

TITLE

CONTROL DEVICE, CHARGING CONTROL DEVICE,
CHARGING SYSTEM, CONTROL METHOD, AND CONTROL
PROGRAM

5 TECHNICAL FIELD

[0001] The present invention relates to a control device, a charging control device, a charging system, a control method, and a control program.

BACKGROUND

10 [0002] Charging systems that perform charging of vehicles having storage batteries mounted therein, such as electric vehicles (EVs) and plug-in hybrid vehicles (PHVs), are known. The charging system includes a monitoring device (a parent device) that monitors an amount of used power and outputs a charging control instruction according to
15 the amount of used power, and a charging control device (a child device) that controls a charger on the basis of the charging control instruction output from the monitoring device. The monitoring device manages power so that contracted power with a power supply company is not exceeded (demand power is not exceeded) (see, for example,
20 Japanese Unexamined Patent Publication No. 2007-318907).

SUMMARY

[0003] The monitoring device and the charging control device are communicatively connected to each other. When communication between the monitoring device and the charging control device is
25 interrupted for some reason (when the monitoring device and the charging control device are disconnected), the transmission of the

charging control instruction from the monitoring device to the charging control device is stopped. In this case, the charging control device controls the charger so that charging stops. For example, in a case in which the monitoring device and the charging control device are connected by wireless communication and a large vehicle or the like passes between the monitoring device and the charging control device, or radio wave (noise) interference occurs, communication can be interrupted for a short period of time. In such a case, when charging stops each time the communication is interrupted, the charging is not performed from charging stop to charging restart and charging efficiency is degraded.

[0004] An object of the present invention is to provide a control device, a charging control device, a charging system, a control method, and a control program capable of improving charging efficiency.

[0005] A control device according to the present invention is a control device for controlling a charger on the basis of a charging control instruction transmitted from a monitoring device in a charging system performing charging on the basis of a power value set according to an amount of used power measured by the monitoring device, the control device including: a reception unit configured to receive the charging control instruction; and a control unit configured to control the charger on the basis of the charging control instruction received by the reception unit, wherein the control unit determines whether charging continues or stops on the basis of the charging control instruction received before a point in time when the charging control instruction is not received when the charging control instruction is not received in the reception unit.

[0006] In the control device according to the present invention, the control unit determines whether charging continues or stops on the basis of the charging control instruction received before a point in time when the charging control instruction is not received when the charging control instruction is not received by the reception unit. Accordingly, with the control device, when a determination is made that charging can continue from a past situation obtained from the charging control instruction received before the point in time when the charging control instruction is not received even in case in which the communication with the monitoring device is temporarily interrupted, it is possible to cause charging to continue in the charger. Therefore, with the control device, it is possible to improve charging efficiency.

[0007] The charging control instruction may include the power value, the control device may further include a storage unit configured to store the power value included in the charging control instruction received by the reception unit, and the control unit may calculate a prediction value on the basis of the power value during a predetermined period before the point in time when the charging control instruction is not received in the power value stored in the storage unit, and determine whether charging continues or stops on the basis of the prediction value. In this configuration, because the continuation or stop of the charging is determined on the basis of the demand prediction value, it is possible to avoid charging being performed in excess of the power value even when the charging control instruction from the monitoring device cannot be received. Therefore, the control device can cause charging to continue in the charger while performing power monitoring.

[0008] The control unit may obtain a slope of a transition of a plurality of the power values during the predetermined period, and calculate the prediction value on the basis of the slope of the transition. With this configuration, it is possible to calculate the prediction value with high accuracy.

[0009] The storage unit may store the power value each time the charging control instruction is received. In this configuration, the storage unit stores power values included in all charging control instructions transmitted from the monitoring device at predetermined communication intervals. Therefore, the control device can calculate the prediction value with high accuracy.

[0010] The storage unit may store a current value corresponding to a maximum increase in the power value, and the control unit may acquire the current value corresponding to the maximum increase relevant to a situation at the point in time when the charging control instruction is not received in the reception unit from the storage unit, and determine whether charging continues or stops on the basis of the prediction value and the current value corresponding to the maximum increase. In this configuration, because the continuation or stop of the charging is determined on the basis of the prediction value and the current value corresponding to the maximum increase, it is possible to more reliably avoid charging being performed in excess of the power value.

[0011] The control unit may calculate a time at which a reference value relevant to the power value is reached when charging is performed with the current value corresponding to the maximum increase with respect to the prediction value from the point in time when the charging control

instruction is not received, cause charging to continue until the time is reached from the point in time when the charging control instruction is not received, and cause charging to stop when the time is reached from the point in time when the charging control instruction is not received.

5 In this configuration, it is possible to more reliably avoid charging being performed in excess of the power value.

[0012] A charging control device according to the present invention includes the control device; and a charger controlled by the control device.

10 [0013] A charging control device according to the present invention includes the control device. Therefore, the charging control device can improve charging efficiency.

[0014] When the charging instruction from the control device is not input, the charger may continue to perform charging to a predetermined target value on the basis of the charging instruction input before a point in time when the charging instruction is not input. In this configuration, the charger continues to perform charging even when the communication between the control device and the charger is temporarily interrupted. Therefore, with the charging control device, it is possible to improve charging efficiency.

[0015] The charger may not receive a new charging request when the charging control instruction is not received by the reception unit. With this configuration, it is possible to reliably avoid charging being performed in excess of the power value.

25 [0016] A charging system according to the present invention includes a monitoring device configured to monitor an amount of used power, set a

power value according to the amount of used power, and transmit a charging control instruction based on the power value; and the control device.

[0017] A charging system according to the present invention includes the above control device. Therefore, with the charging system, it is possible to improve charging efficiency.

[0018] A control method according to the present invention is a control method for controlling a charger on the basis of a charging control instruction transmitted from a monitoring device in a charging system performing charging on the basis of a power value set according to an amount of used power measured by the monitoring device, the control method including: a reception step of receiving the charging control instruction; and a control step of controlling the charger on the basis of the charging control instruction received in the reception step, wherein, when the charging control instruction is not received in the reception step, the control step includes determining whether charging continues or stops on the basis of the charging control instruction received before a point in time when the charging control instruction is not received.

