[CLAIMS]

[Claim 1]

A charging and discharging control device for controlling charging and discharging of a secondary battery connected to a load of a moving object which receives a supply of power from an overhead line and generates regenerative power, the charging and discharging control device comprising:

a first limit current calculation unit configured to acquire load power which is required power or regenerative power in the load and a charge voltage of the secondary battery and obtain a first limit current for determining a limit of an adjustment current which is a setting value for controlling the charging and discharging of the secondary battery according to the load power based on the acquired load power and charge voltage;

a limit current setting unit configured to set a limit value of the adjustment current to the first limit current when the first limit current obtained by the first limit calculation unit is less than an absolute value of a second limit current for determining the limit of the adjustment current based on the performance of the secondary battery, and to set a limit value of the adjustment current to the second limit current when the first limit current is greater than the absolute value of the second limit current;

an adjustment logic determination unit configured to determine a relationship of the adjustment current corresponding to a state of charge (SOC) of the secondary battery in a range that does not exceed the limit value of the adjustment current based on the limit value of the adjustment current set by the limit current setting unit and a set SOC target value of the secondary battery; and

an adjustment current determination unit configured to determine the adjustment current corresponding to the SOC of the secondary battery based on the relationship determined by the adjustment logic determination unit.

[Claim 2]

The charging and discharging control device according to claim 1, further comprising:

an SOC target value setting unit configured to set the SOC target value of the secondary battery.

[Claim 3]

The charging and discharging control device according to claim 2, wherein the SOC target value setting unit sets the SOC target value predetermined according to a travel route of the moving object based on position information representing a current position of the moving object.

[Claim 4]

The charging and discharging control device according to claim 1, wherein the adjustment logic determination unit determines at least one of a relationship in which the adjustment power is increased to the limit value with an increase of the SOC of the secondary battery in a range from the SOC target value to a maximum value of the SOC predetermined according to the secondary battery and a relationship in which the adjustment power is decreased to the limit value with a decrease of the SOC of the secondary battery in a range from the SOC target value to a minimum value of the SOC predetermined according to the secondary battery.

[Claim 5]

The charging and discharging control device according to claim 1, wherein the limit current setting unit compares an absolute value of the second limit current to an absolute value of the first limit current, and sets a smaller value as the limit value of the adjustment current.

[Claim 6]

The charging and discharging control device according to claim 1, further comprising:

an adjustment current control unit configured to control power amounts of charging and discharging from the secondary battery based on the adjustment current determined by the adjustment current determination unit.

[Claim 7]

The charging and discharging control device according to claim 6, wherein the adjustment current control unit inhibits the discharging from the secondary battery if the SOC of the secondary battery is less than or equal to the SOC target value when the moving object is in a powering state and inhibits the charging to the secondary battery if the SOC of the secondary battery is greater than or equal to the SOC target value when the moving object is in a regenerative state.

[Claim 8]

A charging and discharging control system comprising:

the charging and discharging control device according to claim 1;

the secondary battery;

a motor configured to operate the moving object by receiving the supply of the required power and generate the regenerated power; and

a direct current (DC)-DC converter connected between the overhead line and the secondary battery and between the motor and the secondary battery and configured to convert a voltage of the power supplied from the overhead line and the motor and a voltage of the power supplied from the secondary battery.

[Claim 9]

A charging and discharging control method of controlling charging and discharging of a secondary battery connected to a load of a moving object which receives a supply of power from an overhead line and generates regenerative power, the charging and discharging control method comprising the steps of:

acquiring load power which is required power or regenerative power in the load and a charge voltage of the secondary battery;

obtaining a first limit current for determining a limit of an adjustment current which is a setting value for controlling the charging and discharging of the secondary battery according to the load power based on the acquired load power and charge voltage;

setting a limit value of the adjustment current to the first limit current when the obtained first limit current is less than an absolute value of a second limit current for determining the limit of the adjustment current based on the performance of the secondary battery, and to set a limit value of the adjustment current to the second limit current when the first limit current is greater than the absolute value of the second limit current;

determining a relationship of the adjustment current corresponding to an SOC of the secondary battery in a range that does not exceed the limit value of the adjustment current based on the set limit value of the adjustment current and a set SOC target value of the secondary battery; and

determining the adjustment current corresponding to the SOC of the secondary battery based on the determined relationship.

[Claim 10]

A program for causing a computer to execute the procedures of:

for controlling charging and discharging of a secondary battery connected to a load of a moving object which receives a supply of power from an overhead line and generates regenerative power,

acquiring load power which is required power or regenerative power in the load and a charge voltage of the secondary battery;

obtaining a first limit current for determining a limit of an adjustment current which is a setting value for controlling the charging and discharging of the secondary battery according to the load power based on the acquired load power and charge voltage;

setting a limit value of the adjustment current to the first limit current when the obtained first limit current is less than an absolute value of a second limit current for determining the limit of the adjustment current based on the performance of the secondary battery, and to set a limit value of the adjustment current to the second limit current when the first limit current is greater than the absolute value of the second limit current;

determining a relationship of the adjustment current corresponding to an SOC of the secondary battery in a range that does not exceed the limit value of the adjustment current based on the set limit value of the adjustment current and a set SOC target value of the secondary battery; and

determining the adjustment current corresponding to the SOC of the secondary battery based on the determined relationship.

