United States Patent Application Publication	20250260229
Kind Code	A1
Publication Date	August 14, 2025
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CONTROL METHOD, NEW ENERGY CONVERTER, AND GRID-CONNECTED POWER SYSTEM

Abstract

A grid-forming control method for a new energy converter is provided, and is applied to a new energy converter. The new energy converter includes a conversion circuit and a controller, where an input end of the conversion circuit is configured to connect to a direct current source, and an output end of the conversion circuit is configured to connect to an alternating current system. After obtaining an active power at the output end of the conversion circuit, the controller converts a phase of the active power, to provide an inertia support characteristic in active power and frequency closed-loop control. The controller quickly controls a voltage parameter at the output end of the conversion circuit based on an active power obtained by delaying the phase, so that a voltage at the output end of the conversion circuit can be quickly adjusted without affecting the inertia support characteristic of an inverter.

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Appl. No.: **19/194219**

Filed: **April 30, 2025**

Foreign Application Priority Data

CN	202211363404.8	Nov. 02, 2022

Related U.S. Application Data

parent WO continuation PCT/CN2023/105525 20230703 PENDING child US 19194219

Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS [0001] This application is a continuation of International Application No. PCT/CN2023/105525, filed on Jul. 3, 2023, which claims priority to Chinese Patent Application No. 202211363404.8, filed on Nov. 2, 2022. The disclosures of the aforementioned applications are hereby incorporated by reference in their entireties.

TECHNICAL FIELD
[0002] The embodiments relate to the field of power electronics technologies, and to a control method, a new energy converter, and a grid-connected power system.
BACKGROUND
[0003] In recent years, a continuously rising global temperature drives carbon peaking and carbon neutrality to become a core task for important countries around the world to deal with climate changes. To reduce carbon emissions, clean energy becomes a development trend in the future. The clean energy includes solar energy, wind energy, water energy, tidal energy, and the like. Generally, the clean energy cannot be directly used, but can be converted into electric energy for human use. For example, a photovoltaic power generation system converts solar energy into electric energy, a hydropower generation system converts water energy into electric energy, a wind power generation system converts wind energy into electric energy, and another conversion manner may be used.
[0004] In the conventional technology, the photovoltaic power generation system, the hydropower generation system, and another power generation system all have limiting factors such as intermittentness, fluctuation, and randomness. As a result, a power system cannot be stabilized around the clock. With a large-scale increase in an installed capacity of new energy, power electronic devices accordingly penetrate into phases such as power generation, transmission, distribution, consumption, and storage of the power system, resulting in low inertia, a low short-circuit ratio, and the like of a power grid system. This reduces stability of the power grid system.
SUMMARY
[0005] To resolve the foregoing problem, embodiments provide a control method, a new energy converter, and a grid-connected power system. The new energy converter adjusts an active power at an output end in real time via units such as an instruction adjustment unit, an inertia control unit, and a forward control unit, to implement active power support for a frequency and active power support for a phase. For example, after obtaining an active power at an output end of a conversion circuit, a controller adjusts a phase of the active power, and may provide frequency and phase support characteristics in active power and frequency closed-loop control in coordination with units such as a forward control unit. The controller performs adjustment through a control loop based on an active power obtained through the phase adjustment, to adjust a voltage parameter at an output end of a power electronic converter. In addition, after receiving a power instruction, the controller performs instruction adjustment on the power instruction, and subtracts, from a corresponding active power adjustment value, the active power obtained through the phase adjustment, to obtain a power difference. The controller may quickly control the voltage parameter at the output end of the conversion circuit directly based on the power difference, thereby improving an instruction

response speed of the conversion circuit.

[0006] Therefore, the following solutions are used in embodiments.

[0007] According to a first aspect, an embodiment provides a grid-forming control method for a new energy converter, and is applied to a new energy converter. The new energy converter includes a conversion circuit and a controller, where an input end of the conversion circuit is configured to connect to a direct current source, and an output end of the conversion circuit is configured to connect to an alternating current system. The method includes: controlling, by the controller, the conversion circuit to output an active power, and delaying a phase of the active power when a voltage frequency of the alternating current system fluctuates; and controlling a voltage parameter at the output end of the conversion circuit based on an active power obtained by delaying the phase, for the conversion circuit to output an active power with inertia support. An output of a generator set and a load of a power system constantly change. As a result, it is difficult for the generator set to rotate at a constant speed. When there is an imbalance between an active power of the generator set and an active power of the load in the power system, a frequency of the power system fluctuates due to the power imbalance between the generator set and the load, causing the frequency to fluctuate.

[0008] In this implementation, after obtaining a feedback value of the active power at the output end of the conversion circuit, the controller adjusts a phase of the feedback value of the active power, to provide an inertia support characteristic in active power, frequency, and phase closed-loop control. The controller quickly controls the voltage parameter at the output end of the conversion circuit based on the active power obtained through the phase adjustment. For example, the voltage parameter at the output end of the conversion circuit can be quickly adjusted without affecting the inertia support characteristic of an inverter.

[0009] In an implementation, before the controlling a voltage parameter at the output end of the conversion circuit based on an active power obtained by delaying the phase, the method further includes: receiving a power instruction, where the power instruction is used to control the voltage parameter at the output end of the conversion circuit; and the controlling a voltage parameter at the output end of the conversion circuit based on an active power obtained by delaying the phase includes: subtracting, from an active power corresponding to the power instruction, the active power obtained by delaying the phase, to obtain a power difference; and controlling the voltage parameter at the output end of the conversion circuit based on the power difference.

[0010] In this implementation, after receiving the power instruction, the controller subtracts, from the active power corresponding to the power instruction, the active power obtained through the phase adjustment, to obtain the power difference, and then quickly controls the voltage parameter at the output end of the conversion circuit. In this way, a voltage at the output end of the conversion circuit may be quickly adjusted without affecting the inertia support characteristic of the inverter, thereby improving an instruction response speed of the controller.

[0011] In an implementation, after the receiving a power instruction, the method further includes: converting the active power corresponding to the power instruction into a given power, where when an output voltage at the output end of the conversion circuit is stable, a value of the given power is equal to the active power obtained by delaying the phase; and the subtracting, from an active power corresponding to the power instruction, the active power obtained by delaying the phase, to obtain a power difference includes: subtracting, from the given power, the active power obtained by delaying the phase, to obtain the power difference.

[0012] In this implementation, after receiving the power instruction, the controller converts the active power corresponding to the power instruction into the given power, so that the value of the given power is the same as the active power obtained through the phase adjustment when the output voltage at the output end of the conversion circuit is stable. In this case, the power difference is zero. When the output voltage at the output end of the conversion circuit is stable, the controller may not need to adjust the output voltage at the output end of the conversion circuit.

[0013] In an implementation, the voltage parameter includes a voltage frequency, and the controlling the voltage parameter at the output end of the conversion circuit based on the power difference includes: converting the power difference into the voltage frequency based on a relationship between a power and a frequency of a synchronous motor.

[0014] In this implementation, the controller obtains the voltage frequency through conversion based on the power difference, to adjust a frequency of the output voltage at the output end of the conversion circuit.

