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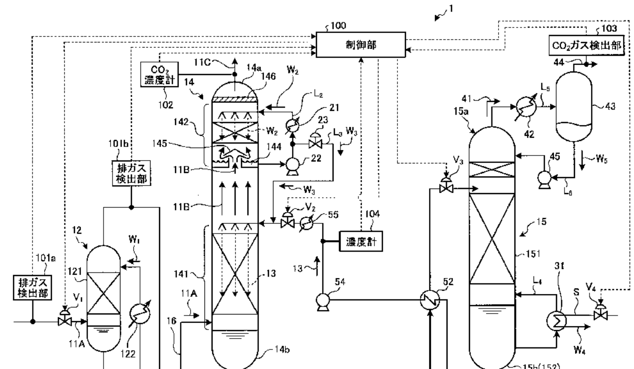
(54) Title: CO_2 RECOVERY DEVICE AND CO_2 RECOVERY METHOD

(54) 発明の名称：ＣＯ２回収装置及びＣＯ２回収方法



100 Control unit
101a, 101b Exhaust gas detection unit
102 CO_2 concentration meter
103 CO_2 gas detection unit
104 Concentration meter

(57) Abstract: Provided are a CO_2 recovery device and a CO_2 recovery method with which it is possible for a CO_2 recovery amount and/or a CO_2 recovery rate to be controlled with high accuracy towards a target value. This CO_2 recovery device (1) is characterised by being equipped with: a CO_2-absorbing tower (14) that causes CO_2 included in exhaust gas (11A) to be absorbed into a CO_2-absorbing liquid (13); a CO_2-absorbing liquid regeneration tower (15) which, by heating, regenerates the CO_2-absorbing liquid (13) that has absorbed the CO_2; a CO_2 recovery rate control unit which measures the CO_2 concentration in the exhaust gas (11A) and which, on the basis of the CO_2 concentration in the exhaust gas discharged from the CO_2-absorbing liquid (13) that has absorbed the CO_2, changes the absorbing liquid circulation amount and the amount of saturated water vapour (S) that is supplied to a regeneration heater (31); and a CO_2 recovery amount control unit which, in accordance with the CO_2 concentration of the exhaust gas (11A) and the exhaust gas flow rate, changes the circulation amount of the CO_2-absorbing liquid (13) and the amount of the saturated water vapour (S) supplied to the regeneration heater (31).

(57) 要約:

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— 国際調査報告（条約第 21 条(3)）

ＣＯ$_2$回収量及び／又はＣＯ$_2$回収率を目標値に向けて高い精度で制御できるＣＯ$_2$回収装置及びＣＯ$_2$回収方法を提供すること。本発明のＣＯ$_2$回収装置１は、排ガス１１Ａに含まれるＣＯ$_2$をＣＯ$_2$吸収液１３に吸収させるＣＯ$_2$吸収塔１４と、ＣＯ$_2$を吸収したＣＯ$_2$吸収液１３を加熱して再生するＣＯ$_2$吸収液再生塔１５と、排ガス１１Ａ中のＣＯ$_2$濃度を計測すると共に、ＣＯ$_2$を吸収したＣＯ$_2$吸収液１３から放出させた排ガス中のＣＯ$_2$濃度に基づいて吸収液循環量及び再生加熱器３１の飽和水蒸気Ｓの供給量を変更するＣＯ$_2$回収率制御部と、排ガス１１Ａ中のＣＯ$_2$濃度及び排ガス流量に応じてＣＯ$_2$吸収液１３の循環量及び再生加熱器３１に対する飽和水蒸気Ｓの供給量を変更するＣＯ$_2$回収量制御部と、を具備することを特徴とする。

DESCRIPTION

Title of the Invention

CO_2 RECOVERY UNIT AND CO_2 RECOVERY METHOD

Technical Field

[0001]

The present invention relates to a CO_2 recovery unit and a CO_2 recovery method, and particularly to a CO_2 recovery unit and a CO_2 recovery method that recover CO_2 in a gas to be treated, using a CO_2-absorbing solution.

Background Art

[0002]

In the related art, CO_2 recovery units that recover CO_2 exhausted from boilers or the like of thermoelectric power plants are suggested (for example, refer to PTL 1). In the CO_2 recovery units, flue gas is introduced into a CO_2 absorber, a CO_2-absorbing solution is brought into contact with CO_2 included in the flue gas so that CO_2 is made to be absorbed thereinto. The CO_2-absorbing solution that has absorbed CO_2 is sent to and heated and decarboxylated in a CO_2-absorbing solution regenerator, and thereby, a high-concentration CO_2 gas is recovered. The CO_2-absorbing solution after the decarboxylation is supplied to the CO_2 absorber by a liquid feed pump, and the CO_2-absorbing solution is circulated and used between the CO_2 absorber and the CO_2-absorbing solution regenerator.

Citation List

Patent Literature

[0003]

[PTL 1] Japanese Patent No. 5237204

[0004]

Meanwhile, in the CO_2 recovery unit described in PTL 1, the control of maintaining CO_2 recovery amount at a target value on the basis of the fluctuations of the gas flow rate of the flue gas, the introduction temperature of the flue gas, and the like from reference values is performed. However, even in a case where the control is performed in this way, it may be difficult to maintain the CO_2 recovery amount at the target value due to the influence of a predetermined relational expression used for the control and the precision of a measurement instrument.

[0005]

The invention has been made in view of such actual circumstances, and seeks to provide a CO_2 recovery unit and a CO_2 recovery method with which a CO_2 recovery amount and/or a CO_2 recovery rate can be controlled with high accuracy toward target values.

Summary of the Invention

[0006]

The present invention provides a CO_2 recovery unit comprising: a CO_2 absorber that brings a gas to be treated and a CO_2-absorbing solution into contact with each other to cause CO_2 included in the gas to be treated to be absorbed into the CO_2-absorbing solution, and supplies the CO_2-absorbing solution which has absorbed the CO_2 to a CO_2-absorbing solution regenerator through a rich solution supply tube; the CO_2-absorbing solution regenerator that heats the CO_2-absorbing solution which has absorbed CO_2, releases CO_2 from the CO_2-absorbing solution, regenerates the CO_2-absorbing solution, and supplies the CO_2-absorbing solution which has been regenerated to the CO_2 absorber through a lean solution supply tube; a first sensor that detects a CO_2 concentration in a flue gas exhausted from the CO_2 absorber; a second sensor that detects a gas flow rate and a concentration of a CO_2 gas 44 exhausted from the CO_2-absorbing solution regenerator; and at least one of: a CO_2 recovery rate control unit that, on the basis of an actual measured value and a target value of a recovery rate of CO_2 in the gas to be treated based on CO_2 concentration in the flue gas detected by the first sensor and CO_2 concentration in the gas released to the outside from the CO_2 absorber, changes a circulation amount of the CO_2-absorbing solution to be supplied to the CO_2 absorber and changes a supply amount of saturated steam to be supplied to a regeneration heater of the CO_2-absorbing solution regenerator to control a difference value between the actual measured value and the target value of the CO_2 recovery rate to be within a predetermined range; and a CO_2 recovery amount control unit that, on the basis of an actual measured value and a target value of a recovery amount of CO_2 in the gas to be treated based on a flow rate and a CO_2 concentration in the exhausted CO_2 gas released to the outside from the CO_2-absorbing solution regenerator, changes the circulation amount of the CO_2-absorbing solution to be supplied to the CO_2 absorber and changes the supply amount of the saturated steam to be supplied to the regeneration heater of the CO_2-absorbing solution regenerator to control a difference value between the actual measured value and the target value of the CO_2 recovery amount to be within a predetermined range.

[0006A]

In some embodiments, the CO_2 recovery unit comprises the CO_2 recovery rate controller and the CO_2 recovery amount controller.

[0007]

According to this CO_2 recovery unit, the circulation amount of the CO_2-absorbing solution and the supply amount of the saturated steam to be supplied to the regeneration heater can be appropriately controlled according to changes in the actual measured values of the CO_2 recovery rate and the CO_2 recovery amount in the gas to be treated. Thus, even in a case where there is an influence on a predetermined relational expression to be used for control and the precision of a measuring instrument due to changes in operation condition and the measuring instrument, the CO_2 recovery unit that can control the CO_2 recovery amount and/or the CO_2 recovery rate toward a target value with high accuracy can be realized.

