulfur battery, which is not limited in the present invention.

[0047] The power supply access device further comprises a controller, wherein the controller is connected to the direct-current converter, the unloader and the inverter for controlling the direct-current converter, the unloader, the inverter and a charging-discharging control device. The direct-current converter, the unloader, the inverter and the charging-discharging control device share a controller, so that redundant components and costs can be reduced.

[0048] The charging-discharging control device is arranged between the energy storage unit and the high-voltage bus.

[0049] The unloader is connected to the direct-current converter and the inverter, and the unloader is mounted on a high-voltage bus between the direct-current converter and the inverter.

[0050] Some or all of the rectifier, the direct-current converter, the unloader and the inverter are arranged on the same PCB board, thereby achieving the beneficial effects of reducing the space and reducing the cost.

[0051] In this embodiment, a circuit is as shown in Fig. 3, in which the direct-current converter is a bidirectional BUCK-BOOST circuit; and a positive electrode of the energy storage unit is connected to a first terminal of an inductor L of the bidirectional BUCK-BOOST circuit via a parallel circuit of a second controllable switch Q2 and an unidirectionally-conducted diode D2, and the other terminal of the inductor L is grounded; and the charging-discharging control device comprising a first controllable switch Q1 and a unidirectionally-conducted diode D1 is connected between the first terminal of the inductor L and the high-voltage bus.

[0052] The charging-discharging control device comprises a unidirectional channel

and a controllable channel connected in parallel, wherein when the controllable channel is disconnected, the energy storage unit is discharged via the unidirectional channel, that is, outputting a power to the load; and when the controllable channel is conducted, the energy storage unit is charged via the controllable channel.

[0053] Specifically, the controllable channel is provided with the first controllable switch Q1, the unidirectional channel is provided with the diode D1 for unidirectional conduction, and the controller controls switch-off and switch-on of the first controllable switch Q1 via a control terminal A.

[0054] A charging-discharging control method for a power supply access device in this embodiment comprises the steps of:

[0055] (a) when the power of electricity generated by the power generation unit is greater than the product of the load power and the first coefficient, if the energy storage unit is not fully charged, controlling the charging of the energy storage unit, and if the energy storage unit is fully charged, switching out the energy storage unit, and activating the unloader;

[0056] (b) when the power of the electricity generated by the power generation unit is less than the product of the load power and the second coefficient, controlling the discharging of the energy storage unit, so that the energy storage unit supplies power to the load together with the power generation unit; and

[0057] (c) when the power of the electric power generated by the power generation unit is greater than or equal to the product of the load power and the second coefficient and less than or equal to the product of the load power and the first coefficient, switching out the energy storage unit.

[0058] The second controllable switch Q2 is used to control whether to access the energy storage unit, with the specific control process being as follows:

[0059] (1) when PIN > φ1POUT, if the energy storage unit is fully charged, switching out the energy storage unit, and activating an unloader to release excess power; charging the energy storage unit if the energy storage unit is not fully charged,

[0060] wherein specifically, if the energy storage unit is fully charged, the controller turns off a PWM signal at a control terminal A of the first controllable switch Q1, while turning off a PWM signal at a control terminal B of the second controllable switch Q2, so that the first controllable switch Q1 and the second controllable switch Q2 are both in a switch-off state, and the energy storage unit is switched out to avoid overcharging of the energy storage unit, so as to extend the service life of the energy storage unit;

[0061] and if the energy storage unit is not fully charged, the controller turns on the PWM signal at the control terminal A of the first controllable switch Q1, while turning off the PWM signal at the control terminal B of the second controllable switch Q2, so that the first controllable switch Q1 is in a switch-on state while the second controllable switch Q2 is in a switch-off state, and electricity generated by the power generation unit

is input to the high-voltage bus to charge the energy storage unit by the high-voltage bus;

[0062] (2) when $\varphi 2POUT \leq PIN \leq \varphi 1POUT$, switching out the energy storage unit, and only the power generation unit supplying power to the load, so as to achieve power balance and reduce the number of times of charging and discharging of the energy storage unit, thereby extending the service life of the energy storage unit,

[0063] wherein specifically, the controller turns off the PWM signal at the control terminal A of the first controllable switch Q1 while turning off the PWM signal at the control terminal B of the second controllable switch Q2, so that the first controllable switch Q1 and the second controllable switch Q2 are both in a switch-off state, and the energy storage unit is switched out;

[0064] (3) when $PIN < \varphi 2POUT$, switching in the energy storage unit, discharging the energy storage unit, and supplying power to the load together with the power generation unit, so as to achieve power balance,

[0065] wherein specifically, the controller turns off the PWM signal at the control terminal A of the first controllable switch Q1 while turning on the PWM signal at the control terminal B of the second controllable switch Q2, such that the first controllable switch Q1 is in a switch-off state while the second controllable switch Q2 is in a switch-on state, and the energy storage unit is switched in; and

[0066] wherein PIN is the power of electricity generated by the power generation unit, and POUT is a load power. $\varphi 1$ is a first coefficient, and $\varphi 2$ is a second coefficient, which may be the same or different.

