DC/DC converter and storing electric power; and a first resistor connected to the first DC/DC converter and consuming electric power when the first power storage unit is full, wherein the first DC/DC converter measures voltage of the DC bus, and allows the first power storage unit to store electric power when the voltage of the DC bus is maintained at a first threshold value or higher for a first period of time, the first DC/DC converter measures the voltage of the DC bus, and allows the first resistor to consume electric power when the voltage of the DC bus is maintained at the first threshold value or higher for a second period of time, and wherein the second period of time is longer than the first period of time.

[24] The first DC/DC converter may measure voltage of the DC bus, and may allow the first power storage unit to store electric power when the voltage of the DC bus is maintained at a first threshold value or higher for a first period of time.

[25] The first DC/DC converter may measure the voltage of the DC bus, and may allow the first resistor to consume electric power when the voltage of the DC bus is maintained at the first threshold value or higher for a second period of time, and wherein the second period of time is longer than the first period of time.

[26] The hybrid power supply apparatus may further include: a second power storage unit and a second resistor.

[27] The DC bus may be connected to a second DC/DC converter, and the second power storage unit and the second resistor may be connected to the second DC/DC converter.

[28] The first power storage unit may be an ultracapacitor.

[29] The electric power load may be a draw-works.

[30] The electric power load may be a top drive.

[31] In accordance with another aspect of the present invention, there is provided a hybrid power supply method for an offshore plant, including: measuring, by a DC/DC converter, voltage of a DC bus; storing, by a power storage unit, electric power when the voltage of the DC bus is maintained at a first threshold value or higher for a first period of time; and consuming, by a resistor, electric power when the voltage of the DC bus is maintained at the first threshold value or higher for a second period of time, wherein the DC bus is connected to an electric

power load generating regenerative power and the second period of time is longer than the first period of time.

[32] The DC/DC converter may measure the voltage of the DC bus, and may allow electric power to flow from the DC bus to the power storage unit such that the power storage unit stores electric power, when the voltage of the DC bus is maintained at the first threshold value or higher for the first period of time.

[33] The DC/DC converter may measure the voltage of the DC bus, and may allow electric power to flow from the DC bus to the resistor such that the resistor consumes electric power when the voltage of the DC bus is maintained at the first threshold value or higher for the second period of time.

[34] The power storage unit may be an ultracapacitor.

[35] The electric power load may be a draw-works.

[36] The electric power load may be a top drive.

[37] In accordance with a further aspect of the present invention, there is provided a hybrid power supply apparatus for an offshore plant, including: a power generator; an AC/DC converter converting alternating current produced by the power generator into direct current and supplying the direct current to a DC bus; a first electric power load connected to the DC bus via a first DC/AC converter and generating regenerative power; a first power storage unit storing regenerative power when regenerative power is generated in the first electric power load; a first resistor consuming electric power when the first power storage unit is full; a second electric power load connected to the DC bus via a second DC/AC converter and generating regenerative power; a second power storage unit storing regenerative power when regenerative power is generated in the second electric power load; a second resistor consuming electric power when the second power storage unit is full; and a first DC/DC converter connected to the DC bus; wherein the first power storage unit and the first resistor are connected to the first DC/DC converter, the first DC/DC converter measures voltage of the DC bus, and allows the first power storage unit to store electric power when the voltage of the DC bus is maintained at a first threshold value or higher for a first period of time, the first DC/DC converter measures the voltage of the DC bus, and allows the first resistor to consume electric power when the voltage of the DC bus is maintained at the first threshold value or higher for a second period of time, and wherein the second period of time is longer than the first period of time.

[38] The hybrid power supply apparatus may further include: a first DC/DC converter connected to the DC bus; and a second DC/DC converter connected to the DC bus, wherein the first power storage unit and the first resistor are connected to

the first DC/DC converter, and the second power storage unit and the second resistor are connected to the second DC/DC converter.

[39] The first DC/AC converter may detect whether regenerative power is generated in the first electric power load, and send a control signal to the first DC/DC converter when regenerative power is generated in the first electric power load, and the first DC/DC converter may allow electric power to be supplied from the DC bus to the first power storage unit in response to the control signal such that the first power storage unit stores electric power.

[40] The first DC/DC converter may allow electric power to be supplied from

the DC bus to the first resistor such that the first resistor consumes electric power when detecting that the first power storage unit is full.

[41] The first power storage unit may be an ultracapacitor.