[0008]

In the CO_2 recovery unit of the invention, it is preferable that the CO_2 recovery amount control unit controls the CO_2 recovery amount through proportional calculation and integration calculation on the basis of the difference value between the actual measured value and the target value of the CO_2 recovery amount.

[0009]

In the CO_2 recovery unit of the invention, it is preferable that the CO_2 recovery amount control unit controls the CO_2 recovery amount through proportional calculation and integration calculation on the basis of the difference value between the actual measured value and the target value of the CO_2 recovery amount.

[0010]

In the CO_2 recovery unit of the invention, it is preferable that the CO_2 recovery rate control unit includes a first control mode where the circulation amount and the supply amount of the saturated steam are calculated and controlled at any time, and a second control mode where the circulation amount and the supply amount of the saturated steam are calculated and controlled for each predetermined period, and the CO_2 recovery amount control unit includes a first control mode where the circulation amount and the supply amount of the saturated steam are calculated and controlled at any time, and a second control mode where the circulation amount and the supply amount of the saturated steam are calculated and controlled for each predetermined period.

[0011]

In the CO_2 recovery unit of the invention, it is preferable that any one of the CO_2 recovery rate control unit and the CO_2 recovery amount control unit is caused to be in the first control mode, and the other is caused to be in the second control mode.

[0012]

In the CO_2 recovery unit of the invention, it is preferable that the CO_2 recovery rate control unit is caused to be a first control mode, the CO_2 recovery amount control unit is caused to be a first control mode, and control is performed by providing any one of the CO_2

recovery amount control unit and the CO_2 recovery rate control unit with a dead band.

[0013]

The present invention also provides a CO_2 recovery method comprising: a process of, in a CO_2 absorber, bringing a gas to be treated and a CO_2-absorbing solution into contact with each other to cause CO_2 included in the gas to be treated to be absorbed into the CO_2-absorbing solution and supplying the CO_2-absorbing solution which has absorbed the CO_2 to a CO_2-absorbing solution regenerator through a rich solution supply tube; and a process of, in a CO_2-absorbing solution regenerator, heating the CO_2-absorbing solution which has absorbed CO_2, releasing CO_2 from the CO_2-absorbing solution, and regenerating the CO_2-absorbing solution, and supplying the CO_2-absorbing solution which has been regenerated to the CO_2 absorber through a lean solution supply tube; a process of detecting, by a first sensor, a CO_2 concentration in a flue gas exhausted from theCO_2 absorber; a process of detecting, by a second sensor, a gas flow rate and a concentration of a CO_2 gas 44 exhausted from the CO_2-absorbing solution regenerator; wherein, at least one of: controlling a difference between an actual measured value and a target value of a recovery rate of the CO_2 to be within a predetermined range by changing, based on the actual measured value and the target value of the recovery rate of CO_2 in the gas to be treated based on CO_2 concentration in the flue gas detected by the first sensor and CO_2 concentration in the gas released to the outside from the CO_2 absorber, a circulation amount of the CO_2-absorbing solution to be supplied to the CO_2 absorber and a supply amount of saturated steam to be supplied to a regeneration heater of the CO_2-absorbing solution regenerator, and controlling a difference between an actual measured value and a target value of a recovery amount of CO_2 to be within a predetermined range by changing, based on the actual measured value and the target value of the recovery amount of

CO_2 based on a flow rate and a CO_2 concentration in the exhausted CO_2 gas released to the outside from the CO_2-absorbing solution regenerator, the circulation amount of the CO_2-absorbing solution to be supplied to the CO_2 absorber and the supply amount of the saturated steam to be supplied to the regeneration heater of the CO_2-absorbing solution regenerator.

[0013A]

In some embodiments, the method comprises controlling a difference between the actual measured value and the target value of the recovery rate of the CO_2 and the recovery amount of the CO_2 to be within a predetermined range by changing, the circulation amount of the CO_2-absorbing solution to be supplied to the CO_2 absorber and the supply amount of the saturated steam to be supplied to the regeneration heater of the CO_2-absorbing solution regenerator.

[0014]

According to this CO_2 recovery method, the circulation amount of the CO_2-absorbing solution and the supply amount of the saturated steam to be supplied to the regeneration heater can be appropriately controlled according to changes in the actual measured values of the CO_2 recovery rate and the CO_2 recovery amount in the gas to be treated. Thus, even in a case where there is an influence on a predetermined relational expression to be used for control and the precision of a measuring instrument due to changes in operation condition and the measuring instrument, the CO_2 recovery method that can control the CO_2 recovery amount and/or the CO_2 recovery rate toward the target values with high accuracy can be realized.

[0015]

In the CO_2 recovery method of the invention, it is preferable that the CO_2 recovery rate is controlled through proportional calculation and integration calculation on the basis of the difference value between the actual measured value and the target value of the CO_2 recovery rate.

[0016]

In the CO_2 recovery method of the invention, it is preferable that the CO_2 recovery amount is controlled through proportional calculation and integration calculation on the basis of the difference value between the actual measured value and the target value of the CO_2 recovery amount.

[0017]

In the CO_2 recovery method of the invention, it is preferable that the CO_2 recovery rate and the CO_2 recovery amount are controlled by performing switching between a first control mode where the circulation amount and the supply amount of the saturated steam are calculated and controlled at any time, and a second control mode where the circulation amount and the supply amount of the saturated steam are calculated and controlled for each predetermined period.

[0018]

In the CO_2 recovery method of the invention, it is preferable that any one of the CO_2 recovery rate and the CO_2 recovery amount is controlled in the first control mode, and the other is controlled in the second control mode.

[0019]

In the CO_2 recovery method of the invention, it is preferable that the CO_2 recovery rate and the CO_2 recovery amount are controlled in the first control mode, and any one of the CO_2 recovery amount and the CO_2 recovery rate is controlled by providing a dead band.

[0020]

According to the invention, the CO_2 recovery unit and the CO_2 recovery method with which the CO_2 recovery amount and/or the CO_2 recovery rate can be controlled with high accuracy toward the target values can be realized.

Brief Description of Drawings

[0021]

Fig. 1 is a schematic view of a CO_2 recovery unit related to an embodiment of the invention.

Fig. 2 is a functional block diagram of a control unit related to the embodiment of the invention.

Fig. 3 is a flow chart illustrating a method of controlling a CO_2 recovery rate control unit and a CO_2 recovery amount control unit related to the present embodiment.

Fig. 4 is a conceptual diagram of an operation control in which a dead band of the CO_2 recovery unit related to the present embodiment is provided.

Detailed Description of the Invention

[0022]

The present inventors have noted that, in a related-art CO_2 recovery unit, even in a case where a CO_2 recovery amount and a CO_2 recovery rate are controlled to target values obtained

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on the basis of relationships between CO_2 concentration in a gas to be treated, the flow rate of the gas to be treated, and a reference value and a measured value of temperature, the target values and actual measured values may deviate from each other under the influence of measurement accuracy using a relational expression and a measurement instrument that are used for calculation. The present inventors also have found out that the CO_2 recovery amount and/or the CO_2 recovery rate can be controlled with high accuracy toward the target values by providing control units for the CO_2 recovery amount and the CO_2 recovery rate, respectively, to control the CO_2 recovery amount and the CO_2 recovery rate such that the CO_2 recovery amount and the CO_2 recovery rate that are actually measured using a gas flowmeter and a gas concentration meter reach the target values, and have completed the invention.

[0023]

Hereinafter, an embodiment of the invention will be described in detail with reference to the accompanying drawings. In addition, the invention is not limited to the following embodiment, and can be appropriately changed and carried out. Additionally, the configurations of CO_2 recovery units related to the following respective embodiments can be appropriately combined and carried out.