[0015] In an implementation, the voltage parameter further includes a voltage phase, and the controlling the voltage parameter at the output end of the conversion circuit based on the power difference includes: performing integration on a voltage angular velocity to obtain the voltage phase. The voltage frequency is determined based on the power difference, and the voltage angular velocity is determined based on the voltage frequency.

[0016] In this implementation, the controller performs integration on the voltage angular velocity to obtain the voltage phase, to adjust a phase of the output voltage at the output end of the conversion circuit.

[0017] In an implementation, the voltage parameter further includes a voltage amplitude, and the controlling the voltage parameter at the output end of the conversion circuit based on the power difference includes: controlling the voltage amplitude and the voltage phase based on a rated reactive power value, an actual reactive power value, the voltage angular velocity, the voltage phase, a rated amplitude value, and an actual amplitude value. A reactive power is determined based on an output voltage signal and an output current signal, the voltage frequency is determined based on the power difference, the voltage angular velocity is determined based on the voltage frequency, and the voltage phase is determined based on the voltage angular velocity.

[0018] In this implementation, the controller controls the voltage amplitude based on the actual reactive power value, the voltage angular velocity, the voltage phase, the rated amplitude value, and the rated value of the reactive power, to adjust the phase of the output voltage at the output end of the conversion circuit.

[0019] In an implementation, the method further includes: generating a trigger signal based on the voltage parameter, where the trigger signal is used to trigger a power electronic device inside the conversion circuit to be turned on or off, to further adjust the voltage parameter at the output end of the conversion circuit.

[0020] According to a second aspect, an embodiment provides a new energy converter, including a conversion circuit and a controller. The controller is configured to: control the conversion circuit to output an active power, and delay a phase of the active power when a voltage frequency of an alternating current system fluctuates; and control a voltage parameter at an output end of the conversion circuit based on an active power obtained by delaying the phase, for the conversion circuit to output an active power having a frequency and phase support function.

[0021] In an implementation, the controller is further configured to: receive a power instruction, where the power instruction is used to control the voltage parameter at the output end of the conversion circuit; subtract, from an active power corresponding to the power instruction, the active power obtained through the phase adjustment, to obtain a power difference; and control the voltage parameter at the output end of the conversion circuit based on the power difference. The new energy converter is a commonly used power electronic converter, for example, an inverter, a rectifier, a modular multi-level converter, or another converter, or a bidirectional converter.

[0022] In an implementation, the controller is further configured to: convert the active power corresponding to the power instruction into a given power, where when an output voltage at the output end of the conversion circuit is stable, a value of the given power is equal to the active power obtained by delaying the phase; and subtract, from the given power, the active power obtained by delaying the phase, to obtain the power difference.

[0023] In an implementation, the voltage parameter includes a voltage frequency, and the controller

is configured to convert the power difference into the voltage frequency based on a relationship between a power and a frequency of a synchronous motor.

[0024] In an implementation, the voltage parameter further includes a voltage phase, and the controller is configured to perform integration on a voltage angular velocity to obtain the voltage phase. The voltage frequency is determined based on the power difference, and the voltage angular velocity is determined based on the voltage frequency.

[0025] In an implementation, the voltage amplitude is controlled based on a rated reactive power value, an actual reactive power value, the voltage angular velocity, the voltage phase, a rated amplitude value, and an actual amplitude value. A reactive power is determined based on an output voltage signal and an output current signal, the voltage frequency is determined based on the power difference, the voltage angular velocity is determined based on the voltage frequency, and the voltage phase is determined based on the voltage angular velocity.

[0026] In an implementation, the controller is further configured to generate a trigger signal based on the voltage parameter, where the trigger signal is used to trigger a power electronic device inside the conversion circuit to adjust the voltage parameter at the output end of the conversion circuit.

[0027] According to a third aspect, an embodiment provides a grid-connected power system, including a new energy component, and at least one new energy converter that may be implemented in the second aspect. An input end of the new energy converter is connected to the new energy component, or is indirectly connected to the new energy component by using a direct current converter, or is connected to another energy storage apparatus, and an output end of the new energy converter is configured to connect to a power grid or a load. The converter is configured to: convert a direct current of the new energy component or a direct current output by the direct current converter into an alternating current of the power grid, or convert an alternating current of the power grid into a direct current.

[0028] According to a fourth aspect, an embodiment provides a non-transitory computer-readable storage medium. The non-transitory computer-readable storage medium stores a computer program, and when the computer program is executed in a computer, the computer is enabled to perform embodiments that may be implemented in the first aspect.

[0029] According to a fifth aspect, an embodiment provides a computer program product. The computer program product stores instructions, and when the instructions are executed by a computer, the computer is enabled to implement embodiments that may be implemented in the first aspect.

Description

BRIEF DESCRIPTION OF DRAWINGS

[0030] The following briefly describes the accompanying drawings required for describing embodiments.

[0031] FIG. **1** is a diagram of an architecture of a grid-connected power system in the conventional technology;

[0032] FIG. **2**(*a*) is a diagram of a process of executing an instruction response by a grid-forming control unit in the conventional technology;

[0033] FIG. **2**(*b*) is a diagram of a process of executing frequency and phase support responses by a grid-forming control unit in the conventional technology;

[0034] FIG. **3** is a diagram of an architecture of a grid-forming control unit in the conventional technology;

[0035] FIG. **4** is a diagram of an architecture of a grid-forming control unit in the conventional technology;

[0036] FIG. **5** is a diagram of an architecture of a controller according to an embodiment; and

[0037] FIG. **6** is a schematic flowchart of a control method according to an embodiment.

DETAILED DESCRIPTION OF EMBODIMENTS

[0038] The following describes the solutions in embodiments with reference to the accompanying drawings.

[0039] The term "and/or" describes an association relationship between associated objects and indicates that three relationships may exist. For example, A and/or B may indicate the following three cases: only A exists, both A and B exist, and only B exists. The character "/" indicates an "or" relationship between the associated objects. For example, A/B indicates A or B.

[0040] In the embodiments, the terms "first", "second", and the like are intended to distinguish between different objects, but do not indicate a particular order of the objects. For example, a first response message, a second response message, and the like are used to distinguish between different response messages, but do not indicate a particular order of the response messages.

[0041] In embodiments, terms such as "example" or "for example" are used to represent giving an example, an illustration, or a description. Any embodiment or design scheme described by "example" or "for example" in embodiments should not be explained as being more preferred or having more advantages than another embodiment or design scheme. To be precise, the terms such as "example" or "for example" are intended to present a related concept in a specific manner.

[0042] In the descriptions of embodiments, unless otherwise specified, "a plurality of" means two or more. For example, a plurality of processing units are two or more processing units, and a plurality of elements are two or more elements.

[0043] When an external power supply system, for example, a photovoltaic power generation system, a hydropower generation system, a wind power generation system, or a backup power supply, is connected to a power grid system, an inverter generally needs to be connected in series to the power grid system. The inverter can adjust voltage parameters such as a voltage frequency, a voltage phase, and a voltage amplitude of the external power supply system, so that the voltage parameters of the external power supply system are the same as those of a national power supply system.

