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(54) **GAS TREATMENT DEVICE, GAS TREATMENT METHOD, CO2 RECOVERY DEVICE, AND CO2 RECOVERY METHOD**

GASBEHANDLUNGSVORRICHTUNG, GASBEHANDLUNGSVERFAHREN, CO2-RÜCKGEWINNUNGSVORRICHTUNG UND CO2-RÜCKGEWINNUNGSVERFAHREN

DISPOSITIF DE TRAITEMENT DE GAZ, PROCÉDÉ DE TRAITEMENT DE GAZ, DISPOSITIF DE RÉCUPÉRATION DE CO2 ET PROCÉDÉ DE RÉCUPÉRATION DE CO2

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Description

Field

[0001] The present invention relates to an air pollution control unit and an air pollution control method, and a CO_2 recovery unit and a CO_2 recovery method each for removing particles from a gas.

Background

[0002] The greenhouse effect of CO_2 has been pointed out as one of the causes of global warming phenomena, and countermeasures thereto have recently become urgent worldwide to protect the global environment. CO_2 is generated from all kinds of human activity fields where fossil fuels are combusted, and there tend to be stronger calls for the regulation of carbon dioxide emissions. Such demands are directed to power generating facilities such as thermal power plants which use large amounts of fossil fuels, and have led to intense studies on methods in which flue gas exhausted from industrial facilities such as boilers and gas turbines are brought into contact with amine-based CO_2 absorbent, and thereby CO_2 is removed and recovered from the flue gas, and on air pollution control systems which store the recovered CO_2 without releasing it to the atmosphere.

[0003] Numerous CO_2 recovery units have been proposed which perform steps for removing and recovering CO_2 from a flue gas using CO_2 absorbent described above. Such steps include a step of bringing the flue gas and the CO_2 absorbent into contact with each other in a CO_2 absorber (hereinafter also simply referred to "absorber"), and a step of heating the CO_2 absorbent which has absorbed CO_2 in an absorbent regenerator (hereinafter also simply referred to as "regenerator") to release CO2 and to regenerate the CO2 absorbent, and circulating the CO2 absorbent back to the CO2 absorber for reuse.

[0004] In the absorber, the flue gas is brought into countercurrent contact with the CO2 absorbent, for example, one including an absorption component such as alkanolamine, and CO2 in the flue gas is absorbed into the CO2 absorbent by chemical reaction (exothermic reaction) and the flue gas from which CO2 is removed is released out of the system. The CO2 absorbent which has absorbed CO2 is also called a rich solution. The rich solution is pressurized with a pump, heated in a heat exchanger using the hot CO2 absorbent (lean solution) regenerated by releasing CO2 in the regenerator, and supplied to the regenerator.

[0005] Incidentally, because flue gas contains particles, an air pollution control unit is installed which performs pretreatments such as gas cleaning and gas cooling on the particle-containing gas before the CO2 removal and recovery steps. An air pollution control unit of this type that has been proposed adopts a system in which a gas is treated by countercurrent gas-liquid contact in a packed section of a gas washing column (see, for example, Patent Literature 1). In another gas treating system that has been proposed, a gas is treated by co-current gas-liquid contact followed by countercurrent gas-liquid contact (see, for example, Patent Literature 2).

Citation ListPatent Literature

[0006]

- Patent Literature 1: Japanese Patent Application Laid-open No. 2005-87828 A
- Patent Literature 2: Japanese Patent Application Laid-open No. S59-160519 A
- Patent literature 3: US 5 405 590.
- Patent literature 4: JP 2001 029741
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- Patent literature 6: US 8 052 948.

Summary

Technical Problem

[0007] Unfortunately, the countercurrent gas-liquid contact system disclosed in Patent Literature 1 has a drawback in that the performance in collecting particles from a gas is not sufficiently enhanced. Furthermore, the system disclosed in Patent Literature 2 which involves co-current gas-liquid contact followed by countercurrent gas-liquid contact has a problem in that the co-current gas-liquid contact section receives a large supply of makeup water. Furthermore, if the particle collection efficiency at the gas washing column is low, for example, particles which are collected into a liquid downstream of the gas washing column become attached to the apparatus to cause fouling and clogging problems, and the particle-containing liquid scatters to the gas to cause adverse effects downstream of the air pollution control unit.

[0008] In light of the problems discussed above, an object of the present invention is to provide an air pollution control unit, an air pollution control method, a CO_2 recovery unit and a CO_2 recovery method which each allow particle-containing gas to be cleaned in a gas washing column with an enhanced particle collection performance.