[0024]

Fig. 1 is a schematic view of a CO_2 recovery unit related to an embodiment of the invention. As illustrated in Fig. 1, a CO_2 recovery unit 1 is an device that absorbs CO_2 in a flue gas (a gas to be treated) 11A containing CO_2 exhausted from industrial facilities, such as a boiler and a gas turbine, and recovers a high-concentration CO_2 gas. The CO_2 recovery unit 1 includes a quencher 12 that cools the flue gas 11A containing CO_2 exhausted from industrial facilities, such as a boiler and a gas turbine; a CO_2 absorber 14 that is provided in a subsequent stage of the quencher 12, brings the cooled flue gas 11A into contact with a CO_2-absorbing solution 13, and makes the CO_2-absorbing solution 13 absorb and remove CO_2 in the flue gas 11A; and a CO_2-absorbing solution regenerator 15 that is provided in the subsequent stage of the CO_2 absorber 14, releases CO_2 from the CO_2-absorbing solution 13 that has absorbed the CO_2, and regenerates the CO_2-absorbing solution 13.

[0025]

In the CO_2 recovery unit 1, the CO_2-absorbing solution 13 circulates between the CO_2 absorber 14 and the CO_2-absorbing solution regenerator 15. The CO_2-absorbing solution 13 (lean solution) absorbs CO_2 in the CO_2 absorber 14, and is supplied to the CO_2-absorbing solution regenerator 15 as the CO_2-absorbing solution 13 (rich solution). Additionally, the CO_2-absorbing solution 13 (rich solution) has substantially all CO_2 removed and regenerated in the CO_2-absorbing solution regenerator 15, and is supplied to the CO_2 absorber 14 as the CO_2-absorbing solution 13 (lean solution).

[0026]

The quencher 12 has a quenching section 121 that cools the flue gas 11A. A circulation line L_1 is provided between a bottom part of the quencher 12 and a top part of the quenching section 121. A heat exchanger 122 that cools cooling water W_1, and a circulation pump 123 that circulate the cooling water W_1 within the circulation line L_1 are provided in the circulation line L_1.

[0027]

In the quenching section 121, the flue gas 11A is cooled by bringing the flue gas 11A into countercurrent contact with the cooling water W_1. The heat exchanger 122 cools the cooling water W_1 heated by the heat exchange with the flue gas 11A. The circulation pump 123 supplies the cooling water W_1, which has flowed down to the bottom part of the quencher 12, to the top part of the quenching section 121 via the heat exchanger 122.

[0028]

The CO_2 absorber 14 includes a CO_2 absorption section 141 that is provided on a lower part side of the CO_2 absorber 14 and has the flue gas 11A cooled in the quencher 12 supplied thereto, a washing section 142 that is provided on an upper part side of the CO_2 absorber 14. A liquid storage section 144 that stores cleaning water W_2 for cleaning a flue gas 11B from which CO_2 has been removed is provided at a bottom part of the washing section 142. A circulation line L_2, through which the cleaning water W_2, containing the CO_2-absorbing solution 13 recovered in the liquid storage section 144, is supplied and circulated from a top part side of the washing section 142, is provided between the liquid storage section 144 and an upper part of the washing section 142. The circulation line L_2 is provided with a heat exchanger 21 that cools the cleaning water W_2, and a circulation pump 22 that circulates the cleaning water W_2, containing the CO_2-absorbing solution 13 recovered in the liquid storage section 144, within the circulation line L_2 via the heat exchanger 21. Additionally, the circulation line L_2 is provided with an extraction line L_3 through which a portion of the cleaning water W_2 (cleaning water W_3) is extracted and supplied to the CO_2 absorption section 141. The extraction line L_3 is provided with a control valve 23 that adjusts the amount of supply of cleaning water W_3 to be supplied to the CO_2-absorbing solution 13 (lean solution).

[0029]

In the CO_2 absorption section 141, the flue gas 11A containing CO_2 and the CO_2-absorbing solution 13 containing alkanolamine or the like come into countercurrent contact with each other. Accordingly, CO_2 in the flue gas 11A is absorbed by the CO_2-absorbing solution 13 through a chemical reaction shown in the following Formula. As a result, the flue gas 11A containing CO_2 becomes the flue gas 11B from which CO_2 has been removed by passing through the CO_2 absorption section 141.

$$R\text{-}NH_2 + H_2O + CO_2 \rightarrow R\text{-}NH_3HCO_3$$

[0030]

In the washing section 142, the flue gas 11B from which CO_2 has been removed rises via a chimney tray 145. Then, the flue gas 11B is brought into gas-liquid contact with the cleaning water W_2 supplied from the top part side of the washing section 142, and becomes a flue gas 11C from which the CO_2-absorbing solution 13 entrained in the flue gas 11B has been recovered by circulation cleaning. The flue gas 11C is exhausted to the outside from a tower top part 14a of the CO_2 absorber 14 after mist in the gas is trapped by a mist eliminator 146.

[0031]

A rich solution supply tube 50 through which the CO_2-absorbing solution 13 (rich solution), which has absorbed CO_2 in the CO_2 absorber 14, is supplied to an upper part side of the CO_2-absorbing solution regenerator 15, is provided between a tower bottom part 14b of the CO_2 absorber 14 and an upper part of the CO_2-absorbing solution regenerator 15. The rich solution supply tube 50 is provided with a rich solvent pump 51 that supplies the CO_2-absorbing solution 13 (rich solution), which has absorbed CO_2 in the CO_2 absorber 14, toward the CO_2-absorbing solution regenerator 15, and a rich-lean solution heat exchanger 52 that heats the CO_2-absorbing solution 13 (rich solution) that has absorbed CO_2, using the CO_2-absorbing solution 13 (lean solution) which has been heated with saturated steam S and from which CO_2 has been removed.

[0032]

The CO_2-absorbing solution regenerator 15 includes a CO_2-absorbing solution supply part 151 that is provided at a central part of the CO_2-absorbing solution regenerator 15 and has the CO_2-absorbing solution 13, which has absorbed CO_2, supplied thereto, and a mirror surface part 152 of a tower bottom part 15b of a lower part of the CO_2-absorbing solution supply part 151.

[0033]

The tower bottom part 15b of the CO_2-absorbing solution regenerator 15 is provided with a circulation line L_4 through which the CO_2-absorbing solution 13 that has flowed down to the tower bottom part 15b circulates. The circulation line L_4 is provided with a regeneration heater 31 that heats the CO_2-absorbing solution 13 with saturated steam S.

[0034]

A tower top part 15a of the CO_2-absorbing solution regenerator 15 is provided with a gas exhaust line L_5 through which a CO_2 gas 41 accompanied by the saturated steam S is exhausted. The gas exhaust line L_5 is provided with a condenser 42 that condenses moisture in the CO_2 gas 41, and a separation drum 43 that separates the CO_2 gas 41 from condensed water W_5. A CO_2 gas 44 from which the condensed water W_5 has been separated is released to the outside from an upper part of the separation drum 43. A condensed water line L_6 through which the condensed water W_5 separated by the separation drum 43 is supplied to the upper part of the CO_2-absorbing solution regenerator 15 is provided between a bottom part of the separation drum 43 and the upper part of the CO_2-absorbing solution regenerator 15. The condensed water line L_6 is provided with a condensed water circulation pump 45 that supplies the condensed water W_5 separated by the separation drum 43 to the upper part of the CO_2-absorbing solution regenerator 15.

[0035]

Additionally, the tower bottom part 15b of the CO_2-absorbing solution regenerator 15 and an upper part of the CO_2 absorption section 141 of the CO_2 absorber 14 are provided with a lean solution supply tube 53 through which the CO_2-absorbing solution 13 (lean solution) in the tower bottom part 15b of the CO_2-absorbing solution regenerator 15 is supplied to the upper part of the CO_2 absorption section 141. The lean solution supply tube 53 is provided with the rich-lean solution heat exchanger 52 that heats the CO_2-absorbing solution 13 (rich solution), which has absorbed CO_2, using the CO_2-absorbing solution 13 (lean solution) which has been heated with saturated steam and from which CO_2 has been removed, a lean solution pump 54 that supplies the lean solution in the tower bottom part 15b of the CO_2-absorbing solution regenerator 15 to the upper part of the CO_2 absorption section 141, and a quenching section 55 that cools the CO_2-absorbing solution 13 (lean solution) to a predetermined temperature.