[42] The first electric power load may be a draw-works.

[43] The first electric power load may be a top drive.

[44] In accordance with another aspect of the present invention, there is provided a hybrid power supply apparatus for an offshore plant, comprising: a power generator; an AC/DC converter converting alternating current produced by the power generator into direct current and supplying the direct current to a DC bus; a first electric power load connected to the DC bus via a first DC/AC converter and generating regenerative power; a first power storage unit storing regenerative power when regenerative power is generated in the first electric power load; a first resistor consuming electric power when the first power storage unit is full; a second electric power load connected to the DC bus via a second DC/AC converter and generating regenerative power; a second power storage unit storing regenerative power when regenerative power is generated in the second electric power load; a second resistor consuming electric power when the second power storage unit is full; a first DC/DC converter connected to the DC bus; a second DC/DC converter connected to the DC bus; a third DC/DC converter connected to the DC bus; and a fourth DC/DC converter connected to the DC bus, wherein the first power storage unit may be connected to the first DC/DC converter, the first resistor may be connected to the second DC/DC converter, the second power storage unit may be connected to the third DC/DC converter, and the second resistor may be connected to the fourth DC/DC converter, the first DC/DC converter measures voltage of the DC bus, and allows the first power storage unit to store electric power when the voltage of the DC bus is maintained at a first threshold value or higher for a first period of time, the first DC/DC converter measures the voltage of the DC bus, and allows the first resistor to consume electric power when the voltage of the DC bus is maintained at the first threshold value or higher for a second period of time, and wherein the second period of time is longer than the first period of time.

[45] In accordance with yet another aspect of the present invention, there is provided a hybrid power supply method for an offshore plant, wherein a first DC/AC converter and a second DC/AC converter are connected to a DC bus, a first electric power load is connected to the first DC/AC converter, and a second electric power load is connected to the second DC/AC converter, including: detecting, by the first DC/AC converter, whether regenerative power is generated in the first electric power load; storing, by a first power storage unit, regenerative power generated in the first electric power load when a voltage of the DC bus is maintained at a first threshold value or higher for a first period of time; detecting, by the second DC/AC converter, whether regenerative power is generated in the second electric power load; storing, by a second power storage unit, regenerative power generated in the second electric power load, and consuming, by a first resistor, electric power when the voltage of the DC bus is maintained at the first threshold value or higher for a second period of time, wherein the second period of time is longer than the first period of time.

[46] The DC bus may be connected to a first DC/DC converter and a second DC/DC converter; the first power storage unit and a first resistor may be connected to the first DC/DC converter; and the second power storage unit and a second resistor may be connected to the second DC/DC converter.

[47] The hybrid power supply method may further include: sending, by the first DC/AC converter, a control signal indicative of generation of regenerative power in the first electric power load to the first DC/DC converter; and allowing, by the first

DC/DC converter, electric power to be supplied from the DC bus to the first power storage unit in response to the control signal such that the first power storage unit stores electric power.

[48] The hybrid power supply method may further include: detecting, by the first DC/DC converter, that the first power storage unit is full; and allowing, by the first DC/DC converter, electric power to be supplied from the DC bus to the first resistor such that the first resistor consumes.

[49] The hybrid power supply method may further include: consuming, by the second resistor, electric power when the second power storage unit is full.

[50] The first power storage unit may be an ultracapacitor.

[51] The first electric power load may be a draw-works.

[52] The first electric power load may be a top drive.

【Advantageous Effects】

[53] According to embodiments of the present invention, it is possible to provide a hybrid power supply apparatus and method which allow regenerative power generated in a draw-works motor, a top drive motor, and a thruster motor to be stored in a power storage unit and supply electric power stored in the power storage unit upon abrupt increase in power consumption of the draw-works motor, the top drive motor, and the thruster motor to efficiently utilize regenerative power while maintaining power output of a power generator at a constant level to reduce exhaust gas.

[54] In addition, it is possible to provide a hybrid power supply apparatus and method which use an ultracapacitor having high responsiveness as a power storage unit, thereby supplying suitable electric power corresponding to abrupt change in power consumption of electric loads.

[55] Further, it is possible to provide a hybrid power supply apparatus and method which can utilize electric power stored in a power storage unit to safely shut down drilling equipment such as a draw-works or a top drive upon transients or loss of power.