[0044] According to different control logic, existing inverters may be classified into grid-following control inverters, grid-forming control inverters, and other types of inverters. The grid-following control inverter uses a phase-locked loop, to enable the voltage parameters of the external power supply system to be the same as those of the national power supply system. The grid-forming control inverter uses a power control method, to enable the voltage parameters of the external power supply system to be the same as those of the national power supply system.

[0045] When the grid-following control inverter connects the external power supply system to the national power system, the grid-following control inverter presents a characteristic of low inertia or no inertia. If a large-scale external power supply system is connected to the power grid system, characteristics such as inertia and system strength of the power grid system are reduced. However, the grid-forming control inverter does not reduce the characteristics such as the inertia and the system strength of the power grid system. Therefore, the grid-forming control inverter has more advantages than the grid-following control inverter.

[0046] FIG. **1** is a diagram of an architecture of a grid-connected power system in the conventional technology. As shown in FIG. **1**, a grid-connected power system **100** includes a power system **110**, an inverter **120**, and an external power supply system **130**. The external power supply system **130** is connected to the power system **110** by using the inverter **120**. In another embodiment, the grid-connected power system **100** may include other components such as a transformer, an inductor, a power connection wire, and the like. This is not limited.

[0047] The inverter **120** includes a bidirectional direct current/alternating current (DC/AC) conversion circuit **121** and a grid-forming control unit **122**. An input end of the bidirectional DC/AC conversion circuit **121** is electrically connected to the external power supply system **130**. An output end of the bidirectional DC/AC conversion circuit **121** is electrically connected to the

power system **110**. The bidirectional DC/AC conversion circuit **121** converts a direct current of the external power supply system **130** into an alternating current, and inputs the alternating current to the power system **110**.

[0048] The grid-forming control unit **122** is coupled to the bidirectional DC/AC conversion circuit **121**, and is configured to receive an output voltage signal and an output current signal of the output end of the bidirectional DC/AC conversion circuit **121**, and an input voltage signal and an input current signal of the input end of the bidirectional DC/AC conversion circuit **121**. The output voltage signal may be a direct current voltage of the bidirectional DC/AC conversion circuit **121**. Alternatively, the output voltage signal may be an alternating current voltage of the bidirectional DC/AC conversion circuit **121**.

[0049] After receiving an output voltage signal and an output current signal of the bidirectional DC/AC conversion circuit **121**, the grid-forming control unit **122** adjusts a voltage parameter at the output end of the bidirectional DC/AC conversion circuit **121**, so that the voltage parameter at the output end of the bidirectional DC/AC conversion circuit **121** is the same as a voltage parameter of the power system **110**. The voltage parameter may be a voltage frequency, a voltage phase, and a voltage amplitude.

[0050] FIG. **2**(*a*) is a diagram of a process of executing an instruction response by a grid-forming control unit in the conventional technology. As shown in FIG. **2**(*a*), the grid-forming control unit **122** is divided into a grid-forming control synchronization unit **1221**, a phase control unit **1222**, an amplitude control unit **1223**, and a preprocessing unit **1224** based on functions performed.

[0051] The preprocessing unit **1224** receives an output voltage signal and an output current signal of the output end of the bidirectional DC/AC conversion circuit **121**, and calculates an active power Pe. The grid-forming control synchronization unit **1221** may receive an active power Pref corresponding to a power instruction sent from the outside and the active power Pe of the preprocessing unit **1224**. By analogy with a nonlinear positive relationship between a power and a frequency of a synchronous motor, the grid-forming control synchronization unit **1221** may determine a relationship between a power and a frequency. The grid-forming control synchronization unit **1221** calculates a voltage angular velocity ωsyn based on the received active power. A relationship between an angular velocity ω and a frequency f is $\omega=2\pi f$. After receiving the voltage angular velocity ωsyn, the phase control unit **1222** performs integration on the voltage angular velocity ωsyn to obtain a voltage phase θsyn. The amplitude control unit **1223** receives parameters such as the voltage angular velocity ωsyn and the voltage phase θsyn, may calculate a voltage amplitude Ve, and send a control instruction to the bidirectional DC/AC conversion circuit **121**, so that the bidirectional DC/AC conversion circuit **121** adjusts a voltage parameter of an output voltage at the output end.

[0052] As shown in FIG. **2**(*a*), when the grid-forming control unit **122** executes an instruction response, the grid-forming control synchronization unit **1221** receives the externally sent power instruction. When the grid-forming control unit **122** receives a change in the active power Pref corresponding to the power instruction, the active power Pe at the output end of the bidirectional DC/AC conversion circuit **121** changes accordingly. The grid-forming control synchronization unit **1221** quickly converts the active power Pref into the voltage angular velocity ωsyn, so that an output power of the bidirectional DC/AC conversion circuit **121** can quickly respond to the power instruction.

[0053] As shown in FIG. **2**(*b*), when the grid-forming control unit **122** executes frequency and phase support responses, the grid-forming control synchronization unit **1221** receives the active power Pe of the preprocessing unit **1224**. When the grid-forming control unit **122** receives a change in the active power Pe of the preprocessing unit **1224**, the grid-forming control synchronization unit **1221** slowly converts the active power Pe into the voltage angular velocity ωsyn, to prevent the inverter **120** from quickly adjusting the voltage parameter of the output voltage at the output end, and reduce frequency and phase support characteristics of the power system **110**.

[0054] When the grid-forming control unit **122** executes two types of different control logic: the instruction response and the frequency and phase support responses, conversion speeds of the grid-forming control synchronization unit **1221** are opposite. If the conversion speed of the grid-forming control synchronization unit **1221** is high, the frequency and phase support characteristics of the inverter **120** may be weakened. If the conversion speed of the grid-forming control synchronization unit **1221** is slow, a speed of responding to the power instruction by the inverter **120** is reduced. Therefore, the existing grid-forming control unit **122** cannot resolve a problem of a contradiction between a power instruction response and frequency and phase support responses.

[0055] To resolve the problem that the grid-forming control unit **122** cannot resolve the contradiction between the instruction response and the frequency and phase support responses, two solutions are provided in the conventional technology. The two solutions are respectively as follows.

[0056] As shown in FIG. **3**, the grid-forming control unit **122** may further include a parameter adaptive adjustment unit **1225**. The parameter adaptive adjustment unit **1225** is coupled to the grid-forming control synchronization unit **1221**. When the external power supply system **130** is connected to the power system **110**, a voltage parameter of the external power supply system **130** is different from the voltage parameter of the power system **110**, and the inverter **120** needs to be controlled to adjust the voltage parameter of the external power supply system **130**.

[0057] After receiving the externally sent power instruction, the grid-forming control synchronization unit **1221** executes the power instruction response. When receiving the active power Pref corresponding to the power instruction, the grid-forming control unit **122** sends the active power Pref to the parameter adaptive adjustment unit **1225**. The parameter adaptive adjustment unit **1225** generates a control parameter based on the active power Pref, information about a control environment in which the grid-forming control unit **122** is located, and another state variable. The grid-forming control synchronization unit **1221** may autonomously adjust, based on the control parameter, a speed of converting the active power Pref into the voltage angular velocity ωsyn. This may improve a speed of responding to the power instruction by the inverter **120**, but reduce the frequency and phase support characteristics of the inverter **120**.