[CLAIMS]

[Claim 1]

A charging and discharging control device for controlling charging and discharging of a secondary battery connected to a load of a moving object which receives a supply of power from an overhead line and generates regenerative power, the charging and discharging control device comprising:

a first limit current calculation unit configured to acquire load power which is required power or regenerative power in the load and a charge voltage of the secondary battery and obtain a first limit current for determining a limit of an adjustment current which is a setting value for controlling the charging and discharging of the secondary battery according to the load power based on the acquired load power and charge voltage;

a limit current setting unit configured to set a limit value of the adjustment current to the first limit current when an absolute value of the first limit current obtained by the first limit calculation unit is less than an absolute value of a second limit current for determining the limit of the adjustment current based on the performance of the secondary battery, and to set a limit value of the adjustment current to the second limit current when the absolute value of the first limit current is greater than the absolute value of the second limit current;

an adjustment logic determination unit configured to determine a relationship of the adjustment current corresponding to a state of charge (SOC) of the secondary battery in a range that does not exceed the limit value of the adjustment current based on the limit value of the adjustment current set by the limit current setting unit and a set SOC target value of the secondary battery; and

an adjustment current determination unit configured to determine the adjustment current corresponding to the SOC of the secondary battery based on the relationship determined by the adjustment logic determination unit, wherein

the adjustment logic determination unit determines at least one of a relationship in which the adjustment current is increased to the limit value with an increase of the SOC of the secondary battery in a range from the SOC target value to a maximum value of the SOC predetermined according to the secondary battery and a relationship in which the adjustment current is decreased to the limit value with a decrease of the SOC of the secondary battery in a range from the SOC target value to a minimum value of the SOC predetermined according to the secondary battery.

[Claim 2]

The charging and discharging control device according to claim 1, further comprising:

an SOC target value setting unit configured to set the SOC target value of the secondary battery.

[Claim 3]

The charging and discharging control device according to claim 2, wherein the SOC target value setting unit sets the SOC target value predetermined according to a travel route of the moving object based on position information representing a current position of the moving object.

[Claim 4]

The charging and discharging control device according to claim 1, wherein the limit current setting unit compares an absolute value of the second limit current to an absolute value of the first limit current, and sets a smaller value as the limit value of the adjustment current.

[Claim 5]

The charging and discharging control device according to claim 1, further comprising:

an adjustment current control unit configured to control power amounts of charging and discharging from the secondary battery based on the adjustment current determined by the adjustment current determination unit.

[Claim 6]

The charging and discharging control device according to claim 6, wherein the adjustment current control unit inhibits the discharging from the secondary battery if the SOC of the secondary battery is less than or equal to the SOC target value when the moving object is in a powering state and inhibits the charging to the secondary battery if the SOC of the secondary battery is greater than or equal to the SOC target value when the moving object is in a regenerative state.

[Claim 7]

A charging and discharging control system comprising:

the charging and discharging control device according to claim 1;

the secondary battery;

a motor configured to operate the moving object by receiving the supply of the required power and generate the regenerated power; and

a direct current (DC)-DC converter connected between the overhead line and the secondary battery and between the motor and the secondary battery and configured to convert a voltage of the power supplied from the overhead line and the motor and a voltage of the

power supplied from the secondary battery.

[Claim 8]

A charging and discharging control method of controlling charging and discharging of a secondary battery connected to a load of a moving object which receives a supply of power from an overhead line and generates regenerative power, the charging and discharging control method comprising the steps of:

acquiring load power which is required power or regenerative power in the load and a charge voltage of the secondary battery;

obtaining a first limit current for determining a limit of an adjustment current which is a setting value for controlling the charging and discharging of the secondary battery according to the load power based on the acquired load power and charge voltage;

setting a limit value of the adjustment current to the first limit current when an absolute value of the obtained first limit current is less than an absolute value of a second limit current for determining the limit of the adjustment current based on the performance of the secondary battery, and to set a limit value of the adjustment current to the second limit current when the absolute value of the first limit current is greater than the absolute value of the second limit current;

determining a relationship of the adjustment current corresponding to an SOC of the secondary battery in a range that does not exceed the limit value of the adjustment current based on the set limit value of the adjustment current and a set SOC target value of the secondary battery; and

determining the adjustment current corresponding to the SOC of the secondary battery based on the determined relationship, wherein

in the step of determining the relationship of the adjustment current, at least one of a

relationship in which the adjustment current is increased to the limit value with an increase of the SOC of the secondary battery in a range from the SOC target value to a maximum value of the SOC predetermined according to the secondary battery and a relationship in which the adjustment current is decreased to the limit value with a decrease of the SOC of the secondary battery in a range from the SOC target value to a minimum value of the SOC predetermined according to the secondary battery is determined.

[Claim 9]

A program for causing a computer to execute the procedures of:

for controlling charging and discharging of a secondary battery connected to a load of a moving object which receives a supply of power from an overhead line and generates regenerative power,

acquiring load power which is required power or regenerative power in the load and a charge voltage of the secondary battery;

obtaining a first limit current for determining a limit of an adjustment current which is a setting value for controlling the charging and discharging of the secondary battery according to the load power based on the acquired load power and charge voltage;

setting a limit value of the adjustment current to the first limit current when an absolute value of the obtained first limit current is less than an absolute value of a second limit current for determining the limit of the adjustment current based on the performance of the secondary battery, and to set a limit value of the adjustment current to the second limit current when the absolute value of the first limit current is greater than the absolute value of the second limit current;

determining a relationship of the adjustment current corresponding to an SOC of the secondary battery in a range that does not exceed the limit value of the adjustment current

based on the set limit value of the adjustment current and a set SOC target value of the secondary battery; and

determining the adjustment current corresponding to the SOC of the secondary battery based on the determined relationship, wherein

in the procedure of determining the relationship of the adjustment current, at least one of a relationship in which the adjustment current is increased to the limit value with an increase of the SOC of the secondary battery in a range from the SOC target value to a maximum value of the SOC predetermined according to the secondary battery and a relationship in which the adjustment current is decreased to the limit value with a decrease of the SOC of the secondary battery in a range from the SOC target value to a minimum value of the SOC predetermined according to the secondary battery is determined.