[0067] When $\varphi 1$ is the same as $\varphi 2$, for example, $\varphi 1 = 1$, $\varphi 2 = 1$, and at this moment, when PIN is less than POUT, the energy storage unit is discharged and supplies power to the load together with the power generation unit; when PIN is equal to POUT, the energy storage unit is switched out; and when PIN is greater than POUT, if the energy storage unit is fully charged, the energy storage unit is switched out to avoid overcharging of the energy storage unit and extend the service life of the energy storage unit, and if the energy storage unit is not fully charged, excess power is used to charge the energy storage unit.

[0068] In order to avoid frequent switching in the case where PIN is approximately equal to POUT, that is, slightly smaller than POUT, the energy storage unit is discharged, then PIN is slightly larger than POUT, the energy storage unit is switched out or the energy storage unit is charged, different $\varphi 1$ and $\varphi 2$ can be used, wherein $\varphi 1$ is larger than $\varphi 2$, for example, $\varphi 1 = 1.05$ and $\varphi 2 = 1$, and at this moment, when PIN is less than POUT, the energy storage unit is discharged and supplies power to the load together with the power generation unit; when PIN is greater than 1.05 times POUT, the corresponding operation is performed depending on whether the energy storage unit is fully charged; and when PIN is between POUT and 1.05 times and POUT, the energy storage unit is switched out, that is to say, the power of the electricity generated by the

power generation unit is balanced with the load power.

[0069] In another embodiment, by means of a circuit as shown in Fig. 4, the direct-current converter is a BOOST circuit, and a positive electrode of the energy storage unit is connected to the charging-discharging control device via an inductor L of the BOOST circuit, and then connected to the high-voltage bus via the charging-discharging control device. Specifically, the first controllable switch Q1 is connected in parallel with the unidirectionally-conducted diode D1, and then connected between the inductor L and the high-voltage bus.

[0070] The first controllable switch Q1 can use IGBT and MOS transistors, and if the IGBT and MOS transistors themselves have unidirectionally-conducted diodes, it is not necessary to separately arrange a unidirectionally-conducted diode at this moment; however, if the current is relatively large, the unidirectionally-conducted diode may also be arranged separately.

[0071] In another embodiment, by means of a circuit as shown in Fig. 5, the direct-current converter is a BOOST circuit, and the first controllable switch Q1 can use a bidirectional thyristor.

[0072] In this embodiment, the power supply access device comprises a set of energy storage unit access terminals, and in another embodiment, as shown in Fig. 6, the power supply access device comprises two sets of energy storage unit access terminals, and is capable of accessing two sets of energy storage units: a battery 1 and a battery 2, wherein the battery 1 and battery 2 respectively control charging and discharging via charging and discharging control devices, and when the difference between the power of the load and that of the electricity generated by the power generation unit is substantial, two sets of batteries can be simultaneously used for discharging to output a power, so as to ensure stable power supplying of a power supply system; alternatively, when one set of batteries is charged, the other set of batteries is used for discharging to output a power.

[0073] Of course, the power supply access device may also comprise a set of energy storage unit access terminals, which is not limited in the present invention.

[0074] By means of the power supply access device in this embodiment, multiple sets of energy storage unit access terminals can access energy storage units having the same or different charging and discharging properties, for example, all accessing lead-acid batteries, and may also respectively access the lead-acid battery and a lithium battery, wherein the lithium battery is more suitable for frequent charging and discharging, and therefore, during a power supply process, the lithium battery is preferentially used; or the lead-acid battery and the lithium battery are discharged at different frequencies.

[0075] A battery management system (BMS) is mainly to improve the utilization rate of a battery, prevent overcharging and overdischarging of the battery, extend the service life of the battery, and monitor the state of the battery.