[0058] When the grid-forming control unit **122** executes the frequency and phase support responses, the preprocessing unit **1224** sends the active power Pe to the grid-forming control unit **122**. When the voltage parameter of the power system **110** changes, the grid-forming control unit **122** receives a change in the active power Pe. The grid-forming control unit **122** sends the active power Pe to the parameter adaptive adjustment unit **1225**. The parameter adaptive adjustment unit **1225** generates a control parameter based on the active power Pe, information about a control environment in which the grid-forming control unit **122** is located, and another state variable. The grid-forming control synchronization unit **1221** may reversely and autonomously adjust, based on the control parameter, a speed of converting an angular velocity ω of the active power into the voltage angular velocity ωsyn. This may improve the frequency and phase support characteristics of the inverter **120**, but reduce a speed of responding to the power instruction by the inverter **120**.

[0059] In the conventional technology, the grid-forming control unit **122** introduces a path based on parameter adaptation, and adjusts a conversion speed of the grid-forming control synchronization unit **1221** by using a control parameter generated by the parameter adaptive adjustment unit **1225** based on the active power and an environment factor. The control parameter is in a dynamic change state, so that properties such as an active power conversion speed, the frequency and phase support characteristics, and the like of the inverter **120** change with the control parameter, causing a reduction in stability of the inverter **120**. In addition, the control parameter generated by the parameter adaptive adjustment unit **1225** may enable the grid-forming control synchronization unit **1221** to autonomously adjust the conversion speed within a specific value range. However, in some working conditions, when the control parameter exceeds the specific value range, it is difficult for the grid-forming control synchronization unit **1221** to autonomously adjust the conversion speed.

[0060] As shown in FIG. **4**, the grid-forming control unit **122** may further include a fast instruction compensation unit **1226**. An output end of the fast instruction compensation unit **1226** is coupled to both the phase control unit **1222** and the amplitude control unit **1223**. When the external power supply system **130** is connected to the power system **110**, a voltage parameter of the external power supply system **130** is different from the voltage parameter of the power system **110**, and the inverter **120** needs to be controlled to adjust the voltage parameter of the external power supply system **130**.

[0061] After receiving the power instruction, the inverter **120** sends the active power Pref corresponding to the power instruction to the grid-forming control synchronization unit **1221** and the fast instruction compensation unit **1226**. After receiving the externally sent power instruction, the grid-forming control synchronization unit **1221** executes the power instruction response. The fast instruction compensation unit **1226** generates a parameter like a frequency compensation amount or a phase compensation amount based on a variation of the active power corresponding to the power instruction and another variable. The grid-forming control synchronization unit **1221** converts the active power into the voltage angular velocity ωsyn, and then inputs the voltage angular velocity ωsyn to the phase control unit **1222**. The phase control unit **1222** may perform phase compensation based on the phase compensation amount of the fast instruction compensation unit **1226**, or the amplitude control unit **1223** may perform frequency compensation based on the frequency compensation amount of the fast instruction compensation unit **1226**, so that a speed of responding to the power instruction by the inverter **120** may be improved. However, the frequency and phase support characteristics of the inverter **120** may be weakened.

[0062] To resolve a defect of an existing inverter, embodiments provide a new energy converter, a control method, and a grid-connected power system.

[0063] FIG. **5** is a diagram of a structure of a new energy converter according to an embodiment. As shown in FIG. **5,** a new energy converter **500** includes a conversion circuit **510** and a controller **520**. In the embodiments, one end of the new energy converter **500** is electrically connected to an external power supply system, and the other end of the new energy converter **500** is electrically connected to a power system.

[0064] In an embodiment, the new energy converter **500** may be an inverter, a rectifier, a modular multi-level converter, or another converter. In another embodiment, the new energy converter **500** may be a bidirectional converter.

[0065] In an embodiment, the external power supply system may be a backup power supply, a photovoltaic power generation system, a hydropower generation system, a wind power generation system, or another power supply system.

[0066] In an embodiment, the power system may be a power grid system, a household power grid, an enterprise power grid, or another power system.

[0067] The conversion circuit **510** includes a bidirectional DC/AC conversion circuit, configured to: convert an alternating current into a direct current, or convert a direct current into an alternating current. In an embodiment, a voltage of the external power supply system is a direct current, a voltage of the power system is an alternating current, and the conversion circuit **510** converts the direct current of the external power supply system into an alternating current of a specified voltage value. In another embodiment, the conversion circuit **510** may be another type of conversion circuit. This is not limited.

[0068] The controller **520** may be a digital signal processing (DSP) unit, a field programmable gate array (FPGA), a microcontroller unit (MCU), or another device having a computing and control function. In the embodiments, after receiving an output voltage signal U.sub.1 and an output current signal I.sub.1 of an output end of the conversion circuit **510** and an input voltage signal U.sub.2 and an input current signal I.sub.2 of an input end of the conversion circuit **510**, the controller **520** adjusts a voltage parameter of an output voltage at the output end of the conversion circuit **510**. After receiving a power instruction that is externally input, the controller **520** adjusts

the voltage parameter of the output voltage at the output end of the conversion circuit **510** based on an active power corresponding to the power instruction, the output voltage signal U.sub.1 and the output current signal I.sub.1 of the output end of the conversion circuit **510**, and the input voltage signal U.sub.2 and the input current signal I.sub.2 of the input end of the conversion circuit **510**. The voltage parameter may be a voltage frequency fsyn, a voltage phase θsyn, and a voltage amplitude Ve.

[0069] In this embodiment, the controller **520** may be divided into a preprocessing unit **521**, an inertia control unit **522**, an instruction adjustment unit **523**, a subtractor **524**, a forward control unit **525**, a phase control unit **526**, an amplitude control unit **527**, and a modulation unit **528** based on functions performed. The preprocessing unit **521**, the inertia control unit **522**, the instruction adjustment unit **523**, the subtractor **524**, the forward control unit **525**, the phase control unit **526**, the amplitude control unit **527**, and the modulation unit **528** may all be implemented by using software, or may be implemented by using hardware, or may be implemented by using a combination of software and hardware.

[0070] The preprocessing unit **521** is configured to receive the output voltage signal U.sub.1 and the output current signal I.sub.1 of the output end of the conversion circuit **510**. The preprocessing unit **521** is further configured to: calculate an active power Pe and a reactive power Qe based on the output voltage signal U.sub.1 and the output current signal I.sub.1, input the active power Pe to the inertia control unit **522**, and input the reactive power Qe, the input voltage signal U.sub.2, and the output voltage signal U.sub.1 to the amplitude control unit **527**. The active power Pe and the reactive power Qe may be an average power or an instantaneous power. For the average power, the active power Pe is alternating current energy that is generated or consumed in a unit time, and is an average power in a periodicity. The reactive power Qe means that in an alternating current circuit with reactance, an electric field or a magnetic field absorbs energy from a power supply in a part of a periodicity, and releases energy in another part of the periodicity. The average power is zero in the entire periodicity, but the energy is continuously exchanged between the power supply and a reactance element (capacitor or inductor). A maximum exchange rate is the reactive power Qe. For the instantaneous power, a value of the instantaneous power is equal to a product of an instantaneous voltage and an instantaneous current. The instantaneous power of the alternating current is not a constant value. An average value of the instantaneous power in a periodicity is referred to as the active power. Therefore, the active power is also referred to as the average power.