[0019] In the control method according to the present invention, the control step includes determining whether charging continues or stops on the basis of the charging control instruction received before a point in time when the charging control instruction is not received in a case in which the charging control instruction is not received in the reception step. Accordingly, with the control method, when a determination is made that charging can continue from a past situation obtained from the charging control instruction received before the point in time when the

charging control instruction is not received even in a case in which the communication with the monitoring device is temporarily interrupted, it is possible to cause charging to continue in the charger. Therefore, with the control method, it is possible to improve charging efficiency.

5 [0020] A control program according to the present invention is a control program for controlling a charger on the basis of a charging control instruction transmitted from a monitoring device in a charging system performing charging on the basis of a power value set according to an amount of used power measured by the monitoring device, the control
10 program causing a computer to execute: a reception step of receiving the charging control instruction; and a control step of controlling the charger on the basis of the charging control instruction received in the reception step, wherein, when the charging control instruction is not received in the reception step, the control step includes determining
15 whether charging continues or stops on the basis of the charging control instruction received before a point in time when the charging control instruction is not received.

[0021] In the control program according to the present invention, the control step includes determining whether charging continues or stops
20 on the basis of the charging control instruction received before a point in time when the charging control instruction is not received in a case in which the charging control instruction is not received in the reception step. Accordingly, with the control program, when a determination is made that charging can continue from a past situation obtained from the
25 charging control instruction received before the point in time when the charging control instruction is not received even in a case in which the

communication with the monitoring device is temporarily interrupted, it is possible to cause charging to continue in the charger. Therefore, the control program can improve charging efficiency.

[0022] A control device according to the present invention is a control device for controlling a charger on the basis of a charging control instruction transmitted from a monitoring device in a charging system performing charging on the basis of an amount of used power measured by the monitoring device and a capacity of a breaker, the control device including: a reception unit configured to receive the charging control instruction; and a control unit configured to control the charger on the basis of the charging control instruction received by the reception unit, wherein the control unit determines whether charging continues or stops on the basis of information relevant to the capacity of the breaker when the charging control instruction is not received by the reception unit.

[0023] In the control device according to the present invention, the control unit determines whether charging continues or stops on the basis of information relevant to the capacity of the breaker when the charging control instruction is not received by the reception unit. Accordingly, in the control device, when a determination is made that charging can continue within a range of capacity on the basis of the information relevant to the capacity of the breaker even in a case in which the communication with the monitoring device is temporarily interrupted, it is possible to cause the charging to continue in the charger. Therefore, with the control device, it is possible to improve charging efficiency.

[0024] According to the present invention, it is possible to improve charging efficiency.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] FIG. 1 is a diagram illustrating a vehicle charging system according to a first embodiment.

FIG. 2 is a diagram illustrating a configuration of a monitoring control device.

FIG. 3 is a diagram illustrating a configuration of a charging control device.

FIG. 4 is a flowchart illustrating an operation of the charging control device.

FIG. 5 is a flowchart illustrating an operation of the charger.

FIG. 6 is a diagram illustrating a vehicle charging system according to a second embodiment.

FIG. 7 is a diagram illustrating a server configuration.

FIG. 8 is a diagram illustrating a vehicle charging system according to a third embodiment.

FIG. 9 is a diagram illustrating a configuration of a monitoring control device illustrated in FIG. 8.

FIG. 10 is a diagram illustrating a configuration of the charging control device illustrated in FIG. 8.

DETAILED DESCRIPTION

[0026] Hereinafter, embodiments of the present invention will be described in detail with reference to the accompanying drawings. In the description of the drawings, the same or equivalent elements are denoted by the same reference signs, and repeated description will be omitted.

[0027] [First embodiment]

FIG. 1 is a diagram illustrating a vehicle charging system according to a first embodiment. As illustrated in FIG. 1, a vehicle charging system 1 is a system for charging a storage battery (not illustrated) of a vehicle V such as an electric vehicle (EV) or a plug-in hybrid vehicle (PHV). The vehicle charging system 1 performs charging of one or a plurality of vehicles V. The vehicle charging system 1 can perform charging of the plurality of vehicles V at the same time. In the vehicle charging system 1, for example, the vehicle V is charged using commercial power P.

[0028] The commercial power P is supplied as AC power (three-phase 200 V). A load L1 is connected to the commercial power P via a transformer TA, and a load L2 is connected to the commercial power P via a transformer TB. Further, a charger 24, which will be described below, is connected to the commercial power P via the transformer TB.

The transformers TA and TB are step-down converters that convert received high-voltage power into low-voltage power. The load L1 is, for example, an air conditioner. The load L2 is, for example, a lighting. The transformers TA and TB can be three-phase transformers or single-phase transformers. Three-phase power is supplied to the load L1 via the transformer TA, which is a three-phase transformer. Single-phase power (100 V, 200 V) is supplied to the load L2 and the charger 24 via the transformer TB, which is a single-phase transformer.

[0029] The vehicle charging system 1 includes a monitoring device 3 and a charging control device 5. The monitoring device 3 and the charging control device 5 may be disposed at a distance from each other. The monitoring device 3 and the charging control device 5 are

communicatively connected to each other.

[0030] <Monitoring device>

The monitoring device 3 monitors an amount of used power (received power amount) of the commercial power P and outputs a
5 charging control instruction according to the amount of used power to the charging control device 5. The monitoring device 3 is installed in, for example, a cubicle of a high-voltage power reception facility. A single-phase power is supplied to the monitoring device 3 as a power. The monitoring device 3 includes a measurer 10, a current sensor 12, a
10 monitoring control device 14, and a communicator 16. The monitoring control device 14 and the communicator 16 may be different devices or may be one device.

[0031] The measurer 10 measures a used amount of the commercial power P. The measurer 10 is connected to the commercial power P.
15 The measurer 10 includes, for example, a pulse sensor that outputs a pulse signal according to the amount of used power of the commercial power P. The pulse sensor outputs one pulse for each preset predetermined power. The measurer 10 outputs measurement data (pulse data), which is a measurement result, to the monitoring control
20 device 14.

[0032] The current sensor 12 detects a current. The current sensor 12 is, for example, a zero-phase current transformer. The current sensor 12 detects a current value of apparent power supplied to each of the load L1 and the load L2. The current sensor 12 outputs a current value,
25 which is a detection result, to the monitoring control device 14.

[0033] The monitoring control device 14 is a computer system or

processor mounted in an integrated circuit. The monitoring control device 14 includes a central processing unit (CPU), a read only memory (ROM), a random access memory (RAM), an input and output interface, and the like. Various programs or data are stored in the ROM.