[56] Furthermore, it is possible to provide a hybrid power supply apparatus and

【CLAIMS】

【Claim 1】

A hybrid power supply apparatus for an offshore plant, comprising:

a power generator;

an AC/DC converter converting alternating current produced by the power generator into direct current and supplying the direct current to a DC bus;

an electric power load connected to the DC bus and generating regenerative power;

a first DC/DC converter connected to the DC bus;

a first power storage unit connected to the first DC/DC converter and storing electric power; and

a first resistor connected to the first DC/DC converter and consuming electric power when the first power storage unit is full,

wherein the first DC/DC converter measures voltage of the DC bus, and allows the first power storage unit to store electric power when the voltage of the DC bus is maintained at a first threshold value or higher for a first period of time,

the first DC/DC converter measures the voltage of the DC bus, and allows the first resistor to consume electric power when the voltage of the DC bus is maintained at the first threshold value or higher for a second period of time, and wherein the second period of time is longer than the first period of time.

【Claim 2】

The hybrid power supply apparatus according to claim 1, further comprising: a second power storage unit and a second resistor.

【Claim 3】

The hybrid power supply apparatus according to claim 2, wherein the DC bus is connected to a second DC/DC converter, and the second power storage unit and the second resistor are connected to the second DC/DC converter.

【Claim 4】

The hybrid power supply apparatus according to claim 1, wherein the first power storage unit is an ultracapacitor.

【Claim 5】

The hybrid power supply apparatus according to claim 1, wherein the electric power load is a draw-works.

【Claim 6】

The hybrid power supply apparatus according to claim 1, wherein the electric power load is a top drive.

【Claim 7】

A hybrid power supply method for an offshore plant, comprising:

measuring, by a DC/DC converter, voltage of a DC bus;

storing, by a power storage unit, electric power when the voltage of the DC bus is maintained at a first threshold value or higher for a first period of time; and

consuming, by a resistor, electric power when the voltage of the DC bus is maintained at the first threshold value or higher for a second period of time,

wherein the DC bus is connected to an electric power load generating regenerative power and the second period of time is longer than the first period of time.

【Claim 8】

The hybrid power supply method according to claim 7, wherein the DC/DC converter measures the voltage of the DC bus, and allows electric power to flow

from the DC bus to the power storage unit such that the power storage unit stores electric power, when the voltage of the DC bus is maintained at the first threshold value or higher for the first period of time.

【Claim 9】

The hybrid power supply method according to claim 8, wherein the DC/DC converter measures the voltage of the DC bus, and allows electric power to flow from the DC bus to the resistor such that the resistor consumes electric power when the voltage of the DC bus is maintained at the first threshold value or higher for the second period of time.

【Claim 10】

The hybrid power supply method according to claim 7, wherein the power storage unit is an ultracapacitor.

【Claim 11】

The hybrid power supply method according to claim 7, wherein the electric power load is a draw-works.

【Claim 12】

The hybrid power supply method according to claim 7, wherein the electric power load is a top drive.

【Claim 13】

A hybrid power supply apparatus for an offshore plant, comprising:

a power generator;

an AC/DC converter converting alternating current produced by the power generator into direct current and supplying the direct current to a DC bus;

a first electric power load connected to the DC bus via a first DC/AC converter and generating regenerative power;

a first power storage unit storing regenerative power when regenerative

power is generated in the first electric power load;

a first resistor consuming electric power when the first power storage unit is full;

a second electric power load connected to the DC bus via a second DC/AC converter and generating regenerative power;

a second power storage unit storing regenerative power when regenerative power is generated in the second electric power load;

a second resistor consuming electric power when the second power storage unit is full; and

a first DC/DC converter connected to the DC bus;

wherein the first power storage unit and the first resistor are connected to the first DC/DC converter,

the first DC/DC converter measures voltage of the DC bus, and allows the first power storage unit to store electric power when the voltage of the DC bus is maintained at a first threshold value or higher for a first period of time,

the first DC/DC converter measures the voltage of the DC bus, and allows the first resistor to consume electric power when the voltage of the DC bus is maintained at the first threshold value or higher for a second period of time, and wherein the second period of time is longer than the first period of time.

【Claim 14】

The hybrid power supply apparatus according to claim 13, further comprising:

a second DC/DC converter connected to the DC bus,

wherein the second power storage unit and the second resistor are connected to the second DC/DC converter.