[0076] In this embodiment, the controller achieves the following functions of the

BMS:

[0077] (1) estimating a state of charge (SOC) of the energy storage unit, that is, the remaining electric quantity of the energy storage unit, and ensuring that the SOC is maintained within a reasonable range, thereby preventing a damage caused to the energy storage unit due to overcharging or overdischarging; and

[0078] (2) collecting terminal voltages as well as charging and discharging current in real time during charging and discharging processes of the energy storage unit, thereby preventing the occurrence of an overcharging or overdischarging phenomenon of the battery.

[0079] The controller achieves the BMS function, which may effectively save 3% of the battery service life, thereby reducing the cost of the overall apparatus.

[0080] The preferred specific embodiments of the present invention are described in detail above. It should be understood that numerous modifications and changes can be made by a person skilled in the art according to the concept of the present invention without involving any inventive effort. Hence, any technical solution that can be obtained by a person skilled in the art according to the concept of the present invention on the basis of the prior art by means of logic analysis, reasoning or limited experiments should be within the protection scope determined by the claims.

What is claimed is:

1. A power supply access device for accessing a power generation unit for generating power and an energy storage unit and supplying power to a load, the power supply access device comprising a rectifier, a direct-current converter, an unloader and an inverter, with the rectifier being used to rectify an input from the power generation unit, the direct-current converter being used to boost an input from the energy storage unit, the input from the power generation unit, or the rectified input from the power generation unit, the unloader being used to release excess energy, and the inverter being used to convert direct current into alternating current, characterized in that the power generating unit is connected to the rectifier and the power supply access device further comprises a charging-discharging control device and a controller, with the charging-discharging control device being used to control the discharging or charging of the energy storage unit, and the controller controlling the charging- discharging control device and the charging-discharging control device controls whether the direct-current converter access the energy storage unit by the following steps:

when the power of electricity generated by the power generation unit is greater than a product of a load power and a first coefficient, if the energy storage unit is not fully charged, charging the energy storage unit, and if the energy storage unit is fully charged, switching out the energy storage unit, and activating the unloader;

when the power of the electricity generated by the power generation unit is less than a product of the load power and a second coefficient, switching in the energy storage unit, so that the energy storage unit is discharged, and the energy storage unit supplies power to the load together with the power generation unit; and

when the power of the electricity generated by the power generation unit is greater than or equal to the product of the load power and the second coefficient and less than or equal to the product of the load power and the first coefficient, switching out the energy storage unit.

2. The power supply access device of claim 1, characterized in that the controller is connected to the direct-current converter, the unloader and the inverter; the controller is used to control the direct-current converter, the unloader and the inverter; the unloader is connected to the direct-current converter and the inverter; and the unloader is mounted on a high-voltage bus between the direct-current converter and the inverter.

3. The power supply access device of claim 1 or 2, characterized in that the charging-discharging control device is arranged between the energy storage unit and the high-voltage bus.

4. The power supply access device of claim 3, characterized in that the direct- current converter is a BOOST circuit.

5. The power supply access device of claim 4, characterized in that a positive electrode of the energy storage unit is connected to the charging-discharging control device via an inductor of the BOOST circuit, and then connected to the high- voltage bus via the charging-discharging control device.

6. The power supply access device of claim 3, characterized in that the direct- current converter is a bidirectional BUCK-BOOST circuit.

7. The power supply access device of claim 6, characterized in that the positive electrode of the energy storage unit is connected to a first terminal of an inductor of the bidirectional BUCK-BOOST circuit via a parallel circuit of a second controllable switch and an unidirectionally-conducted diode, the other terminal of the inductor is grounded, and the charging-discharging control device is connected between the first terminal of the inductor and the high-voltage bus.

8. The power supply access device of claim 7, characterized in that the second controllable switch is used to control whether to access the energy storage unit.

9. The power supply access device of at least one of claims 1-8, characterized in that the charging-discharging control device comprises a unidirectional channel and a controllable channel connected in parallel, wherein when the controllable channel is disconnected, the energy storage unit is discharged via the unidirectional channel, and when the controllable channel is conducted, the energy storage unit is charged via the controllable channel.

10. The power supply access device of claim 9, characterized in that the controllable channel is provided with a first controllable switch, and the unidirectional channel is provided with a diode for unidirectional conduction.

11. The power supply access device of at least one of claims 1-10, characterized in that the power supply access device comprises one or more sets of energy storage unit access terminals.

12. The power supply access device of claim 11, characterized in that the energy storage unit access terminals are used to access energy storage units having the same charging and discharging properties.