5 [0034] FIG. 2 is a diagram illustrating a configuration of the monitoring control device 14. As illustrated in FIG. 2, the monitoring control device 14 includes a storage unit 140 and a control unit 142.

[0035] The storage unit 140 stores various pieces of data. The storage unit 140 stores the measurement data output from the measurer 10 and the current value output from the current sensor 12. Further, the storage unit 140 stores a reference value. The reference value is a value (a power value) set to a value that is, for example, about 10% smaller than a maximum demand value of a demand power value, which will be described below. The reference value is appropriately set by a customer (an operator).

10 [0036] The reference value is set for the following reasons. A maximum value of a demand value (a maximum demand value) for the past year (the current month and the previous 11 months) (a maximum monthly value of an average amount of used power every 30 minutes) is applied to a basic electricity charge and thus, when a demand value larger than a demand value for the past 11 months is measured even once a month, a basic electricity charge for the subsequent year is determined on the basis of that value. In order to curb or reduce electricity charges, it is effective to perform control for curbing the maximum demand value (demand control). Therefore, a reference value set to a numerical value that does not exceed the maximum

demand value is used.

[0037] The control unit 142 calculates the amount of used power of the commercial power P on the basis of the measurement data and the current value stored in the storage unit 140. The control unit 142 calculates the amount of used power at predetermined time intervals. The predetermined time is, for example, one minute. The control unit 142 calculates a power value of a demand power of the commercial power P (hereinafter also referred to as a “demand power value”) on the basis of the amount of used power. The control unit 142 stores the demand power value in the storage unit 140. The storage unit 140 stores the demand power value for each minute.

[0038] The control unit 142 generates and outputs a charging control instruction. The charging control instruction includes at least a charging power value (a current value) in the charger 24 of the charging control device 5 and the demand power value. The control unit 142 sets the charging power value on the basis of the amount of used power and the reference value. Specifically, the control unit 142 compares the amount of used power with the reference value, and when the control unit 142 determines that the amount of used power does not exceed the reference value, the control unit 142 sets a predetermined charging power value that has been set in advance.

[0039] When the control unit 142 determines that the amount of used power exceeds the reference value, the control unit 142 sets a charging power value smaller than the predetermined charging power value (a power value obtained by reducing a current value). The control unit 142 outputs a charging control instruction including the set charging

power value to the communicator 16. The control unit 142 outputs the charging control instruction at predetermined time intervals. The predetermined time is, for example, one minute.

[0040] As illustrated in FIG. 1, the communicator 16 performs communication with the charging control device 5. In the embodiment, the communicator 16 performs wireless communication with a communicator 20 (described below) of the charging control device 5. The communicator 16 can perform wireless communication in a 920 MHz band, for example. The communicator 16 transmits a charging control instruction output from the monitoring control device 14 to the charging control device 5.

[0041] <Charging control device>

The charging control device 5 controls the charger 24 on the basis of the charging control instruction transmitted from the monitoring device 3. The charging control device 5 is installed near a parking lot in which the vehicle V is parked, for example. Single-phase power is supplied as power to the charging control device 5. The charging control device 5 includes a communicator (a reception unit) 20, a charging control device 22, and a charger 24. The communicator 20 and the charging control device 22 constitute a control device. The communicator 20 and the charging control device 22 may be different devices or may be one device.

[0042] The communicator 20 performs communication with the monitoring device 3. The communicator 20 performs wireless communication with the communicator 16 of the monitoring device 3. The communicator 20 can perform, for example, wireless

communication in a 920 MHz band. The communicator 20 performs transmission and reception of information. The communicator 20 receives the charging control instruction from the monitoring device 3 (a reception step). The communicator 20 outputs the received charging control instruction to the charging control device 22.

[0043] The charging control device 22 controls the charger 24 on the basis of the charging control instruction output from the communicator 20. The charging control device 22 is a computer system or processor mounted on an integrated circuit. The charging control device 22 includes a CPU, a ROM, a RAM, an input and output interface, and the like. Various programs or data are stored in the ROM.

[0044] FIG. 3 is a diagram illustrating a configuration of the charging control device 22. As illustrated in FIG. 3, the charging control device 22 includes a storage unit 220 and a control unit 222.

[0045] The storage unit 220 stores various pieces of data. The storage unit 220 stores the demand power value included in the charging control instruction output from the communicator 20. The storage unit 220 stores the demand power value at predetermined time intervals. The predetermined time interval is an interval at which the monitoring device 3 transmits the charging control instruction, for example, one minute. That is, the storage unit 220 stores the demand power value each time the charging control instruction is received. Further, the storage unit 220 stores a current value corresponding to a maximum increase in the demand power value. The current value corresponding to the maximum increase is a current value with a largest increase in the demand power value stored at the same date and time in the past.

Further, the storage unit 220 stores the reference value set by the monitoring device 3. The reference value is stored in the storage unit 220 at an appropriate timing.

[0046] A control program P1 is stored in the storage unit 220. The control program P1 is a program for operating the charging control device 22, and operates a computer or the like so that control by the control unit 222 or the like is executed. The control program P1 causes the computer to execute a reception step of receiving the charging control instruction, and a control step of controlling the charger on the basis of the charging control instruction received in the reception step. The control program P1 may be provided after being fixedly stored in a tangible storage medium such as a CD-ROM, a DVD-ROM, or a semiconductor memory. Alternatively, the control program P1 may be provided via a communication network as a data signal superimposed on carrier waves.

[0047] The control unit 222 outputs a charging instruction (a current value) to the charger 24 on the basis of the power value of the charging control instruction output from the communicator 20. The control unit 222 outputs the charging instruction to the charger 24 until a charging amount of the storage battery of the vehicle V reaches the target value (a threshold value). When the charging amount of the vehicle V reaches the target value, the control unit 222 stops outputting the charging instruction to the charger 24.

[0048] When the charger 24 is charging and the charging control instruction is not received by the communicator 20, the control unit 222 determines whether charging continues or stops on the basis of the

charging control instruction received before a point in time when the charging control instruction is not received (control step). When the charging control instruction is not input at predetermined time intervals (one minute), that is, when the charging control instruction is not output from the communicator 20 at the predetermined time intervals, the control unit 222 determines that the charging control instruction is not received by the communicator 20. The control unit 222 sets a time when the control unit 222 determines that the charging control instruction is not received in the communicator 20 as the point in time when the charging control instruction is not received. The point in time when the charging control instruction is not received may be a point in time corresponding to an interval of a predetermined time. Specifically, the control unit 222 may set a time when the charging control instruction is received normally (one minute after a previous charging control instruction is received) as the point in time when the charging control instruction is not received.