[0036]

The CO_2 recovery unit 1 related to the present embodiment includes a flue gas detecting unit 101a that is provided in a flow passage for the flue gas 11A to be introduced into the quencher 12, a flue gas detecting unit 101b that is provided in a flow passage for the flue gas 11A exhausted from the quencher 12, a CO_2 concentration meter 102 that is provided in a flow passage for the flue gas 11C exhausted from CO_2 absorber 14, a CO_2 gas detecting unit 103 that is provided in a flow passage for the CO_2 gas 44 exhausted from the separation drum 43, and a concentration meter 104 that measures the concentration of the CO_2-absorbing solution (lean solution) 13 to be supplied to the CO_2 absorber 14.

[0037]

A flue gas detecting unit 101a measures CO_2 concentration in the flue gas 11A to be introduced into the quencher 12, and transmits the measured CO_2 concentration to a control unit 100. The flue gas detecting unit 101b measures the gas flow rate and the gas temperature of the flue gas 11A exhausted from the quencher 12, and transmits the measured CO_2 concentration, gas flow rate, and gas temperature to the control unit 100. The CO_2 concentration meter 102 detects CO_2 concentration in the flue gas 11C exhausted from the CO_2 absorber 14, and transmits the detected CO_2 concentration to the control unit 100.

[0038]

The CO_2 gas detecting unit 103 detects the gas flow rate and the concentration of the CO_2 gas 44 exhausted from the separation drum 43, and transmits the gas flow rate and the concentration to the control unit 100. The concentration meter 104 measures the concentration of the CO_2-absorbing solution (lean solution) 13 to be supplied to the CO_2 absorber 14, and transmits the measured concentration of the CO_2-absorbing solution (lean solution) 13 to the control unit 100.

[0039]

Fig. 2 is a functional block diagram of the control unit 100 related to the present embodiment. The control unit 100 related to the present embodiment includes a set value calculating unit 110 that calculates set values as various reference values required for the operation of the CO_2 recovery unit 1 on the basis of input data, a CO_2 recovery rate control unit 111 and a CO_2 recovery amount control unit 112 that correct the set values on the basis of an actual measured value of the CO_2 recovery rate of the CO_2 recovery unit 1, and calculate corrected data, a flue gas control unit 113 that controls the flow rate of the flue gas 11A to be introduced into the quencher 12 via a control valve V_1, an absorbing solution control unit 114 that controls the liquid amount of the CO_2-absorbing solution (lean solution) 13 to be supplied to CO_2 absorber 14 via a control valve V_2 and controls the liquid amount of the CO_2-absorbing solution (rich solution) 13 to be supplied to the CO_2-absorbing solution regenerator 15 via a control valve V_3, and a steam control unit 115 that controls the flow rate of the saturated steam S to be supplied to the regeneration heater 31 via a control valve V_4.

[0040]

The set value calculating unit 110 calculates, according to a predetermined relational expression, a set value of the gas flow rate of the flue gas 11A based on a reference value that is set in advance on the basis of a CO_2 recovery rate target value and a CO_2 recovery amount target value, the CO_2 concentration and gas temperature in the flue gas 11A, and the concentration of the CO_2-absorbing solution (lean solution) 13, a set value of the flow rate of the CO_2-absorbing solution (lean solution) 13 to be supplied to CO_2 absorber 14, a set value of the flow rate of the CO_2-absorbing solution (rich solution) 13 to be supplied to CO_2-absorbing solution regenerator 15, and a set value of the flow rate of the saturated steam S to be supplied to the regeneration heater 31, and transmits the calculated results to the CO_2 recovery rate control unit 111, the CO_2 recovery amount control unit 112, and the flue gas control unit 113.

[0041]

The CO_2 recovery rate control unit 111 compares the CO_2 concentration in the flue gas 11A detected by the flue gas detecting unit 101 and the actual measured value of the CO_2 recovery rate measured by the CO_2 concentration meter 102 with the set values thereof, and calculates correction values (target values) obtained by calculating the flow rate of the saturated steam S and the flow rate of the CO_2-absorbing solution 13 required in order to bring the CO_2 recovery rate close to the set values and by correcting the set values. Here, the CO_2 recovery rate control unit 111 corrects a set value through proportional calculation and integration calculation for the deviation of a difference between the actual measured value and the target value of the CO_2 recovery rate. The CO_2 recovery rate control unit 111 transmits the corrected data to the absorbing solution control unit 114 and the steam control unit 115 as corrected data.

[0042]

The CO_2 recovery amount control unit 112 compares an actual measured value of the CO_2 recovery amount measured by the CO_2 gas detecting unit 103 with the target value of the CO_2 recovery amount, and calculates a correction value (target value) obtained by calculating the flow rate of the saturated steam S and the flow rate of the CO_2-absorbing solution 13 required in order to make the CO_2 recovery amount reach the target value and by correcting a set value. Here, the CO_2 recovery amount control unit 112 corrects the set value through proportional calculation and integration calculation for the deviation of a difference between the actual measured value and the target value of the CO_2 recovery amount. The CO_2 recovery amount control unit 112 transmits the corrected data to the absorbing solution control unit 114 and the steam control unit 115 as corrected data.

[0043]

The flue gas control unit 113 controls the flow rate of the flue gas 11A to be introduced into the quencher 12 via the control valve V_1 on the basis of the calculation results of the set value calculating unit 110.

[0044]

The absorbing solution control unit 114 controls the liquid amount of the CO_2-absorbing solution (lean solution) 13 to be supplied to the CO_2 absorber 14 via the control valve V_2 on the basis of the calculation results of the CO_2 recovery rate control unit 111 and the CO_2 recovery amount control unit 112, and controls the liquid amount of the CO_2-absorbing solution (rich solution) 13 to be supplied to the CO_2-absorbing solution regenerator 15 via the control valve V_3.

[0045]

The steam control unit 115 controls the flow rate of the saturated steam S to be supplied to the regeneration heater 31 via the control valve V_4 on the basis of the calculation results of the CO_2 recovery rate control unit 111 and the CO_2 recovery amount control unit 112.

[0046]

Next, the overall operation of the CO_2 recovery unit

1 related to the present embodiment will be described. The flue gas 11A containing CO_2 exhausted from industrial facilities, such as a boiler and a gas turbine, is introduced into the quencher 12, and is brought into countercurrent contact with and cooled by the cooling water W_1 after the CO_2 concentration, gas flow rate, and temperature in the flue gas 11A are measured by the flue gas detecting unit 101. The cooled flue gas 11A is introduced into the CO_2 absorber 14 via a flue 16. The flue gas 11A introduced into the CO_2 absorber 14 is brought into countercurrent contact with the CO_2-absorbing solution 13 containing alkanolamine or the like in the CO_2 absorption section 141, and becomes the flue gas 11B from which CO_2 in the flue gas 11A has been absorbed by the CO_2-absorbing solution 13 and CO_2 has been removed.

[0047]

The flue gas 11B from which CO_2 has been removed rises via the chimney tray 145, is brought into gas-liquid contact with the cleaning water W_2 supplied from the top part side of the washing section 142, and becomes the flue gas 11C from which the CO_2-absorbing solution 13 entrained in the flue gas 11B has been recovered by circulation cleaning. The CO_2 concentration in the flue gas 11C is measured by the CO_2 concentration meter 102 and the flue gas 11C is exhausted from the tower top part 14a of the

CO_2 absorber 14 to the outside, after the mist in the gas is caught by the mist eliminator 146.

[0048]

The CO_2-absorbing solution 13 (rich solution) that has absorbed CO_2 is sent to the rich-lean solution heat exchanger 52 by a rich solvent pump 51 via a rich solution supply tube 50 in the CO_2 absorber 14. In the rich-lean solution heat exchanger 52, the CO_2-absorbing solution 13 (rich solution) sent from the CO_2 absorber 14 is heat-exchanged with the CO_2-absorbing solution 13 (lean solution) sent from the CO_2-absorbing solution regenerator 15. The CO_2-absorbing solution 13 (rich solution) after this heat exchange is supplied to the upper part of the CO_2-absorbing solution regenerator 15. The CO_2-absorbing solution 13 supplied to the CO_2-absorbing solution regenerator 15 has CO_2 removed therefrom and becomes a semi-lean solution, while flowing down to the tower bottom part 15b via the CO_2-absorbing solution supply part 151. This semi-lean solution is circulated through the circulation line L_4, is heated by the saturated steam S in the regeneration heater 31, and becomes the CO_2-absorbing solution 13 (lean solution). The saturated steam S after being heated becomes the saturated steam condensed water W_4. The CO_2 gas 41 removed from the CO_2-absorbing solution 13 is released to the outside as the CO_2 gas 44 from which the condensed water W_5 has been separated through the upper part of the separation drum 43 after the moisture thereof is condensed by the condenser 42. In the CO_2 gas detecting unit 103, the CO_2 concentration in the CO_2 gas 44 is measured.