13. The power supply access device of claim 11, characterized in that the energy storage unit access terminals are used to access energy storage units having different charging and discharging properties, and the controller discharges the energy storage unit with different priorities or at different frequencies.

14. The power supply access device of at least one of claims 1-13, characterized in that the controller has a battery management function.

15. The power supply access device of claim 14, characterized in that the battery management function comprises:

estimating a state of charge of the energy storage unit; and

collecting terminal voltages as well as charging and discharging current in real time during charging and discharging processes of the energy storage unit.

16. The power supply access device of at least one of claims 1-15, characterized in that some or all of the rectifier, the direct-current converter, the unloader and the inverter are arranged on the same PCB board.

17. A charging-discharging control method for a power supply access device of at least one of claims 1-16, characterized by comprising the steps of:

(a) when the power of electricity generated by the power generation unit is greater than the product of the load power and the first coefficient, if the energy storage unit is not fully charged, controlling the charging of the energy storage unit, and if the energy storage unit is fully charged, switching out the energy storage unit, and activating the unloader;

(b) when the power of the electricity generated by the power generation unit is less than the product of the load power and the second coefficient, controlling the discharging of the energy storage unit, so that the energy storage unit supplies power to the load together with the power generation unit; and

(c) when the power of the electricity generated by the power generation unit is greater than or equal to the product of the load power and the second coefficient and less than or equal to the product of the load power and the first coefficient, switching out the energy storage unit.

18. The charging-discharging control method for a power supply access device of claim 17, characterized in that the first coefficient is greater than or equal to the second coefficient.