[0049] When the communicator 20 determines that the charging control instruction is not received, the control unit 222 controls the charger 24 according to a situation before the charging control instruction is not input. That is, when the communication between the monitoring device 3 and the charging control device 5 is interrupted, the control unit 222 controls the charger 24 according to a situation before the communication is interrupted.

[0050] Specifically, the control unit 222 calculates a demand prediction value on the basis of the demand power value stored in the storage unit 220. The control unit 222 acquires the demand power value during a

predetermined period before a point in time when the charging control instruction is not input. Specifically, the control unit 222 acquires the demand power value during a predetermined period including the demand power value immediately before a point in time when the charging control instruction is not input. The predetermined period is, for example, 30 minutes. The control unit 222 calculates the demand prediction value on the basis of a slope of a transition of the acquired demand power value. Specifically, the control unit 222 acquires the slope from a transition (a group of 30 points) of the demand power value for the past 30 minutes. The control unit 222 obtains a prediction line passing through a point of a latest demand power value on the basis of the slope, and calculates the demand prediction value from a relationship between the prediction line and a demand graph.

[0051] The control unit 222 predicts a time at which the reference value stored in the storage unit 220 is exceeded on the basis of the calculated demand prediction value and the current value corresponding to the maximum increase stored in the storage unit 220. Specifically, the control unit 222 adds the current value corresponding to the maximum increase to the demand prediction value, and calculates the time at which the reference value is exceeded. That is, the control unit 222 calculates hours (minutes) for which the current value corresponding to the maximum increase is supplied at the demand prediction value until the reference value is exceeded.

[0052] The control unit 222 acquires data relevant to the current value corresponding to the maximum increase (hereinafter also referred to as “increase data”) from the storage unit 220. The control unit 222

acquires the current value corresponding to the maximum increase relevant to a situation at the point in time when the charging control instruction is not received in the communicator 20 from the storage unit 220. The current value corresponding to the maximum increase relevant to the situation may be a current value corresponding to the maximum increase, for example, in a time of the same month as the point in time when the charging control instruction is not received, a time of the same day of week as that point in time, and a season at that point in time. In the present embodiment, the control unit 222 acquires the increase data on the basis of a preset priority. The control unit 222 acquires the increase data in descending order of priority. The priority is set as follows, for example. The priority is lowered in the order of “1,” “2,” “3,” and “4.” The priority is appropriately set by the operator or the like.

- 1: Increase data on the same month and the same time of a previous year
- 2: Increase data on the same day of the week and the same time of a previous year
- 3: Increase data on the same time of a previous day
- 4: Increase data for the past 30 minutes

[0053] When the point in time when the charging control instruction is not input is “year YYYY month MM day DD,” “Tuesday,” and “AA:BB,” the control unit 222 searches the storage unit 220 for increase data on the same month (month MM) and the same time (month MM) (AA:BB) of a previous year. When the increase data on the same month and the same time of the previous year is stored in the storage unit 220, the control unit 222 acquires the increase data.

[0054] When the increase data on the same month and the same time of the previous year is not stored in the storage unit 220, the control unit 222 searches the storage unit 220 for increase data on the same day of the week (Tuesday) and the same time (AA:BB). When the increase data on the same day of the week and the same time is stored in the storage unit 220, the control unit 222 acquires the increase data.

[0055] When the increase data on the same day of the week and the same time is not stored in the storage unit 220, the control unit 222 searches the storage unit 220 for increase data at the same time (AA:BB) of the previous day. When the increase data at the same time of the previous day is stored in the storage unit 220, the control unit 222 acquires the increase data.

[0056] When data corresponding to the maximum increase on the same time of the previous day is not stored in the storage unit 220, the control unit 222 acquires the increase data for the past 30 minutes at the point in time when the charging control instruction is not input from the storage unit 220. The control unit 222 stores the increase data acquired as described above in the storage unit 220 as data used for current processing.

[0057] The control unit 222 calculates an excess time at which the reference value is exceeded on the basis of the acquired increase data and the demand prediction value. The control unit 222 determines whether charging continues or stops on the basis of the excess time. The control unit 222 determines that charging continues within the excess time. In this case, the control unit 222 generates the charging instruction and outputs the charging instruction to the charger 24 so that

the charger 24 performs charging. The control unit 222 determines that charging stops when the excess time is reached. In this case, the control unit 222 stops outputting the charging instruction to the charger 24. Accordingly, charging in the charger 24 is completed.

5 [0058] An operation (control method) of the charging control device 5 will be described with reference to FIG. 4. FIG. 4 is a flowchart illustrating the operation of the charging control device 5. Hereinafter, an operation when the charging control device 5 does not receive the charging control instruction will be described.

10 [0059] As illustrated in FIG. 4, the charging control device 5 determines whether or not the charging control instruction has been received (step S01). When the charging control device 5 determines that the charging control instruction has been received (step S01: YES), the charging control device 5 ends the processing. When the charging
15 control device 5 determines that the charging instruction has not been received (step S01: NO), the charging control device 5 proceeds to step S02.

[0060] In step S02, the charging control device 5 calculates the demand prediction value. The charging control device 5 then acquires the
20 increase data (step S03). Subsequently, the charging control device 5 adds the current value corresponding to the maximum increase to the demand prediction value to calculate an excess time at which the reference value is exceeded (step S04). The charging control device 5 generates the charging instruction and outputs the charging instruction
25 to the charger 24 so that the charger 24 performs charging within the calculated excess time (step S05).

[0061] Subsequently, the charging control device 5 determines whether or not the excess time has been reached (step S06). When the charging control device 5 determines that the excess time has been reached (step S06: YES), the charging control device 5 stops outputting the charging instruction (step S07). When the charging control device 5 determines that the excess time has not been reached (step S06: NO), the process returns to the processing of step S05.

[0062] As illustrated in FIG. 1, one or a plurality of chargers 24 are provided in the charging control device 5. The charger 24 performs charging of the storage battery of the vehicle V. A single-phase power of 200 V is supplied to the charger 24 from the commercial power P via the transformer TB. The charger 24 and the charging control device 22 are communicatively connected to each other. The charger 24 controls a charging current on the basis of the charging instruction (the current value) output from the charging control device 22, and performs charging of the storage battery of the vehicle V. The charger 24 and the vehicle V are connected by a charging cable C.