[0049]

The CO_2-absorbing solution 13 (lean solution) of the tower bottom part 15b of the CO_2-absorbing solution regenerator 15 is supplied to the upper part of the CO_2 absorption section 141 of the CO_2 absorber 14 by the lean solution pump 54 after being heat-exchanged with the CO_2-absorbing solution 13 (rich solution) by the rich-lean solution heat exchanger 52 via the lean solution supply tube 53.

[0050]

Fig. 3 is a flow chart illustrating a method of controlling the CO_2 recovery rate control unit 111 and the CO_2 recovery amount control unit 112 related to the present embodiment. As illustrated in Fig. 3, the CO_2 recovery rate control unit 111 controls the operation of the CO_2 recovery rate on the basis of the set value of the flow rate of the CO_2-absorbing solution 13 based on a reference value that is set in advance on the basis of the CO_2 concentration in the flue gas 11A, the flow rate and temperature of the flue gas 11A, and a set value of the flow rate of the saturated steam S to be supplied to the regeneration heater 31, in early stages of the operation of the CO_2 recovery unit 1 (Step ST11). Additionally, after elapse of a predetermined period, the CO_2 recovery rate control unit 111 measures an actual measured value of the CO_2 recovery rate using the flue gas detecting unit 101a and the CO_2 concentration meter 102, compares the actual measured value of the CO_2 recovery rate with the target value thereof (Step ST12), calculates the flow rate of the saturated steam S and the flow rate of the CO_2-absorbing solution 13 in order to make the CO_2 recovery rate reach the target value, and corrects the set value (Step ST13). The CO_2 recovery rate control unit 111 controls the CO_2 recovery rate on the basis of the set value obtained by correcting the flow rate of the CO_2-absorbing solution 13 and the flow rate of the saturated steam S to be supplied to the regeneration heater 31 (Step ST14).

[0051]

Here, the CO_2 recovery rate control unit 111 corrects the set value such that the flow rate of the saturated steam S and the flow rate of the CO_2-absorbing solution 13 (lean solution) are increased with respect to the set value, for example, in a case where the actual measured value (for example, 85%) of the CO_2 recovery rate is lower than the target value (for example, 90%). Accordingly, since the absorbing solution control unit 114 increases the flow rate of the CO_2-absorbing solution 13 (lean solution) and the steam control unit 115 increases the flow rate of the saturated steam S, it is possible to increase the actual measured value of the CO_2 recovery rate of CO_2 recovery unit 1 toward the target value thereof.

[0052]

The CO_2 recovery amount control unit 112 controls the CO_2 recovery amount on the basis of the set value of the flow rate of the CO_2-absorbing solution 13 based on the reference value that is set in advance on the basis of the CO_2 concentration in the flue gas 11A, the flow rate and temperature of the flue gas 11A, and a set value of the flow rate of the saturated steam S to be supplied to the regeneration heater 31, in early stages of the operation of the CO_2 recovery unit 1 (Step ST11). Additionally, after elapse of a predetermined period, the CO_2 recovery amount control unit 112 measures the actual measured value of the CO_2 recovery amount using the CO_2 gas detecting unit 103, compares the measured actual measured value with the target value (Step ST12), calculates the flow rate of the saturated steam S and the flow rate of the CO_2-absorbing solution 13 in order to make the CO_2 recovery amount reach the target value, and corrects the set value (Step ST13). Then, the CO_2 recovery amount control unit 112 controls the CO_2 recovery amount on the basis of the set value obtained by correcting the flow rate of the CO_2-absorbing solution 13 and the flow rate of the saturated steam S to be supplied to the regeneration heater 31 (Step ST14).

[0053]

Here, the CO_2 recovery amount control unit 112 corrects the set value such that the flow rate of the saturated steam S and the flow rate of the CO_2-absorbing solution 13 (rich solution) are increased with respect to the set value, for example, in a case where the actual measured value (for example, 85 t/h) of the CO_2 recovery amount is lower than the target value (for example, 90 t/h). Accordingly, since the absorbing solution control unit 114 increases the flow rate of the CO_2-absorbing solution 13 (rich solution) and the steam control unit 115 increases the flow rate of the saturated steam S, it is possible to increase the actual measured value of the CO_2 recovery amount of CO_2 recovery unit 1 toward the target value thereof.

[0054]

As described above, according to the present embodiment, the circulation amount of the CO_2-absorbing solution 13 and the amount of the saturated steam S supplied to the regeneration heater 31 can be appropriately controlled according to changes in the actual measured values of the CO_2 recovery rate and the CO_2 recovery amount in the flue gas 11A. Accordingly, even in a case where there is an influence on the predetermined relational expression to be used for the operation control of the CO_2 recovery unit and the precision of a measuring instrument due to changes in operation condition and the measuring instrument, the CO_2 recovery unit 1 that can control the CO_2 recovery amount and/or the CO_2 recovery rate to the target values with high accuracy can be realized.

[0055]

In addition, an example in which both of the CO_2 recovery rate control unit 111 and the CO_2 recovery amount control unit 112 are provided, and thus both of the CO_2 recovery rate and the CO_2 recovery amount are controlled has been described in the above-described embodiment. However, the invention is not limited to this configuration. The CO_2 recovery unit 1 may have a configuration including any one of the CO_2 recovery rate control unit 111 and the CO_2 recovery amount control unit 112. Even in this case, the circulation amount of the CO_2-absorbing solution 13 and the amount of the saturated steam S supplied to the regeneration heater 31 can be appropriately controlled according to changes in the actual measured values of the CO_2 recovery rate and the CO_2 recovery amount. Thus, it is possible to accurately control the CO_2 recovery rate and the CO_2 recovery amount.

[0056]

Additionally, an example in which the absorbing solution control unit 114 and the steam control unit 115 are controlled on the basis of the corrected data that the CO_2 recovery rate control unit 111 and the CO_2 recovery amount control unit 112 have corrected has been described in the above-described embodiment. However, the invention is not limited to this configuration. The CO_2 recovery unit 1 may control the flue gas control unit 113, the absorbing solution control unit 114, and the steam control unit 115, on the basis of the data obtained by further adding the CO_2 concentration in the flue gas 11A and the gas flow rate, temperature, and the like of the flue gas 11A to the corrected data that the CO_2 recovery rate control unit 111 and the CO_2 recovery amount control unit 112 have corrected.

[0057]

Moreover, an example in which the operation of the CO_2 recovery unit 1 is controlled using the corrected data of both of the CO_2 recovery rate control unit 111 and the CO_2 recovery amount control unit 112 has been described in the above-described embodiment. However, the invention is not limited to this configuration. The CO_2 recovery unit 1 may operate any one of the CO_2 recovery rate control unit 111 and the CO_2 recovery amount control unit 112 in a first control mode where the corrected data is calculated and controlled at any time, and may operate the other in a second control mode where calculation processing is not performed at any time and the calculation processing is performed for each predetermined period. By controlling the operation in this way, the interference between the corrected data can be reduced even in a case where a measurement error or the like has occurred between the calculation processing using the CO_2 recovery rate control unit 111, and the calculation processing using the CO_2 recovery amount control unit 112. Thus, it is possible to control the CO_2 recovery rate and/or the CO_2 recovery amount to the target values with high accuracy.

[0058]

Moreover, in then above-described embodiment, an operation control may be performed by providing a dead band, without performing the integration calculation regarding any one of the CO_2 recovery rate control unit 111 and the CO_2 recovery amount control unit 112. Fig. 4 is a conceptual diagram of an operation control in which a dead band is provided. In addition, in Fig. 4, a horizontal axis represents operation time, and a vertical axis represents CO_2 recovery rate (%) or CO_2 recovery amount (t/h).