[0071] In this embodiment, the conversion circuit **510** further includes a sampling module. The sampling module samples the output voltage and an output current at the output end to obtain the output voltage and the output current. The sampling module converts the output voltage and the output current into digital signals to obtain the output voltage signal U.sub.1 and the output current signal I.sub.1, and inputs the output voltage signal U.sub.1 and the output current signal I.sub.1 to the controller **520**. The sampling module samples an input voltage and an input current at the input end to obtain the input voltage and the input current. The sampling module converts the input voltage and the input current into digital signals to obtain the input voltage signal U.sub.2 and the input current signal I.sub.2, and inputs the input voltage signal U.sub.2 and the input current signal I.sub.2 to the controller **520**.

[0072] The conversion circuit **510** may be a bidirectional conversion circuit. In an embodiment, the input end of the conversion circuit **510** is an external power supply system, and the output end of the conversion circuit **510** is a power system. The output voltage is an alternating current voltage, the output current is an alternating current, the input voltage is a direct current voltage, and the input current is a direct current. In an embodiment, the input end of the conversion circuit **510** is a power system, and the output end of the conversion circuit **510** is an external power supply system. The output voltage is a direct current voltage, the output current is a direct current, the input voltage is an alternating current voltage, and the input current is an alternating current.

[0073] The inertia control unit **522** may be a combination of one or more of functions such as a

proportional function, an integral equation, a first-order low-pass filter, a multi-order low-pass filter, and the like. When a voltage frequency or a voltage phase of the power system fluctuates, the power system may cause an output power at the output end of the conversion circuit **510** to fluctuate. The inertia control unit **522** may convert a phase of the active power Pe to obtain an active power Peic obtained by delaying the phase. In addition, when the inertia control unit **522** converts the phase of the active power Pe, an amplitude of the active power Pe changes. In the embodiments, the inertia control unit **522** converts the amplitude and the phase of the active power Pe, to delay the phase of the active power Pe and change the amplitude of the active power Pe. The inertia control unit **522** provides frequency and phase support characteristics for the new energy converter **500** in active power and frequency closed-loop control.

[0074] In an embodiment, inertia control of the inertia control unit **522** may be equivalent to a first-order low-pass filter of a swing equation. After the active power Pe is input to the first-order low-pass filter, the first-order low-pass filter may convert the amplitude and the phase of the active power Pe based on stability parameter 1/K.sub.D conversion, to delay the phase of the active power Pe and change the amplitude of the active power Pe.

[0075] The instruction adjustment unit **523** may be a combination of one or more of functions such as a proportional function, an integral equation, a rotor motion equation, a first-order low-pass filter, a multi-order low-pass filter, and the like. The instruction adjustment unit **523** is configured to: process an active power Pref corresponding to an input power instruction, and convert the active power Pref corresponding to the power instruction into a given power Prefa. When the output voltage at the output end of the conversion circuit **510** is stable, that is, a control system is in a stable state, the given power Prefa output by the instruction adjustment unit **523** is the same as the active power Peic that is obtained by delaying the phase and that is output by the inertia control unit **522**.

[0076] In an embodiment, the instruction adjustment unit **523** is a proportional function. The instruction adjustment unit **523** divides the active power Pref corresponding to the power instruction by a specified proportional value to obtain the given power Prefa.

[0077] In an embodiment, the instruction adjustment unit **523** is a first-order low-pass filter. The instruction adjustment unit **523** performs filtering processing on the active power Pref corresponding to the power instruction, and converts the active power Pref corresponding to the power instruction into the given power Prefa.

[0078] The subtractor **524** is configured to: receive the given power Prefa output by the instruction adjustment unit **523** and the active power Peic that is obtained by delaying the phase and that is output by the inertia control unit, and subtract, from the given power Prefa, the active power Peic obtained by delaying the phase, to obtain a power difference ΔP.

[0079] The forward control unit **525** may be a combination of one or more of functions such as a proportional function, a differential equation, a low-pass filter, a high-pass filter, a lead/lag correction function, and the like. By analogy with a nonlinear positive relationship between a power and a frequency of a synchronous motor, the forward control unit **525** may determine a relationship between a power and a frequency. After receiving the power difference ΔP, the forward control unit **525** quickly converts the power difference ΔP into a voltage angular velocity ωsyn based on the relationship between the power and the frequency, and outputs the voltage angular velocity ωsyn to the phase control unit **526**, the amplitude control unit **527**, and the modulation unit **528**.

[0080] In an embodiment, the forward control unit **525** is a combination of a proportional function, a differential equation, and a low-pass filter. The forward control unit **525** divides the power difference ΔP by a specified proportional value, and performs differential and filtering processing to obtain the voltage angular velocity ωsyn corresponding to the power difference ΔP.

[0081] The phase control unit **526** may be an integrator or a combination of an integrator and another device. After receiving the voltage angular velocity ωsyn, the phase control unit **526**

performs integration on the voltage angular velocity ωsyn to obtain a voltage phase θsyn, and outputs the voltage phase θsyn to the amplitude control unit **527** and the modulation unit **528**.

[0082] The amplitude control unit **527** may be a combination of one or more of functions such as a proportional function, an integral equation, a proportional integral equation, and the like. After receiving parameters such as the reactive power Qe, the input voltage signal U.sub.2, and the output voltage signal U.sub.1 that are from the preprocessing unit **521**, the voltage angular velocity ωsyn from the forward control unit **525**, the voltage phase θsyn from the phase control unit **526**, an actual amplitude value, an externally input rated amplitude value Vref, an externally input rated reactive power value Qref, the amplitude control unit **527** may control a voltage amplitude Ve, and output the voltage amplitude Ve to the modulation unit **528**.

[0083] The modulation unit **528** receives the voltage angular velocity ωsyn, the voltage phase θsyn, and the voltage amplitude Ve, and generates a trigger signal based on the voltage angular velocity ωsyn, the voltage phase θsyn, and the voltage amplitude Ve. A relationship between an angular velocity ω and a frequency f is $\omega = 2\pi f$, and a voltage frequency fsyn may be obtained based on the voltage angular velocity ωsyn. After receiving the trigger signal, the conversion circuit **510** may control a power electronic device inside the conversion circuit **510** to operate, to adjust a frequency, a phase, and an amplitude of the output voltage at the output end of the conversion circuit **510**.

[0084] In this embodiment, after receiving the output voltage signal U.sub.1 and the output current signal I.sub.1 of the conversion circuit **510**, the controller **520** inputs the output voltage signal U.sub.1 and the output current signal I.sub.1 to the preprocessing unit **521**, so that the preprocessing unit **521** calculates the active power Pe and the reactive power Qe. The inertia control unit **522** converts the amplitude and the phase of the active power Pe to obtain the active power Peic obtained by delaying the phase, so that the frequency and phase support characteristics are provided for the new energy converter **500** in the active power and frequency closed-loop control.

[0085] When a voltage parameter of the power system does not change, the active power Pe calculated by the preprocessing unit **521** is 0. The control system does not need to provide the frequency and phase support characteristics for the power system. When the voltage parameter of the power system changes, the controller **520** implements a function of frequency and phase support responses. The inertia control unit **522** delays the phase of the active power Pe, and changes the amplitude of the active power Pe, so that the frequency and phase support characteristics are provided for the new energy converter **500** in the active power and frequency closed-loop control.