[0063] When the charging instruction from the charging control device 22 is not input during charging, the charger 24 performs charging control on the basis of a current value of an immediately previous charging instruction. That is, when the communication between the charging control device 5 and the charger 24 is interrupted, the charger 24 performs charging on the basis of a charging instruction immediately before the communication is interrupted. Specifically, when the charger 24 receives the charging instruction according to the current value of, for example, "30A", the charger 24 continues to perform

charging at "30A". The charger 24 performs charging on the basis of a current charging amount and the target value. The charger 24 ends charging when the charging amount reaches the target value.

[0064] When there is a new charging request in a state in which the charging control instruction is not received in the communicator 20, the charger 24 does not receive the charging request. That is, the charger 24 does not receive a new charging start instruction when the charging control instruction is not received in the charging control device 5.

[0065] An operation of the charger 24 will be described with reference to FIG. 5. FIG. 5 is a flowchart illustrating the operation of the charger 24. Hereinafter, an operation of the charger 24 when the charging instruction is not received will be described.

[0066] As illustrated in FIG. 5, the charger 24 determines whether or not the charging instruction has been received (step S11). When the charging control device 5 determines that the charging control instruction has been received (step S11: YES), the charging control device 5 ends the processing. When the charging control device 5 determines that the charging instruction has not been received (step S11: NO), the charging control device 5 proceeds to step S12.

[0067] In step S12, the charger 24 performs charging on the basis of the charging instruction (current value) immediately before the communication is interrupted. The charger 24 determines whether or not the charging amount has reached the target value (step S13). When the charger 24 determines that the charging amount has reached the target value (step S13: YES), the charger 24 stops charging (step S14). When the charger 24 determines that the charging amount has not

reached the target value (step S13: NO), the charger 24 returns to the processing of step S12.

[0068] As described above, in the vehicle charging system 1 according to the present embodiment, when the charging control instruction is not received in the communicator 20, the control unit 222 of the charging control device 22 determines whether charging continues or stops on the basis of a charging control instruction received before the point in time when the charging control instruction is not received. Accordingly, when the charging control device 22 determines that charging can continue from a past situation obtained from the charging control instruction received before the point in time when the charging control instruction is not received even in case in which the communication with the monitoring device 3 is temporarily interrupted, the charging control device 22 can cause charging to continue in the charger 24. Therefore, with the vehicle charging system 1, it is possible to improve charging efficiency.

[0069] In the vehicle charging system 1 according to the present embodiment, the charging control instruction transmitted from the monitoring device 3 includes the demand power value. The charging control device 22 includes the storage unit 220 that stores the demand power value included in the charging control instruction received by the communicator 20. The control unit 222 calculates the demand prediction value on the basis of the demand power value during a predetermined period before the point in time when the charging control instruction is not received in the demand power value stored in the storage unit 220, and determines whether charging continues or stops on

the basis of the demand prediction value. In this configuration, because the continuation or stop of the charging is determined on the basis of the demand prediction value, it is possible to avoid charging being performed in excess of the demand power value even when the charging control instruction from the monitoring device 3 cannot be received. Therefore, the charging control device 22 can cause charging to continue in the charger 24 while performing demand monitoring.

[0070] In the vehicle charging system 1 according to the present embodiment, the control unit 222 obtains a slope of a transition of a plurality of demand power values during a predetermined period, and calculates the demand prediction value on the basis of the slope of the transition. With this configuration, it is possible to calculate the demand prediction value with high accuracy.

[0071] In the vehicle charging system 1 according to the present embodiment, the storage unit 220 stores the demand power value each time the charging control instruction is received. In this configuration, the storage unit 220 stores the demand power values included in all the charging control instructions transmitted from the monitoring device 3 at predetermined communication intervals. Therefore, in the charging control device 22, it is possible to accurately calculate the demand prediction value.

[0072] In the vehicle charging system 1 according to the present embodiment, the storage unit 220 stores the current value corresponding to the maximum increase in the demand power value. The control unit 222 acquires the current value corresponding to the maximum increase relevant to a situation at a point in time when the communicator 20 does

not receive the charging control instruction from the storage unit 220,
and determines whether charging continues or stops on the basis of the
demand prediction value and the current value corresponding to the
maximum increase. In this configuration, because the continuation or
5 stop of the charging is determined on the basis of the demand prediction
value and the current value corresponding to the maximum increase, it
is possible to more reliably avoid charging being performed in excess of
the demand power value.

[0073] For example, because an air conditioner or the like is used when
10 the point in time when the charging control instruction is not received in
the communicator 20 (when the communication between the monitoring
device 3 and the charging control device 5 is interrupted) is noon in
summer (for example, August), the current value corresponding to the
maximum increase is larger than that in spring, for example. Thus,
15 because the current value corresponding to the maximum increase
relevant to a situation at the point in time when the charging control
instruction is not received in the communicator 20 is acquired from the
storage unit 220, and a determination is made as to whether charging
continues or stops on the basis of the demand prediction value and the
20 current value corresponding to the maximum increase, it is possible to
make a determination suitable for the point in time when the charging
control instruction is not received.

[0074] In the vehicle charging system 1 according to the present
embodiment, when charging is performed with the current value
25 corresponding to the maximum increase with respect to the demand
prediction value from the point in time when the charging control

instruction is not received, the control unit 222 calculates the excess time when the reference value relevant to the demand power is reached. The control unit 222 causes charging to continue until the excess time is reached from the point in time when the charging control instruction is not received, and stops charging when the excess time is reached from the point in time when the charging control instruction is not received. In this configuration, it is possible to more reliably avoid charging being performed in excess of the demand power value.

[0075] In the vehicle charging system 1 according to the present embodiment, when the charging instruction from the charging control device 22 is not input, the charger 24 continues to perform charging to a predetermined target value on the basis of the charging instruction input before a point in time when the charging instruction is not input. In this configuration, the charger 24 continues to perform charging even when the communication between the charging control device 22 and the charger 24 is temporarily interrupted. Therefore, with the vehicle charging system 1, it is possible to improve charging efficiency.

[0076] In the vehicle charging system 1 according to the present embodiment, the charger 24 does not receive a new charging request when the charging control instruction is not received in the communicator 20. In this configuration, it is possible to reliably avoid charging being performed in excess of the demand power value.