Drawings

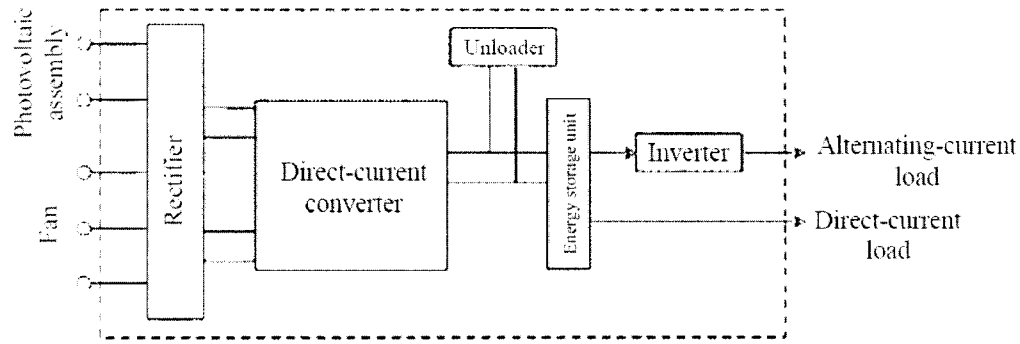


Figure 1

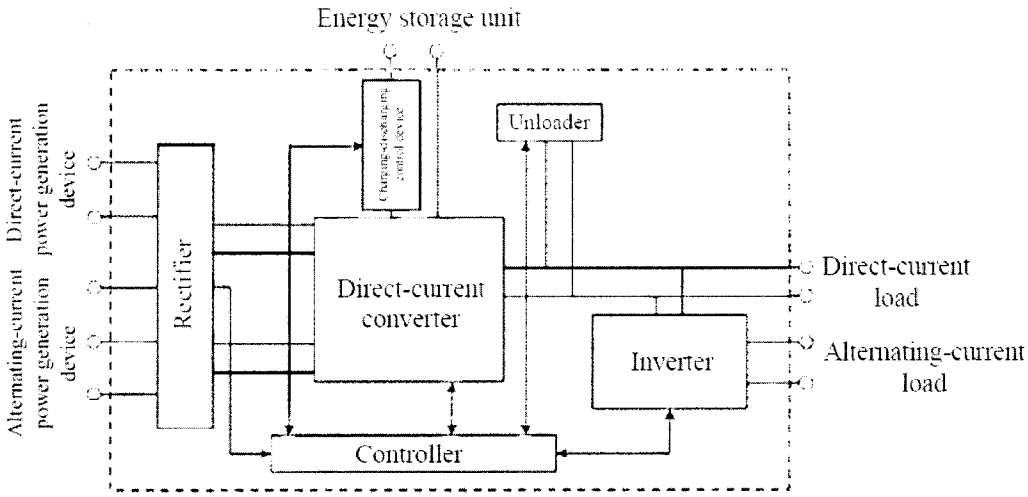


Figure 2

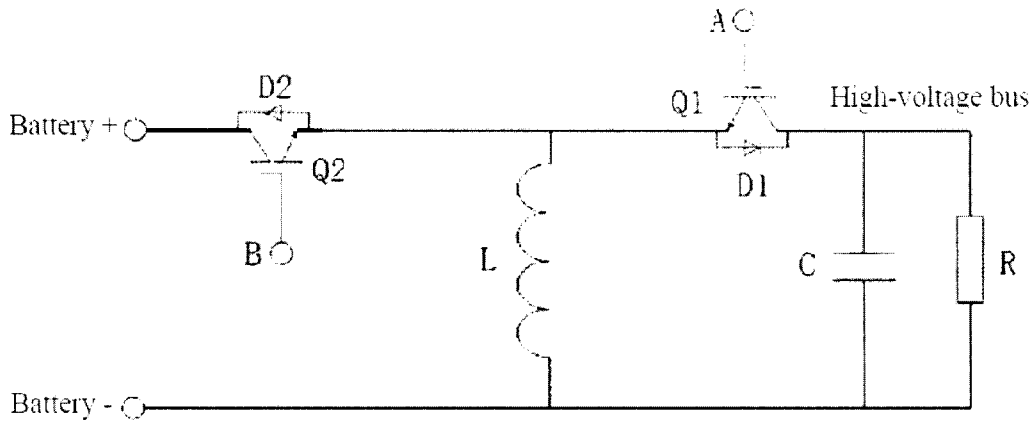


Figure 3

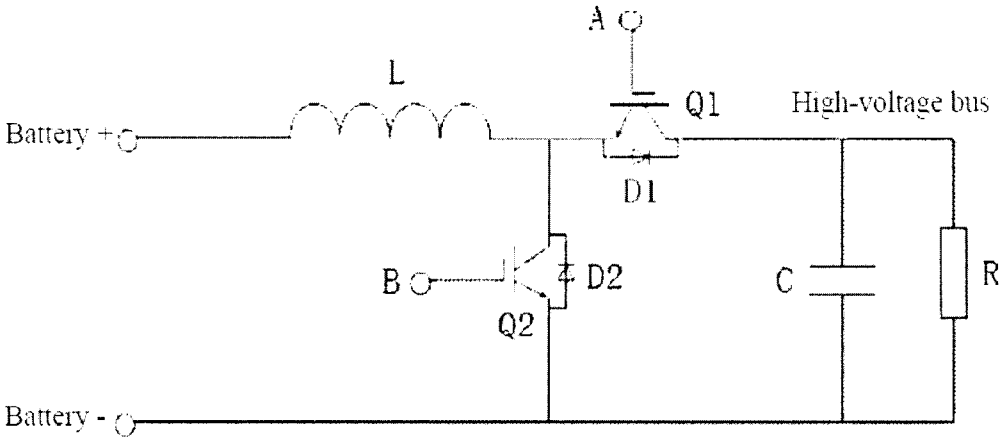


Figure 4

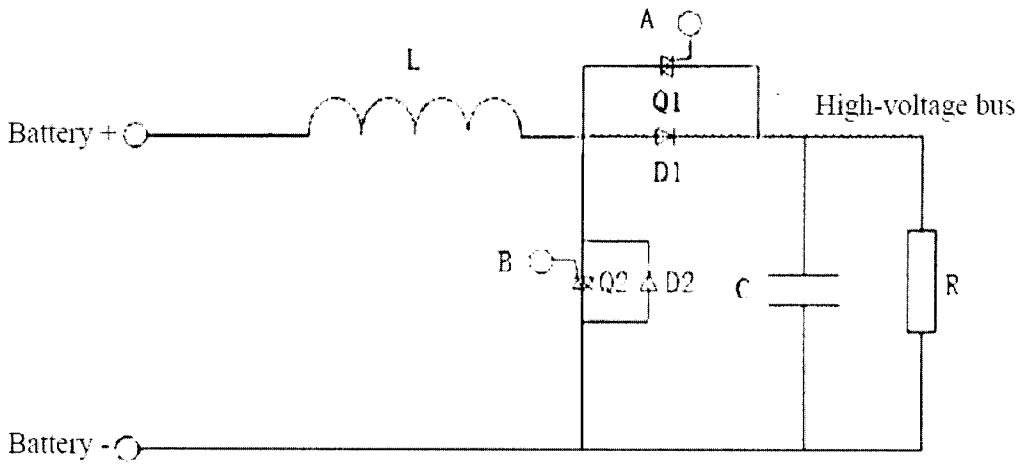


Figure 5

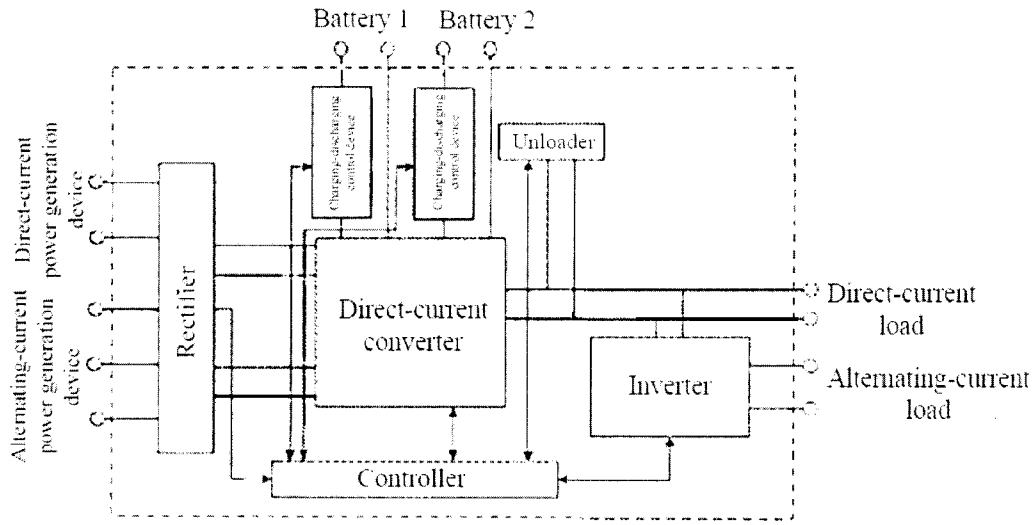