[0059]

As illustrated in Fig. 4, in the present embodiment, for example if an operation control is performed such that difference values D between target values (SP) and actual measured values (PV) of the CO_2 recovery rate and the CO_2 recovery amount fall within a predetermined range by integration calculation based on the following Expression (1), the difference values D gradually decrease with elapse of the operation time t. Thus, when the difference values D between the target values (SP) and the actual measured values (PV) of the CO_2 recovery rate (%) or CO_2 recovery amount (t/h) have reached a range of operation time t2 smaller than a predetermined range B from the range of the operation time t1, the operation control is performed by proportional calculation by providing a dead band without performing the integration calculation regarding any one of the CO_2 recovery rate control unit 111 and the CO_2 recovery amount control unit 112. As a result, even in a case where an interference of the corrected data between the CO_2 recovery rate control unit 111 and the CO_2 recovery amount control unit 112 occurs, regarding any one of the CO_2 recovery rate control unit

111 and the CO_2 recovery amount control unit 112, a predetermined offset smaller than an offset (for example, about 2% of a set value of the CO_2 recovery unit 1) caused by the interference of the corrected data between the target values (SP) and the actual measured values (PV) of the CO_2 recovery rate (%) or the CO_2 recovery amount (t/h) can be secured. Accordingly, since it is possible to prevent any interference of the corrected data, the offset caused by the interference of the corrected data at the time of the operation of CO_2 recovery unit 1 can be reduced to a range of 0.5% to 1%.

[0060]

[Expression 1]

$$\begin{aligned} Out &= k \cdot e + \int \frac{e}{Ti} \\ e &= SP - PV \end{aligned} \quad \cdots (1)$$

[0061]

Additionally, an example in which the flue gas 11A containing CO_2 exhausted from industrial facilities, such as a boiler and a gas turbine, is treated by the CO_2-absorbing solution 13 has been described in the above-described embodiment. However, as gases to be treated that are treated by the CO_2-absorbing solution 13, various gases can be applied if they are gases containing CO_2.

Reference Signs List

[0062]

1: CO_2 RECOVERY UNIT

11A, 11B, 11C: FLUE GAS

12: QUENCHER

121: QUENCHING SECTION

122: HEAT EXCHANGER

123: CIRCULATION PUMP

13: CO_2-ABSORBING SOLUTION

13S: STEAM

14: CO_2 absorber

14a: TOWER TOP PART

14b: TOWER BOTTOM PART

141: CO_2 ABSORPTION SECTION

142: WASHING SECTION

144: LIQUID STORAGE SECTION

145: CHIMNEY TRAY

146: MIST ELIMINATOR

15: CO_2-ABSORBING SOLUTION REGENERATOR

15a: TOWER TOP PART

15b: TOWER BOTTOM PART

151: CO_2-ABSORBING SOLUTION SUPPLY PART

152: MIRROR SURFACE PART

16: FLUE

21: HEAT EXCHANGER

22: CIRCULATION PUMP

23: CONTROL VALVE

31: REGENERATION HEATER

41, 44: CO_2 GAS

42: CONDENSER

43: SEPARATION DRUM

45: CONDENSED WATER CIRCULATION PUMP

50: RICH SOLUTION SUPPLY TUBE

51: RICH SOLVENT PUMP

52: RICH-LEAN SOLUTION HEAT EXCHANGER

53: LEAN SOLUTION SUPPLY TUBE

54: LEAN SOLUTION PUMP

55: QUENCHING SECTION

101a: FLUE GAS DETECTING UNIT

101b: FLUE GAS DETECTING UNIT

102: CO_2 CONCENTRATION METER

103: CO_2 GAS DETECTING UNIT

104: CONCENTRATION METER

111: CO_2 RECOVERY RATE CONTROL UNIT

112: CO_2 RECOVERY AMOUNT CONTROL UNIT

113: FLUE GAS CONTROL UNIT

114: ABSORBING SOLUTION CONTROL UNIT

115: STEAM CONTROL UNIT

L_1, L_2, L_4: CIRCULATION LINE

L_3: EXTRACTION LINE

L_5: GAS EXHAUST LINE

L_6: CONDENSED WATER LINE

S: SATURATED STEAM

W_1: COOLING WATER

W_2, W_3: CLEANING WATER

W_4: SATURATED STEAM CONDENSED WATER

W_5: CONDENSED WATER

[0063]

The reference in this specification to any prior publication (or information derived from it), or to any matter which is known, is not, and should not be taken as an acknowledgment or admission or any form of suggestion that that prior publication (or information derived from it) or known matter forms part of the common general knowledge in the field of endeavour to which this specification relates.

[0064]

Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" and "comprising", will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

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THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A CO_2 recovery unit comprising:

a CO_2 absorber that brings a gas to be treated and a CO_2-absorbing solution into contact with each other to cause CO_2 included in the gas to be treated to be absorbed into the CO_2-absorbing solution, and supplies the CO_2-absorbing solution which has absorbed the CO_2 to a CO_2-absorbing solution regenerator through a rich solution supply tube;

the CO_2-absorbing solution regenerator that heats the CO_2-absorbing solution which has absorbed CO_2, releases CO_2 from the CO_2-absorbing solution, regenerates the CO_2-absorbing solution, and supplies the CO_2-absorbing solution which has been regenerated to the CO_2 absorber through a lean solution supply tube;

a first sensor that detects a CO_2 concentration in a flue gas exhausted from the CO_2 absorber;

a second sensor that detects a gas flow rate and a concentration of a CO_2 gas exhausted from the CO_2-absorbing solution regenerator;

and at least one of:

a CO_2 recovery rate control unit that, on the basis of an actual measured value and a target value of a recovery rate of CO_2 in the gas to be treated based on CO_2 concentration in the flue gas detected by the first sensor and CO_2 concentration in the gas released to the outside from the CO_2 absorber, changes a circulation amount of the CO_2-absorbing solution to be supplied to the CO_2 absorber and changes a supply amount of saturated steam to be supplied to a regeneration heater of the CO_2-absorbing solution regenerator to control a difference value between the actual measured value and the target value of the CO_2 recovery rate to be within a predetermined range; and

a CO_2 recovery amount control unit that, on the basis of an actual measured value and a target value of a recovery amount of CO_2 in the gas to be treated based on a flow rate and a CO_2 concentration in the exhausted CO_2 gas released to the outside from the CO_2-absorbing solution regenerator,

changes the circulation amount of the CO_2-absorbing solution to be supplied to the CO_2 absorber and changes the supply amount of the saturated steam to be supplied to the regeneration heater of the CO_2-absorbing solution regenerator to control a difference value between the actual measured value and the target value of the CO_2 recovery amount to be within a predetermined range.

2. The CO_2 recovery unit according to claim 1, comprising the CO_2 recovery rate controller and the CO_2 recovery amount controller.

3. The CO_2 recovery unit according to claim 1 or 2, wherein the CO_2 recovery amount control unit controls the CO_2 recovery amount through proportional calculation and integration calculation on the basis of the difference value between the actual measured value and the target value of the CO_2 recovery amount.

4. The CO_2 recovery unit according to any one of claims 1 to 3, wherein the CO_2 recovery rate control unit controls the CO_2 recovery rate through proportional calculation and integration calculation on the basis of the difference value between the actual measured value and the target value of the CO_2 recovery rate.

5. The CO_2 recovery unit according to any one of claims 1 to 4,

wherein the CO_2 recovery rate control unit includes a first control mode where the circulation amount and the supply amount of the saturated steam are calculated and controlled at any time, and a second control mode where the calculation is not performed at any time and the circulation amount and the supply amount of the saturated steam are calculated and controlled for each predetermined period, and

wherein the CO_2 recovery amount control unit includes a first control mode where the circulation amount and the supply amount of the saturated steam are calculated and controlled at any time, and a second control mode where the calculation is not performed at any time and the circulation amount and the supply amount of the saturated steam are calculated and controlled for each predetermined period.

6. The CO_2 recovery unit according to claim 5, wherein any one of the CO_2 recovery rate control unit and the CO_2 recovery amount control unit is caused to be in the first control mode, and the other is caused to be in the second control mode.