[0077] [Second embodiment]

Next, a second embodiment will be described. FIG. 6 is a diagram illustrating a vehicle charging system according to the second embodiment. As illustrated in FIG. 6, the vehicle charging system 1A

includes a monitoring device 3, a charging device 7, and a server (control device) 9.

[0078] The monitoring device 3 and the server 9, and the charging device 7 and the server 9 are communicatively connected to each other via the network N. A configuration of network N is not limited. For example, the network N may include the Internet (a public network), a communication carrier network, a business network, and the like.

[0079] <Monitoring device>

The communicator 16 of the monitoring device 3 performs communication with the server 9. The communicator 16 performs communication with the server 9 via the network N. The communicator 16 transmits the charging control instruction to the server 9.

[0080] <Charging device>

The charging device 7 performs charging on the basis of a charging instruction transmitted from the server 9. The charging device 7 is installed near, for example, a parking lot in which the vehicle V is parked. A single-phase power is supplied to the charging device 7 as a power. The charging device 7 includes a communicator 30 and a charger 32.

[0081] The communicator 30 performs communication with the server 9. The communicator 30 performs communication with the server 9 via the network N. The communicator 30 receives the charging instruction from the server 9. The communicator 30 outputs the received charging instruction to the charger 32.

[0082] One or a plurality of chargers 32 are provided. The charger 32

performs charging of the storage battery of the vehicle V. The single-phase power of 200 V is supplied to the charger 32 from the commercial power P via the transformer TB. The charger 32 controls a charging current on the basis of the charging instruction (a current value) output from the communicator 30, and performs charging of the storage battery of the vehicle V. The charger 24 and the vehicle V are connected by the charging cable C.

[0083] When the charging instruction from the communicator 30 is not input during charging, the charger 32 performs charging control on the basis of the current value of the immediately previous charging instruction. That is, when the communication between the charging device 7 and the server 9 is interrupted, or when the communication between the communicator 30 and the charger 32 is interrupted, the charger 32 performs charging on the basis of the charging instruction immediately before the communication is interrupted. Specifically, when the charger 32 receives the charging instruction according to a current value of, for example, "30A", the charger 32 continues to perform charging at "30A". The charger 32 performs charging on the basis of the current charging amount and the target value. The charger 32 ends charging when the charging amount reaches the target value.

[0084] When there is a new charging request in a case in which the charging control instruction is not received in the communication unit 90 of the server 9, the charger 32 does not receive the charging request. That is, the charger 32 does not receive a new charging start instruction in a state in which the server 9 does not receive the charging control instruction.

[0085] <Server>

The server 9 may include, for example, one or more devices provided on the cloud. The server 9 generates the charging instruction on the basis of the charging control instruction transmitted from the monitoring device 3. The server 9 is a computer system or processor implemented in an integrated circuit. The server 9 includes a CPU, ROM, RAM, an input and output interface, and the like. Various programs or data are stored in the ROM.

[0086] FIG. 7 is a diagram illustrating a configuration of the server 9. As illustrated in FIG. 7, the server 9 includes a communication unit 90, a storage unit 92, and a control unit 94.

[0087] The communication unit 90 performs communication with the monitoring device 3 and the charging device 7. The communication unit 90 performs transmission and reception of information to and from each of the monitoring device 3 and the charging device 7 via the network N. The communication unit 90 receives the charging control instruction from the monitoring device 3 (a reception step). The communication unit 90 outputs the received charging control instruction to the storage unit 92 and the control unit 94. The communication unit 90 transmits the charging instruction to the charging device 7.

[0088] The storage unit 92 stores various pieces of data. The storage unit 92 stores a demand power value included in the charging control instruction output from the communication unit 90. The demand power value is stored at predetermined time intervals. The predetermined time interval is an interval at which the monitoring device 3 transmits the charging control instruction, for example, one

minute. Further, the storage unit 92 stores the current value corresponding to a maximum increase in the demand power value. The current value corresponding to the maximum increase is a current value with a largest increase in the demand power values stored at the same date and time in the past. Further, the storage unit 220 stores the reference value. The reference value is stored in the storage unit 220 at an appropriate timing.

[0089] A control program P2 is stored in the storage unit 92. The control program P2 is a program for operating the server 9, and operates a computer or the like so that control by the control unit 94 or the like is executed. The control program P2 causes the computer to execute a reception step of receiving the charging control instruction, and a control step of controlling the charger on the basis of the charging control instruction received in the reception step.

[0090] The control unit 94 transmits the charging instruction (the current value) to the charging device 7 on the basis of the power value of the charging control instruction output from the communication unit 90. The control unit 94 transmits the charging instruction to the charging device 7 until a charging amount of the storage battery of the vehicle V reaches a target value (threshold value). When the charging amount of the vehicle V reaches the target value, the control unit 94 stops transmitting the charging instruction to the charging device 7.

[0091] When the charger 32 is charging and the charging control instruction is not received in the communication unit 90, the control unit 94 determines whether charging continues or stops on the basis of the charging control instruction received before the point in time when the

charging control instruction is not received (a control step). When the charging control instruction is not input, that is, when the charging control instruction is not output from the communication unit 90, the control unit 94 controls the charger 32 according to a situation before the charging control instruction is not input. That is, when the communication between the monitoring device 3 and the server 9 is interrupted, the control unit 94 controls the charger 32 according to a situation before the communication is interrupted.

[0092] The control unit 94 calculates the excess time at which the reference value is exceeded on the basis of the increase data acquired using the same method as the above method and the demand prediction value. The control unit 94 determines whether charging continues or stops on the basis of the excess time. The control unit 94 determines that charging continues within the excess time. In this case, the control unit 94 generates the charging instruction and transmits the charging instruction to the charging device 7 so that the charger 32 performs charging. The control unit 94 determines that charging stops when the excess time is reached. In this case, the control unit 94 stops transmitting the charging instruction to the charging device 7. Accordingly, charging in the charger 32 is completed.

[0093] As described above, the vehicle charging system 1A according to the present embodiment has the same effects as those of the vehicle charging system 1. That is, in the vehicle charging system 1A, when the charging control instruction is not received in the communication unit 90, the control unit 94 of the server 9 determines whether the charging continues or stops on the basis of the charging control

instruction received before the point in time when the charging control instruction is not received. Accordingly, in the vehicle charging system 1A, when a determination is made that the charging can continue from a past situation obtained from the charging control instruction received before the point in time when the charging control instruction is not received even in a case in which the communication between the monitoring device 3 and the server 9 is temporarily interrupted, it is possible to cause the charging to continue in the charger 32. Therefore, in the vehicle charging system 1A, it is possible to improve charging efficiency.