【Claim 15】

The hybrid power supply apparatus according to claim 14, wherein the first

DC/AC converter detects whether regenerative power is generated in the first electric power load, and sends a control signal to the first DC/DC converter when regenerative power is generated in the first electric power load, and the first DC/DC converter allows electric power to be supplied from the DC bus to the first power storage unit in response to the control signal such that the first power storage unit stores electric power.

【Claim 16】

The hybrid power supply apparatus according to claim 15, wherein the first DC/DC converter allows electric power to be supplied from the DC bus to the first

resistor such that the first resistor consumes electric power when detecting that the first power storage unit is full.

【Claim 17】

The hybrid power supply apparatus according to claim 13, wherein the first power storage unit is an ultracapacitor.

【Claim 18】

The hybrid power supply apparatus according to claim 13, wherein the first electric power load is a draw-works.

【Claim 19】

The hybrid power supply apparatus according to claim 13, wherein the first electric power load is a top drive.

【Claim 20】

A hybrid power supply apparatus for an offshore plant, comprising:

a power generator;

an AC/DC converter converting alternating current produced by the power generator into direct current and supplying the direct current to a DC bus;

a first electric power load connected to the DC bus via a first DC/AC converter and generating regenerative power;

a first power storage unit storing regenerative power when regenerative power is generated in the first electric power load;

a first resistor consuming electric power when the first power storage unit is full;

a second electric power load connected to the DC bus via a second DC/AC converter and generating regenerative power;

a second power storage unit storing regenerative power when regenerative power is generated in the second electric power load;

a second resistor consuming electric power when the second power storage

unit is full;

a first DC/DC converter connected to the DC bus;

a second DC/DC converter connected to the DC bus;

a third DC/DC converter connected to the DC bus; and

a fourth DC/DC converter connected to the DC bus;

wherein the first power storage unit is connected to the first DC/DC converter, the first resistor is connected to the second DC/DC converter, the second power storage unit is connected to the third DC/DC converter, and the second resistor is connected to the fourth DC/DC converter,

the first DC/DC converter measures voltage of the DC bus, and allows the first power storage unit to store electric power when the voltage of the DC bus is maintained at a first threshold value or higher for a first period of time,

the first DC/DC converter measures the voltage of the DC bus, and allows the first resistor to consume electric power when the voltage of the DC bus is maintained at the first threshold value or higher for a second period of time, and wherein the second period of time is longer than the first period of time.

【Claim 21】

A hybrid power supply method for an offshore plant, wherein a first DC/AC converter and a second DC/AC converter are connected to a DC bus, a first electric power load is connected to the first DC/AC converter, and a second electric power load is connected to the second DC/AC converter, comprising:

detecting, by the first DC/AC converter, whether regenerative power is generated in the first electric power load;

storing, by a first power storage unit, regenerative power generated in the first electric power load when a voltage of the DC bus is maintained at a first threshold value or higher for a first period of time;

detecting, by the second DC/AC converter, whether regenerative power is generated in the second electric power load;

storing, by a second power storage unit, regenerative power generated in the second electric power load; and

consuming, by a first resistor, electric power when the voltage of the DC bus is maintained at the first threshold value or higher for a second period of time,

wherein the second period of time is longer than the first period of time.

【Claim 22】

The hybrid power supply method according to claim 21, wherein the DC bus is connected to a first DC/DC converter and a second DC/DC converter; the first power storage unit and the first resistor are connected to the first DC/DC converter; and the second power storage unit and a second resistor are connected to the second DC/DC converter.

【Claim 23】

The hybrid power supply method according to claim 22, further comprising:

sending, by the first DC/AC converter, a control signal indicative of generation of regenerative power in the first electric power load to the first DC/DC converter; and

allowing, by the first DC/DC converter, electric power to be supplied from the DC bus to the first power storage unit in response to the control signal such that the first power storage unit stores electric power.

【Claim 24】

The hybrid power supply method according to claim 23, further comprising:

detecting, by the first DC/DC converter, that the first power storage unit is full; and

allowing, by the first DC/DC converter, electric power to be supplied from the DC bus to the first resistor such that the first resistor consumes.

【Claim 25】

The hybrid power supply method according to claim 22, further comprising:

consuming, by the second resistor, electric power when the second power storage unit is full.

【Claim 26】

The hybrid power supply method according to claim 21, wherein the first power storage unit is an ultracapacitor.

【Claim 27】

The hybrid power supply method according to claim 21, wherein the first electric power load is a draw-works.

【Claim 28】

The hybrid power supply method according to claim 21, wherein the first electric power load is a top drive.