7. The CO_2 recovery unit according to claim 5,

wherein the CO_2 recovery rate control unit is caused to be a first control mode,

wherein the CO_2 recovery amount control unit is caused to be a first control mode, and

wherein control is performed by providing any one of the CO_2 recovery amount control unit and the CO_2 recovery rate control unit with a dead band.

8. A CO_2 recovery method comprising:

a process of, in a CO_2 absorber, bringing a gas to be treated and a CO_2-absorbing solution into contact with each other to cause CO_2 included in the gas to be treated to be absorbed into the CO_2-absorbing solution and supplying the CO_2-absorbing solution which has absorbed the CO_2 to a CO_2-absorbing solution regenerator through a rich solution supply tube; and

a process of, in a CO_2-absorbing solution regenerator, heating the CO_2-absorbing solution which has absorbed CO_2, releasing CO_2 from the CO_2-absorbing solution, and regenerating the CO_2-absorbing solution, and supplying the CO_2-absorbing solution which has been regenerated to the CO_2 absorber through a lean solution supply tube;

a process of detecting, by a first sensor, a CO_2 concentration in a flue gas exhausted from theCO_2 absorber;

a process of detecting, by a second sensor, a gas flow rate and a concentration of a CO_2 gas exhausted from the CO_2-absorbing solution regenerator;

wherein, at least one of:

controlling a difference between an actual measured value and a target value of a recovery rate of the CO_2 to be within a predetermined range by changing, based on the actual measured value and the target value of the recovery rate of CO_2 in the gas to be treated based on CO_2 concentration in the flue gas detected by the first sensor and CO_2 concentration in the gas released to the outside from the CO_2 absorber, a circulation amount of the CO_2-absorbing solution to be supplied to the CO_2 absorber and a supply amount of saturated steam to be supplied to a regeneration heater of the CO_2-absorbing solution regenerator, and

controlling a difference between an actual measured value and a target value of a recovery amount of CO_2 to be within a predetermined range by changing, based on the actual measured value and the target value of the recovery amount of CO_2 based on a flow rate and a CO_2 concentration in the exhausted CO_2 gas released to the outside from the CO_2-absorbing solution regenerator, the circulation amount of the CO_2-absorbing solution to be supplied to the CO_2 absorber and the supply amount of the saturated steam to be supplied to the regeneration heater of the CO_2-absorbing solution regenerator.

9. The CO_2 recovery method according to claim 8, controlling a difference between the actual measured value and the target value of the recovery rate of the CO_2 and the recovery amount of the CO_2 to be within a predetermined range by changing, the circulation amount of the CO_2-absorbing solution to be supplied to the CO_2 absorber and the supply amount of the saturated steam to be supplied to the regeneration heater of the CO_2-absorbing solution regenerator.

10. The CO_2 recovery method according to claim 8 or 9, wherein the CO_2 recovery rate is controlled through proportional calculation and integration calculation on the basis of the difference value between the actual measured value and the target value of the CO_2 recovery rate.

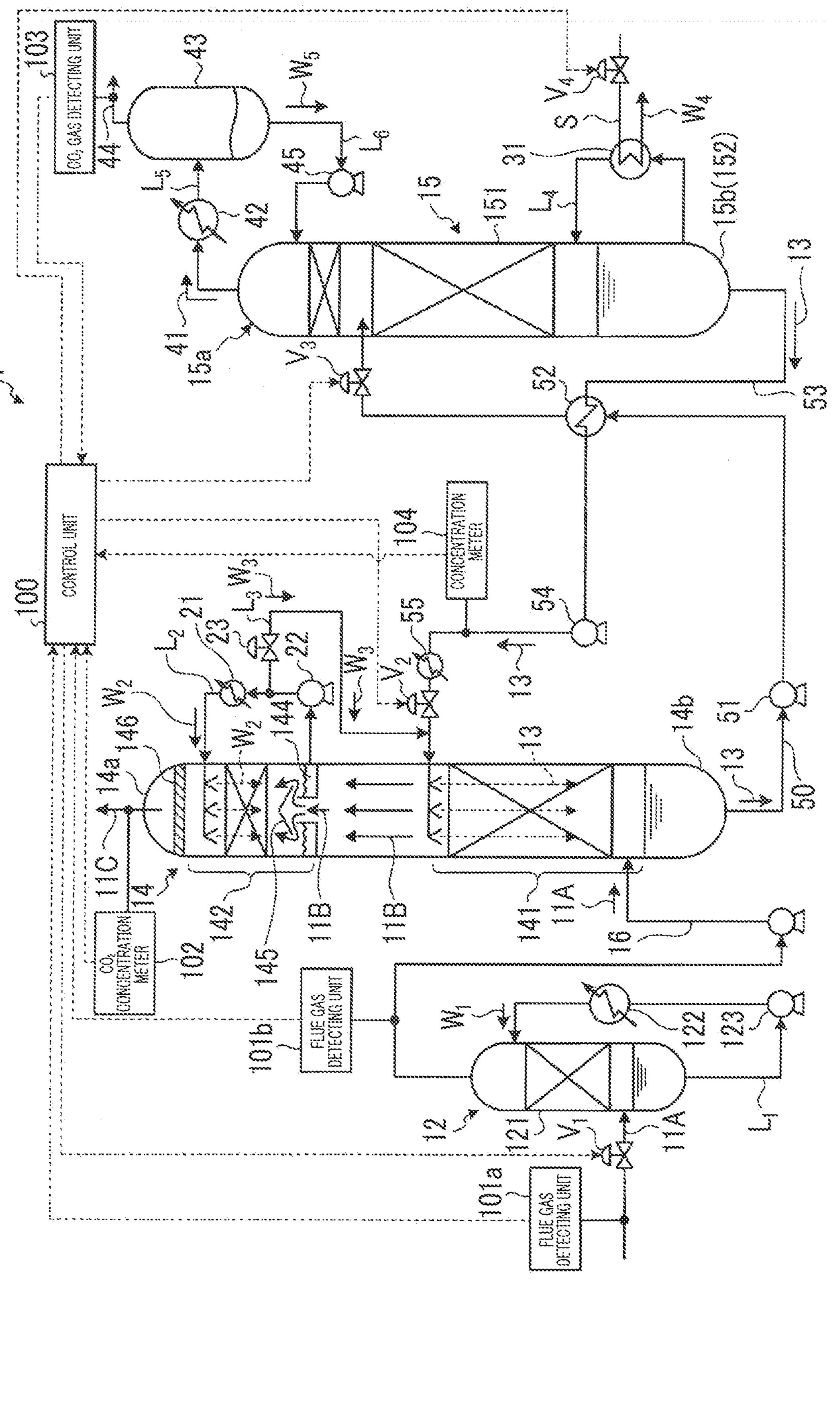
11. The CO_2 recovery method according to any one of claims 8 to 10, wherein the CO_2 recovery amount is controlled through proportional calculation and integration calculation on the basis of the difference value between the actual measured value and the target value of the CO_2 recovery amount.

12. The CO_2 recovery method according to any one of claims 8 to 11, wherein the CO_2 recovery rate and the CO_2 recovery amount are controlled by switching between a first control mode where the calculation is not performed at any time the circulation amount and the supply amount of the saturated steam are calculated and controlled at any time, and a second control mode where the calculation is not performed at any time the circulation amount and the supply amount of the saturated steam are calculated and controlled for each predetermined period.

13. The CO_2 recovery method according to claim 12, wherein any one of the CO_2 recovery rate and the CO_2 recovery amount is controlled in the first control mode, and the other is controlled in the second control mode.

14. The CO_2 recovery method according to claim 12, wherein the CO_2 recovery rate and the CO_2 recovery amount are controlled in the first control mode, and any one of the CO_2 recovery amount and the CO_2 recovery rate is controlled by providing a dead band.