[0094] [Third embodiment]

Next, a third embodiment will be described. FIG. 8 is a diagram illustrating a vehicle charging system according to the third embodiment. As illustrated in FIG. 8, the vehicle charging system 1B uses the commercial power P to charge the vehicle V. The commercial power P supplies an AC power (three-phase 200 V). A charger 24 is connected to the commercial power P via a transformer T, which is a single-phase transformer.

[0095] The vehicle charging system 1B includes a monitoring device 3B and a charging control device 5B. The monitoring device 3B and the charging control device 5B may be disposed at a distance from each other. The monitoring device 3B and the charging control device 5B are communicatively connected to each other.

[0096] <Monitoring device>

The monitoring device 3B monitors the amount of used power of the commercial power P and outputs a charging control instruction

according to the amount of used power to the charging control device 5.
The monitoring device 3B includes a measurer 10, a current sensor 12, a
monitoring control device 14B, a communicator 16, and a breaker 18.
The monitoring control device 14 and the communicator 16 may be
5 different devices or may be one device.

[0097] The current sensor 12 detects a current. The current sensor 12
is, for example, a zero-phase current transformer. The current sensor
12 detects a current value of an apparent power supplied to the charger
24. The current sensor 12 outputs a current value, which is a detection
10 result, to the monitoring control device 14.

[0098] FIG. 9 is a diagram illustrating a configuration of the monitoring
control device 14B. As illustrated in FIG. 9, the monitoring control
device 14B includes a storage unit 140B and a control unit 142B.

[0099] The storage unit 140B stores various pieces of data. The
15 storage unit 140 stores the measurement data output from the measurer
10 and the current value output from the current sensor 12. Further,
the storage unit 140B stores a capacity value relevant to a capacity (a
rated breaking capacity) of the breaker 18. The capacity value is
stored at an appropriate timing.

[0100] The control unit 142B calculates the amount of used power on
20 the basis of the measurement data and the current value stored in the
storage unit 140B. The control unit 142B calculates the amount of
used power at predetermined time intervals. The control unit 142B
generates and outputs the charging control instruction on the basis of the
25 amount of used power and the capacity value. The charging control
instruction includes at least the charging power value (the current value)

in the charger 24 of the charging control device 5B. The control unit 142B sets the charging power value on the basis of the amount of used power and the capacity value. Specifically, the control unit 142B compares the amount of used power with the capacity value, and when
5 the control unit 142B determines that the amount of used power does not exceed the capacity value, the control unit 142B sets a predetermined charging power value that has been set in advance.

[0101] When the control unit 142B determines that the amount of used power exceeds the capacity value, the control unit 142B sets a charging
10 power value smaller than a predetermined charging power value (a power value obtained by reducing the current value). The control unit 142B outputs a charging control instruction including the set charging power value to the communicator 16. The control unit 142B outputs a charging control instruction at predetermined time intervals. The
15 predetermined time is, for example, one minute.

[0102] As illustrated in FIG. 8, the breaker 18 breaks the supply of the power from the commercial power P to the charger 24 when the amount of used power exceeds the rated breaking capacity.

[0103] <Charging control device>

20 The charging control device 5B controls the charger 24 on the basis of the charging control instruction transmitted from the monitoring device 3B. The charging control device 5B includes a communication device (communication unit) 20, a charging control device 22B, and a charger 24. The communicator 20 and the charging control device
25 22B constitute a control device. The communicator 20 and the charging control device 22B may be different devices or may be one

device.

[0104] The charging control device 22B controls the charger 24 on the basis of the charging control instruction output from the communicator 20. FIG. 10 is a diagram illustrating a configuration of the charging control device 22B. As illustrated in FIG. 10, the charging control device 22B includes a storage unit 220B and a control unit 222B.

[0105] The storage unit 220B stores various pieces of data. The storage unit 220 stores the capacity value of the breaker 18. The capacitance value is stored in the storage unit 220B at an appropriate timing.

[0106] A control program P3 is stored in the storage unit 220B. The control program P3 is a program for operating the charging control device 22B, and operates a computer or the like so that control by the control unit 222B or the like is executed. The control program P3 causes the computer to execute a reception step of receiving the charging control instruction, and a control step of controlling the charger on the basis of the charging control instruction received in the reception step.

[0107] The control unit 222B outputs the charging instruction (the current value) to the charger 24 on the basis of the power value of the charging control instruction output from the communicator 20. The control unit 222B outputs the charging instruction to the charger 24 until a charging amount of the storage battery of the vehicle V reaches the target value (threshold value). When the charging amount of the vehicle V reaches the target value, the control unit 222B stops outputting the charging instruction to the charger 24.

[0108] When the charger 24 is charging and the charging control instruction is not received in the communicator 20, the control unit 222B determines whether charging continues or stops on the basis of information relevant to the capacity of the breaker 18. Specifically, the control unit 222B determines whether charging continues or stops on the basis of the capacity value stored in the storage unit 220B. The control unit 222B performs charging control on the basis of the power value of the charging control instruction immediately before the charging control instruction is not received in the communicator 20, and determines that charging continues when the amount of power does not exceed the capacity value. In this case, the control unit 222B generates the charging instruction and outputs the charging instruction to the charger 24 so that the charger 24 performs charging. The control unit 222B performs charging control on the basis of the power value of the charging control instruction immediately before the charging control instruction is not received in the communicator 20, and determines that charging stops when the amount of power exceeds the capacity value. In this case, the control unit 222B stops outputting the charging instruction to the charger 24. Accordingly, charging in the charger 24 is completed.

[0109] One or a plurality of chargers 24 are provided in the charging control device 5B. The charger 24 performs charging of the storage battery of the vehicle V. A single-phase power of 200 V is supplied to the charger 24 from the commercial power P via the transformer T. The charger 24 and the charging control device 22B are communicatively connected to each other. The charger 24 controls the

charging current on the basis of the charging instruction (the current value) output from the charging control device 22B, and performs charging of the storage battery of the vehicle V. The charger 24 and the vehicle V are connected by the charging cable C.