[0086] The controller **520** further receives the power instruction. After receiving the power instruction, the instruction adjustment unit **523** converts the active power Pref corresponding to the power instruction into the given power Prefa. The power difference ΔP input by the subtractor **524** to the forward control unit **525** is a difference between the given power Prefa and the active power Peic obtained through the phase adjustment.

[0087] The forward control unit **525** quickly converts the power difference ΔP into a voltage angular velocity ω. After receiving the voltage angular velocity ω, the phase control unit **526** performs integration on the voltage angular velocity ω to obtain a voltage phase θ. After receiving parameters such as the reactive power Qe, the input voltage signal U.sub.2, the output voltage signal U.sub.1, the voltage angular velocity ω, the voltage phase θ, the actual amplitude value, the externally input rated amplitude value Vref, the externally input rated reactive power value Qref, and the like, the amplitude control unit **527** may control the voltage amplitude Ve. The modulation unit **528** generates a trigger signal based on the received voltage angular velocity ω, the voltage phase θ, and the voltage amplitude Ve.

[0088] After receiving the trigger signal, the conversion circuit **510** may control a power electronic device inside the conversion circuit **510** to operate, so that the power electronic device inside the conversion circuit **510** adjusts a frequency, a phase, and an amplitude of the output voltage at the

output end of the conversion circuit **510**.

[0089] In this embodiment, after receiving the externally sent power instruction, the controller **520** executes a power instruction response. The instruction adjustment unit **523** and the forward control unit **525** may quickly adjust a synchronous angular velocity of a voltage, so that the controller **520** may quickly adjust trigger information. After receiving the trigger information, the conversion circuit **510** may quickly adjust the voltage parameter of the output voltage at the output end of the conversion circuit **510**, thereby improving an instruction response speed of the conversion circuit **510**.

[0090] In an embodiment, the controller **520** does not receive the power instruction, or the active power Pref corresponding to the power instruction is equal to 0. The voltage of the power system is unstable, and the active power Pe calculated by the preprocessing unit **521** is not equal to 0. The power difference ΔP input by the subtractor **524** to the forward control unit **525** is equal to −Peic. In this case, the controller **520** provides the frequency and phase support characteristics for the power system, and adjusts the voltage parameter of the output voltage at the output end of the conversion circuit **510**, so that the voltage parameter of the output voltage at the output end of the conversion circuit **510** changes with the voltage parameter of the power system.

[0091] In an embodiment, the controller **520** does not receive the power instruction, or the active power Pref corresponding to the power instruction is equal to 0. The voltage of the power system is stable, and the active power Pe calculated by the preprocessing unit **521** is equal to 0. The power difference ΔP input by the subtractor **524** to the forward control unit **525** is equal to 0. In this case, the controller **520** adjusts the voltage parameter of the output voltage at the output end of the conversion circuit **510** to tend to a stable state.

[0092] In an embodiment, the controller **520** receives the power instruction, and the active power Pref corresponding to the power instruction is not equal to 0. The power difference ΔP input by the subtractor **524** to the forward control unit **525** is equal to Prefa-Peic. In this case, the controller **520** provides the frequency and phase support characteristics for the power system based on the active power of the preprocessing unit **521**. In addition, the controller **520** quickly adjusts the voltage parameter of the output voltage at the output end of the conversion circuit **510** based on the active power corresponding to the power instruction and the active power of the preprocessing unit **521**, so that the voltage parameter of the output voltage at the output end of the conversion circuit **510** changes with the voltage parameter of the power system.

[0093] In this embodiment, the instruction adjustment unit **523** and the forward control unit **525** act on a short time scale, so that an instruction response speed can be increased. The inertia control unit **522** acts on a long time scale, and can provide the frequency and phase support characteristics.

[0094] FIG. **6** is a schematic flowchart of a control method according to an embodiment. As shown in FIG. **6**, the control method is performed by a controller **520**, and a specific process is as follows:

[0095] Step S**601**: The controller **520** receives an output voltage signal and an output current signal of a conversion circuit **510**.

[0096] For example, one end of the conversion circuit **510** is electrically connected to an external power supply system, and the other end of the conversion circuit **510** is electrically connected to a power system. The conversion circuit **510** converts an alternating current into a direct current, or converts a direct current into an alternating current. A sampling module inside the conversion circuit **510** samples an output voltage and an output current at an output end to obtain the output voltage and the output current. The sampling module samples an input voltage and an input current at an input end to obtain the input voltage and the input current.

[0097] In an embodiment, the sampling module converts the output voltage, the output current, the input voltage, and the input current into digital signals to obtain an output voltage signal U_1, an output current signal I_1, an input voltage signal U_2, and an input current signal **12**, and inputs the output voltage signal U_1, the output current signal I_1, the input voltage signal U_2, and the input current signal I_2 to the controller **520**.

[0098] Step S**602**: The controller **520** calculates an active power and a reactive power based on an output voltage signal and an output current signal.

[0099] For example, after receiving the output voltage signal U.sub.1 and the output current signal I.sub.1 of the conversion circuit **510**, the controller **520** calculates an active power Pe and a reactive power Qe based on the output voltage signal U.sub.1 and the output current signal I.sub.1.

[0100] In an embodiment, the controller **520** includes a preprocessing unit **521**. The preprocessing unit **521** is configured to receive the output voltage signal U.sub.1, the output current signal I.sub.1, the input voltage signal U.sub.2, and the input current signal I.sub.2 of the conversion circuit **510**. The preprocessing unit **521** is further configured to: calculate the active power Pe and the reactive power Qe based on the output voltage signal U.sub.1 and the output current signal I.sub.1, input the active power Pe to an inertia control unit **522**, and input the reactive power Qe, the input voltage signal U.sub.2, and the output voltage signal U.sub.1 to an amplitude control unit **527**.

[0101] Step S**603**: The controller **520** delays a phase of the active power to obtain an active power obtained by delaying the phase.

[0102] For example, the controller **520** converts an amplitude and a phase of the active power Pe to obtain an active power Peic obtained by delaying the phase. The controller **520** processes the amplitude and the phase of the active power Pe, to delay the phase of the active power Pe and change the amplitude of the active power Pe.

[0103] In an embodiment, the controller **520** includes the inertia control unit **522**. When a voltage frequency or a voltage phase of the power system fluctuates, the power system may cause an output power at the output end of the conversion circuit **510** to fluctuate. The inertia control unit **522** may convert the amplitude and the phase of the active power Pe to obtain the active power Peic obtained by delaying the phase. The inertia control unit **522** provides frequency and phase support characteristics for a new energy converter **500** in active power and frequency closed-loop control.

[0104] Step S**604**: The controller **520** calculates a power difference between the active power obtained by delaying the phase and a given power.

[0105] For example, if the controller **520** receives a power instruction, the controller **520** may subtract, from an active power corresponding to the power instruction, the active power obtained by delaying the phase, to calculate the power difference. If the controller **520** does not receive a power instruction, the controller **520** may use the active power obtained by delaying the phase as the power difference.