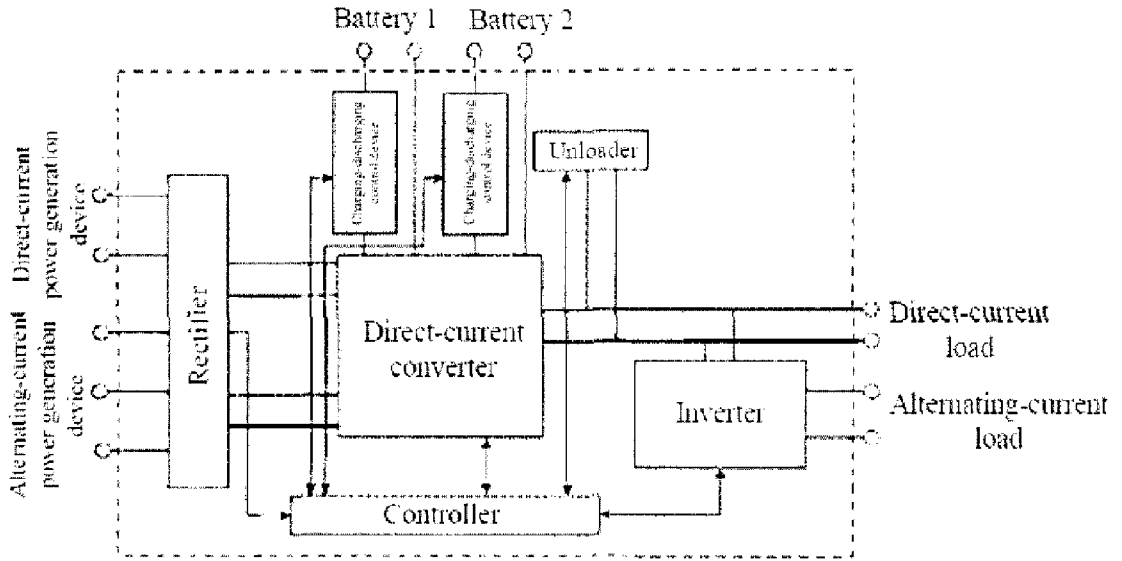


Figure 6


Battery 1
Battery 2
Charging-discharging control device
Charging-discharging control device
Unloader
Direct-current power generation device
Alternating-current power generation device
Rectifier
Direct-current converter
Inverter
Controller
Direct-current load
Alternating-current load