5 [0110] When the charging instruction from the charging control device 22B is not input during charging, the charger 24 performs charging control on the basis of the current value of the immediately previous charging instruction. That is, when the communication between the charging control device 5B and the charger 24 is interrupted, the charger
10 24 performs charging on the basis of the charging instruction immediately before the communication is interrupted. Specifically, when the charger 24 receives the charging instruction according to the current value of, for example, "30A", the charger 24 continues to perform charging at "30A". The charger 24 performs charging on the
15 basis of the current charging amount and the target value. The charger 24 ends charging when the charging amount reaches the target value.

[0111] In a case in which there is a new charging request when the charging control instruction is not received in the communicator 20, the charger 24 does not receive the charging request. That is, the charger
20 24 does not receive a new charging start instruction when the charging control device 5B does not receive the charging control instruction.

[0112] As described above, in the vehicle charging system 1B according to the present embodiment, the control unit 222B of the charging control device 22B determines whether charging continues or
25 stops on the basis of the information relevant to the capacity of the breaker 18 when the charging control instruction is not received in the

communicator 20. Accordingly, in the vehicle charging system 1B, when a determination is made that charging can continue within a range of capacity on the basis of the information relevant to the capacity of the breaker 18 even in a case in which the communication between the monitoring device 3B and the charging control device 5B is temporarily interrupted, it is possible to cause the charging to continue in the charger 24. Therefore, in the vehicle charging system 1B, it is possible to improve charging efficiency.

[0113] Although the embodiments of the present invention have been described above, the present invention is not necessarily limited to the above-described embodiments, and various changes can be made without departing from the gist thereof.

[0114] In the above embodiment, a mode in which an amount of used power of the commercial power P is measured by the measurer 10 has been described as an example. However, the amount of used power may be acquired on the basis of received power information of a smart meter.

[0115] In the above embodiment, a mode in which the communicator 16 of the monitoring devices 3 and 3B and the communicator 20 of the charging control devices 5 and 5B perform wireless communication will be described as an example. However, the communicator 16 and the communicator 20 may perform wired communication.

[0116] In the above embodiment, in the vehicle charging system 1, a mode in which the charging control device 22 collectively controls the plurality of chargers 24 has been described as an example. However, a plurality of charging control devices may be included, and each

charging control device may control the charger 24.

[0117] In addition to the above embodiment, the monitoring control device 14 of the monitoring device 3B of the vehicle charging system 1A may be provided in a server on a cloud.

WHAT IS CLAIMED IS:

1. A control device for controlling a charger on the basis of a charging control instruction transmitted from a monitoring device in a charging system performing charging on the basis of a power value set according to an amount of used power measured by the monitoring device, the control device comprising:

a reception unit configured to receive the charging control instruction; and

a control unit configured to control the charger on the basis of the charging control instruction received by the reception unit,

wherein the control unit determines whether charging continues or stops on the basis of the charging control instruction received before a point in time when the charging control instruction is not received when the charging control instruction is not received by the reception unit.

2. The control device according to claim 1,

wherein the charging control instruction includes the power value,

the control device further comprises a storage unit configured to store the power value included in the charging control instruction received by the reception unit, and

the control unit calculates a prediction value on the basis of the power value during a predetermined period before the point in time when the charging control instruction is not received in the power value stored in the storage unit, and determines whether charging continues or stops on the basis of the prediction value.

3. The control device according to claim 2, wherein the control unit obtains a slope of a transition of a plurality of the power values during the predetermined period, and calculates the prediction value on the basis of the slope of the transition.

5 4. The control device according to claim 2 or 3, wherein the storage unit stores the power value each time the charging control instruction is received.

5. The control device according to any one of claims 2 to 4,
wherein the storage unit stores a current value corresponding to
10 a maximum increase in the power value, and

the control unit acquires the current value corresponding to the maximum increase relevant to a situation at the point in time when the charging control instruction is not received in the reception unit from the storage unit, and determines whether charging continues or stops on
15 the basis of the prediction value and the current value corresponding to the maximum increase.

6. The control device according to claim 5,

wherein the control unit calculates a time at which a reference value relevant to the power value is reached when charging is performed
20 with the current value corresponding to the maximum increase with respect to the prediction value from the point in time when the charging control instruction is not received,

causes charging to continue until the time is reached from the point in time when the charging control instruction is not received, and

25 causes charging to stop when the time is reached from the point in time when the charging control instruction is not received.

7. A charging control device comprising:

the control device according to any one of claims 1 to 5; and

a charger configured to perform charging on the basis of a charging instruction output from the control device.

5 8. The charging control device according to claim 7, wherein, when the charging instruction from the control device is not input, the charger continues to perform charging to a predetermined target value on the basis of the charging instruction input before a point in time when the charging instruction is not input.

10 9. The charging control device according to claim 7 or 8, wherein the charger does not receive a new charging request when the charging control instruction is not received in the reception unit.

10. A charging system comprising:

15 a monitoring device configured to monitor an amount of used power, set a power value according to the amount of used power, and transmit a charging control instruction based on the power value; and

the control device according to any one of claims 1 to 6.

20 11. A control method for controlling a charger on the basis of a charging control instruction transmitted from a monitoring device in a charging system performing charging on the basis of a power value set according to an amount of used power measured by the monitoring device, the control method comprising:

a reception step of receiving the charging control instruction;

and

25 a control step of controlling the charger on the basis of the charging control instruction received in the reception step,

wherein the control step includes determining whether charging continues or stops on the basis of the charging control instruction received before a point in time when the charging control instruction is not received when the charging control instruction is not received in the reception step.

12. A control program for controlling a charger on the basis of a charging control instruction transmitted from a monitoring device in a charging system performing charging on the basis of a power value set according to an amount of used power measured by the monitoring device, the control program causing a computer to execute:

a reception step of receiving the charging control instruction;
and

a control step of controlling the charger on the basis of the charging control instruction received in the reception step,

wherein the control step includes determining whether charging continues or stops on the basis of the charging control instruction received before a point in time when the charging control instruction is not received when the charging control instruction is not received in the reception step.

13. A control device for controlling a charger on the basis of a charging control instruction transmitted from a monitoring device in a charging system performing charging on the basis of an amount of used power measured by the monitoring device and a capacity of a breaker, the control device comprising:

a reception unit configured to receive the charging control instruction; and

a control unit configured to control the charger on the basis of the charging control instruction received by the reception unit,

5 wherein, the control unit determines whether charging continues or stops on the basis of information relevant to the capacity of the breaker when the charging control instruction is not received in the reception unit.