FIG. 1



CONTROL UNIT
CONCENTRATION METER
CO_2 GAS DETECTING UNIT
CO_2 CONCENTRATION METER
FLUE GAS DETECTING UNIT
FLUE GAS DETECTING UNIT

FIG. 2

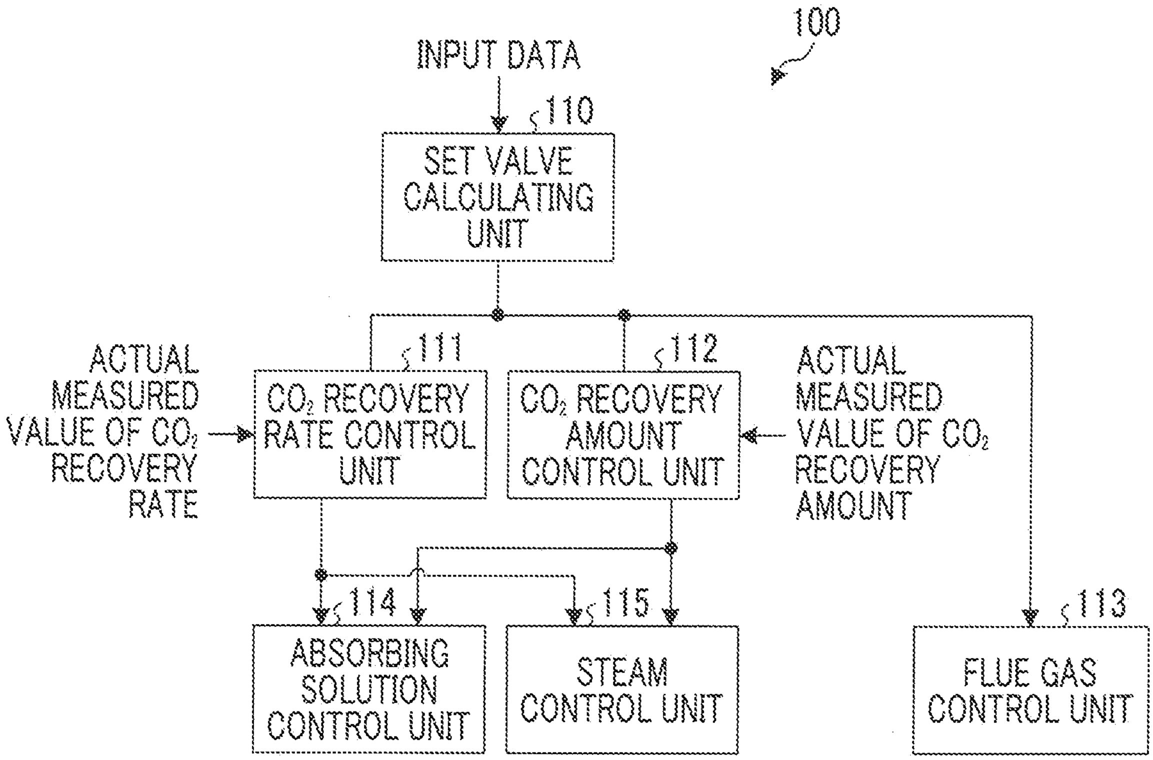

100
INPUT DATA
110
SET VALVE CALCULATING UNIT
111
112
ACTUAL MEASURED VALUE OF CO_2 RECOVERY RATE
CO_2 RECOVERY RATE CONTROL UNIT
CO_2 RECOVERY AMOUNT CONTROL UNIT
ACTUAL MEASURED VALUE OF CO_2 RECOVERY AMOUNT
114
115
113
ABSORBING SOLUTION CONTROL UNIT
STEAM CONTROL UNIT
FLUE GAS CONTROL UNIT

FIG. 3

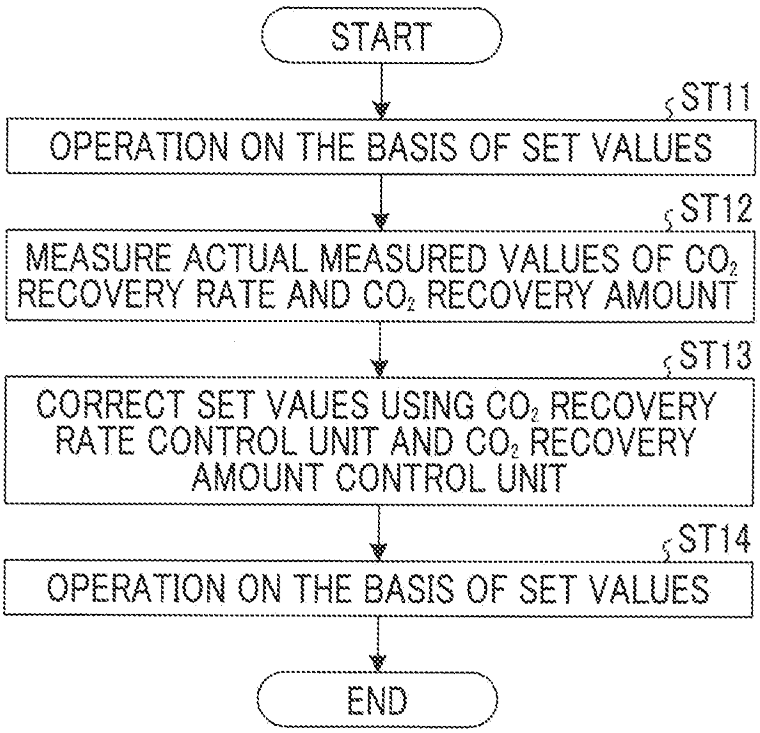
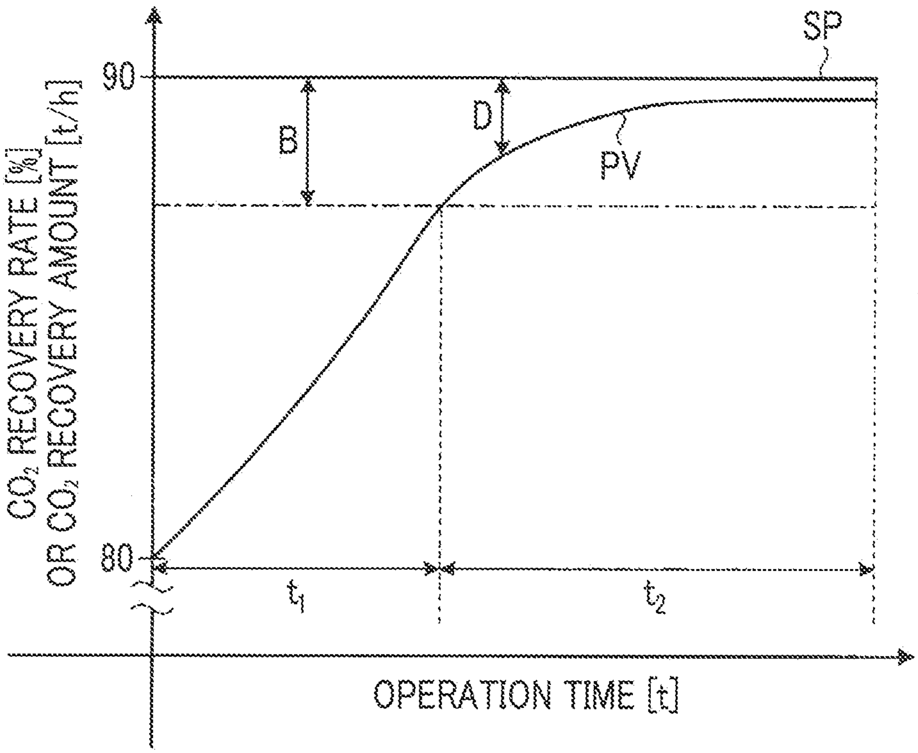

START
ST11
OPERATION ON THE BASIS OF SET VALUES
ST12
MEASURE ACTUAL MEASURED VALUES OF CO_2 RECOVERY RATE AND CO_2 RECOVERY AMOUNT
ST13
CORRECT SET VAUES USING CO_2 RECOVERY RATE CONTROL UNIT AND CO_2 RECOVERY AMOUNT CONTROL UNIT
ST14
OPERATION ON THE BASIS OF SET VALUES
END

FIG. 4


SP
90
80
B
D
PV
CO2 RECOVERY RATE [%]
OR CO2 RECOVERY AMOUNT [t/h]
t1
t2
OPERATION TIME [t]