[0106] In an embodiment, the controller **520** includes an instruction adjustment unit **523**. The instruction adjustment unit **523** is configured to: process an active power Pref corresponding to an input power instruction, and convert the active power Pref corresponding to the power instruction into a given power Prefa. When the output voltage at the output end of the conversion circuit **510** is stable, that is, a control system is in a stable state, the given power Prefa output by the instruction adjustment unit **523** is the same as the active power Peic that is obtained by delaying the phase and that is output by the inertia control unit **522**.

[0107] In an embodiment, the controller **520** does not receive the power instruction, or the active power Pref corresponding to the power instruction is equal to 0. The voltage of the power system is unstable, and the active power Pe calculated by the preprocessing unit **521** is not equal to 0. The power difference ΔP input by a subtractor **524** to a forward control unit **525** is equal to −Peic.

[0108] In an embodiment, the controller **520** does not receive the power instruction, or the active power Pref corresponding to the power instruction is equal to 0. The voltage of the power system is stable, and the active power Pe calculated by the preprocessing unit **521** is equal to 0. The power difference ΔP input by a subtractor **524** to a forward control unit **525** is equal to 0.

[0109] In an embodiment, the controller **520** receives the power instruction, and the active power Pref corresponding to the power instruction is not equal to 0. The power difference ΔP input by a subtractor **524** to a forward control unit **525** is equal to Prefa-Peic.

[0110] Step S**605**: The controller **520** obtains a voltage frequency through conversion based on the

power difference and a relationship between a power and a frequency of a synchronous motor.

[0111] For example, by analogy with a nonlinear positive relationship between a power and a frequency of a synchronous motor, the controller **520** may determine a relationship between a power and a frequency. After receiving the power difference ΔP, the forward control unit **525** converts the power difference ΔP into the voltage frequency based on the relationship between the power and the frequency.

[0112] In an embodiment, the controller **520** includes the forward control unit **525**. After receiving the power difference ΔP, the forward control unit **525** quickly converts the power difference ΔP into a voltage angular velocity ωsyn based on the relationship between the power and the frequency of the synchronous motor, and outputs the voltage angular velocity ωsyn to a phase control unit **526**, the amplitude control unit **527**, and a modulation unit **528**. A relationship between an angular velocity ω and a frequency f is ω=2πf, and a voltage frequency fsyn may be obtained based on the voltage angular velocity ωsyn.

[0113] Step S**606**: The controller **520** performs integration on the voltage angular velocity to obtain a voltage phase.

[0114] In an embodiment, the controller **520** includes the phase control unit **526**. After receiving the voltage angular velocity ωsyn, the phase control unit **526** performs integration on the voltage angular velocity syn to obtain a voltage phase θsyn, and outputs the voltage phase θsyn to the amplitude control unit **527** and the modulation unit **528**.

[0115] Step S**607**: The controller **520** controls the voltage amplitude based on a rated reactive power value, an actual reactive power value, the voltage angular velocity, the voltage phase, a rated amplitude value, and an actual amplitude value.

[0116] In an embodiment, the controller **520** includes the amplitude control unit **527**. After receiving parameters such as the reactive power Qe, the input voltage signal U.sub.2, and the output voltage signal U.sub.1 that are from the preprocessing unit **521**, the voltage angular velocity ωsyn from the forward control unit **525**, the voltage phase θsyn from the phase control unit **526**, the actual amplitude value, an externally input rated amplitude value Vref, an externally input rated reactive power value Qref, the amplitude control unit **527** may control a voltage amplitude Ve, and output the voltage amplitude Ve to the modulation unit **528**.

[0117] Step S**608**: The controller **520** generates a trigger signal based on the voltage angular velocity, the voltage phase, and the voltage amplitude. The trigger signal triggers adjustment of a voltage parameter of the output voltage at the output end of the conversion circuit **510**.

[0118] In an embodiment, the controller **520** includes the modulation unit **528**. The modulation unit **528** receives the voltage angular velocity ωsyn, the voltage phase θsyn, and the voltage amplitude Ve, and generates the trigger signal based on the voltage angular velocity ωsyn, the voltage phase θsyn, and the voltage amplitude Ve. The relationship between the angular velocity ω and the frequency f is ω=2πf, and the voltage frequency fsyn may be obtained based on the voltage angular velocity ωsyn. After receiving the trigger signal, the conversion circuit **510** may control a power electronic device inside the conversion circuit **510** to operate, to adjust a frequency, a phase, and an amplitude of the output voltage at the output end of the conversion circuit **510**.

[0119] In this embodiment, after obtaining the active power at the output end of the conversion circuit, the controller converts the amplitude and the phase of the active power to obtain the active power obtained by delaying the phase, to provide the frequency and phase support characteristics in active power and frequency closed-loop control. The controller controls the voltage parameter at the output end of the conversion circuit based on the active power obtained by delaying the phase, to adjust the voltage parameter at the output end of the conversion circuit. After receiving the power instruction, the controller subtracts, from the active power corresponding to the power instruction, the active power obtained by delaying the phase, to obtain the power difference. The controller may quickly control the voltage parameter at the output end of the conversion circuit directly based on the power difference, thereby improving an instruction response speed of the

conversion circuit.

[0120] An embodiment further provides a grid-connected power system. The grid-connected power system includes a first power system, a second power system, and at least one new energy converter. The first power system may be a backup power supply, a photovoltaic power generation system, a hydropower generation system, a wind power generation system, or another power supply system. The second power system may be a power grid system, a household power grid, an enterprise power grid, or another power system. The new energy converter may execute the solutions shown in FIG. **5** and FIG. **6** and the corresponding solutions mentioned above, so that the grid-connected power system has effects of the foregoing protection solutions.

[0121] An embodiment further provides a computer program product including instructions. The computer program product may be a software or program product that includes instructions and that can run on a computing device or be stored in any usable medium. When the computer program product is run on at least one computing device, the at least one computing device is enabled to perform a control method.

[0122] Embodiments further provide a non-transitory computer-readable storage medium. The non-transitory computer-readable storage medium may be any usable medium that can be stored by a computing device, or a data storage device, such as a data center, including one or more usable media. The usable medium may be a magnetic medium (for example, a floppy disk, a hard disk, or a magnetic tape), an optical medium (for example, a DVD), a semiconductor medium (for example, a solid-state drive), or the like. The non-transitory computer-readable storage medium includes instructions, and the instructions instruct a computing device to perform a control method.

[0123] Further, it should be noted that the foregoing embodiments are merely intended for describing the solutions of the embodiments, but are not limiting. Although described in detail with reference to the foregoing embodiments, persons of ordinary skill in the art should understand that they may still make modifications to the solutions described in the foregoing embodiments or make equivalent replacements to some features thereof without departing from the scope of the solutions of the embodiments.

Claims

1. A grid-forming control method for a new energy converter, applied to a new energy converter, wherein the new energy converter comprises a conversion circuit and a controller, an input end of the conversion circuit is configured to connect to a direct current source, and an output end of the conversion circuit is configured to connect to an alternating current system; and the method comprises: controlling, by the controller, the conversion circuit to output an active power, and delaying a phase of the active power when a voltage frequency of the alternating current system fluctuates; and controlling, by the controller, a voltage parameter at the output end of the conversion circuit based on an active power obtained by delaying the phase, for the conversion circuit to output an active power with inertia support.

2. The method according to claim 1, wherein before the controlling, by the controller, a voltage parameter at the output end of the conversion circuit based on an active power obtained by delaying the phase, the method further comprises: receiving a power instruction, wherein the power instruction is used to control the voltage parameter at the output end of the conversion circuit; and the controlling a voltage parameter at the output end of the conversion circuit based on an active power obtained by delaying the phase comprises: subtracting, from an active power corresponding to the power instruction, the active power obtained by delaying the phase, to obtain a power difference; and controlling the voltage parameter at the output end of the conversion circuit based on the power difference.

3. The method according to claim 2, wherein after the receiving a power instruction, the method further comprises: converting the active power corresponding to the power instruction into a given

power, wherein when an output voltage at the output end of the conversion circuit is stable, a value of the given power is equal to the active power obtained by delaying the phase; and the subtracting, from an active power corresponding to the power instruction, the active power obtained by delaying the phase, to obtain a power difference comprises: subtracting, from the given power, the active power obtained by delaying the phase, to obtain the power difference.

4. The method according to claim 2, wherein the voltage parameter comprises a voltage frequency, and the controlling the voltage parameter at the output end of the conversion circuit based on the power difference comprises: converting the power difference into the voltage frequency based on a relationship between a power and a frequency of a synchronous motor.

5. The method according to claim 1, wherein the voltage parameter further comprises a voltage phase; and the controlling the voltage parameter at the output end of the conversion circuit based on the power difference comprises: performing integration on a voltage angular velocity to obtain the voltage phase, wherein the voltage frequency is determined based on the power difference, and the voltage angular velocity is determined based on the voltage frequency.

6. The method according to claim 1, wherein the voltage parameter further comprises a voltage amplitude; and the controlling the voltage parameter at the output end of the conversion circuit based on the power difference comprises: controlling the voltage amplitude based on a rated reactive power value, an actual reactive power value, the voltage angular velocity, the voltage phase, a rated amplitude value, and an actual amplitude value, wherein the reactive power is determined based on an output voltage signal and an output current signal, the voltage frequency is determined based on the power difference, the voltage angular velocity is determined based on the voltage frequency, and the voltage phase is determined based on the voltage angular velocity.

7. The method according to claim 1, wherein the method further comprises: generating a trigger signal based on the voltage parameter, wherein the trigger signal is used to trigger a power electronic device inside the conversion circuit to adjust the voltage parameter at the output end of the conversion circuit.

8. A new energy converter, comprising a conversion circuit and a controller, wherein the controller is configured to: control the conversion circuit to output an active power, and delay a phase of the active power when a voltage frequency of an alternating current system fluctuates; and control a voltage parameter at an output end of the conversion circuit based on an active power obtained by delaying the phase, for the conversion circuit to output an active power with inertia support.

9. The new energy converter according to claim 8, wherein the controller is further configured to: receive a power instruction, wherein the power instruction is used to control the voltage parameter at the output end of the conversion circuit; subtract, from an active power corresponding to the power instruction, the active power obtained by delaying the phase, to obtain a power difference; and control the voltage parameter at the output end of the conversion circuit based on the power difference.

10. The new energy converter according to claim 9, wherein the controller is further configured to: convert the active power corresponding to the power instruction into a given power, wherein when an output voltage at the output end of the conversion circuit is stable, a value of the given power is equal to the active power obtained by delaying the phase; and subtract, from the given power, the active power obtained by delaying the phase, to obtain the power difference.

11. The new energy converter according to claim 9, wherein the voltage parameter comprises a voltage frequency; and the controller is specifically configured to convert the power difference into the voltage frequency based on a relationship between a power and a frequency of a synchronous motor.

12. The new energy converter according to claim 8, wherein the voltage parameter further comprises a voltage phase; and the controller is specifically configured to perform integration on a voltage angular velocity to obtain the voltage phase, wherein the voltage frequency is determined based on the power difference, and the voltage angular velocity is determined based on the voltage

frequency.

13. The new energy converter according to claim 8, wherein the voltage parameter further comprises a voltage amplitude; and the controller is specifically configured to control the voltage amplitude based on a rated reactive power value, an actual reactive power value, the voltage angular velocity, the voltage phase, a rated amplitude value, and an actual amplitude value, wherein a reactive power is determined based on an output voltage signal and an output current signal, the voltage frequency is determined based on the power difference, the voltage angular velocity is determined based on the voltage frequency, and the voltage phase is determined based on the voltage angular velocity.

14. The new energy converter according to claim 9, wherein the controller is further configured to generate a trigger signal based on the voltage parameter, wherein the trigger signal is used to trigger a power electronic device inside the conversion circuit to adjust the voltage parameter at the output end of the conversion circuit.

15. A grid-connected power system, comprising: a new energy component, and at least one new energy converter, comprising a conversion circuit and a controller, wherein the controller is configured to: control the conversion circuit to output an active power, and delay a phase of the active power when a voltage frequency of an alternating current system fluctuates; and control a voltage parameter at an output end of the conversion circuit based on an active power obtained by delaying the phase, for the conversion circuit to output an active power with inertia support; and an input end of the new energy converter is connected to the new energy component, an output end of the new energy converter is configured to connect to a power grid, and the converter is configured to: convert a direct current of the new energy component into an alternating current of the power grid, or convert an alternating current of the power grid into a direct current of the new energy component.

16. The grid-connected power system according to claim 15, wherein the controller is further configured to: receive a power instruction, wherein the power instruction is used to control the voltage parameter at the output end of the conversion circuit; subtract, from an active power corresponding to the power instruction, the active power obtained by delaying the phase, to obtain a power difference; and control the voltage parameter at the output end of the conversion circuit based on the power difference.

17. The grid-connected power system according to claim 16, wherein the controller is further configured to: convert the active power corresponding to the power instruction into a given power, wherein when an output voltage at the output end of the conversion circuit is stable, a value of the given power is equal to the active power obtained by delaying the phase; and subtract, from the given power, the active power obtained by delaying the phase, to obtain the power difference.

18. The grid-connected power system according to claim 16, wherein the voltage parameter comprises a voltage frequency; and the controller is specifically configured to convert the power difference into the voltage frequency based on a relationship between a power and a frequency of a synchronous motor.

19. The grid-connected power system according to claim 15, wherein the voltage parameter further comprises a voltage phase; and the controller is specifically configured to perform integration on a voltage angular velocity to obtain the voltage phase, wherein the voltage frequency is determined based on the power difference, and the voltage angular velocity is determined based on the voltage frequency.

20. The grid-connected power system according to claim 15, wherein the voltage parameter further comprises a voltage amplitude; and the controller is specifically configured to control the voltage amplitude based on a rated reactive power value, an actual reactive power value, the voltage angular velocity, the voltage phase, a rated amplitude value, and an actual amplitude value, wherein a reactive power is determined based on an output voltage signal and an output current signal, the voltage frequency is determined based on the power difference, the voltage angular velocity is

determined based on the voltage frequency, and the voltage phase is determined based on the voltage angular velocity.