Solution to Problem

[0009] To solve the above problem, a first invention according to the present invention is an air pollution control unit configured to bring particle-containing gas and washing liquid into contact with each other to collect particles in the particle-containing gas. The air pollution control unit includes a gas washing column having a gas cleaning section in which the particle-containing gas and the washing liquid are brought into co-current contact with each other, a gas cooling column which is disposed downstream of the gas washing column along a gas flow

and in which the particle-containing gas that has been cleaned and cooling liquid are brought into countercurrent contact with each other, and a gas communication path through which the gas washing column and the gas cooling column are made to communicate with each other on a bottom side and through which the cleaned gas that has been cleaned in the gas washing column is introduced into the gas cooling column. The gas washing column includes a washing liquid reservoir section which is disposed downstream of the gas cleaning section along the gas flow and in which the washing liquid is dropped and reserved, a washing liquid circulation line through which the washing liquid from the washing liquid reservoir section is circulated to a top side of the gas washing column, and a sloped plate which is disposed at a connection opening of the gas communication path on the gas washing column side and regulates the gas flow. The gas cooling column includes a condensed water reservoir section in which condensed water that has been condensed from the cleaned gas is reserved, a condensed water circulation line through which the condensed water from the condensed water reservoir section is circulated to a gas cooling section, a cooling device which is interposed in the condensed water circulation line and cools the condensed water, a demister which is disposed downstream of the gas cooling section along the gas flow, and a condensed water transfer line through which the condensed water from the gas cooling column is transferred to the gas washing column.

[0010] A second invention is the air pollution control unit according to the first invention, in which the air pollution control unit comprises, at the washing liquid reservoir section, a liquid level meter which measures the amount of the washing liquid reserved.

[0011] A third invention is the air pollution control unit according to the first or second invention, in which the particle-containing gas contains sulfur oxide, and the air pollution control unit comprises a basic compound supply section which supplies a basic compound into the washing liquid.

[0012] A fourth invention is a CO_2 recovery unit including the air pollution control unit according to the third invention, a gas exhausting line through which treated gas discharged from the gas cooling column is exhausted, a CO_2 absorber in which the cooled gas is introduced through the gas exhausting line, and CO_2 in the cooled gas and CO_2 absorbent are brought into contact with each other, and thereby CO_2 is removed, a CO_2 absorbent regenerator in which a rich solution that has absorbed CO_2 is regenerated with steam from a reboiler, a rich solution supply line through which the rich solution is drawn from the CO_2 absorber and is introduced to the CO_2 absorbent regenerator, and a lean solution supply line through which a lean solution that has released CO_2 and has been regenerated in the CO_2 absorbent regenerator is drawn from the CO_2 absorbent regenerator and is introduced into the CO_2 absorber to be reused as the CO_2 absorbent.

[0013] A fifth invention is an air pollution control method configured to bring particle-containing gas and washing liquid into contact with each other and thereby to collect particles in the particle-containing gas. The air pollution control method includes a dedusting step in which the particle-containing gas and the washing liquid are brought into co-current contact with each other in a gas washing column, and gas after gas cleaning flows down and collides with a fluid surface in a washing liquid reservoir section through a gas flow channel which is narrowed by a gas flow regulating plate, and thereby the gas is dedusted, a cooling step in which the cleaned gas resulting from the dedusting is cooled in a gas cooling column, and at the same time water in the cleaned gas is condensed with cooling water and thereby condensed water is obtained, and a washing liquid replenishing step in which the condensed water obtained is supplied to the gas washing column to replenish the washing liquid.

[0014] A sixth invention is the air pollution control method according to the fifth invention, in which the pressure loss in the gas washing column is controlled by controlling the liquid level in the washing liquid reservoir section.

[0015] A seventh invention is the air pollution control method according to the fifth or sixth invention, in which the particle-containing gas contains sulfur oxide, and a basic compound is supplied into the washing liquid to perform desulfurization.

[0016] An eighth invention is a CO_2 recovery method including a cleaning and desulfurization step in which particle-containing gas containing sulfur oxide and CO_2 is introduced into a gas washing column, a basic compound is supplied into washing liquid that is being circulated, and the particle-containing gas is dedusted and desulfurized, a cooling step in which the cleaned gas resulting from the dedusting and desulfurization is cooled in a gas cooling column, and at the same time water in the cleaned gas is condensed with cooling water and thereby condensed water is obtained, a washing liquid replenishing step in which the condensed water obtained is supplied to the gas washing column to replenish the washing liquid, a CO_2 absorbing step in which treated gas resulting from the gas cooling is introduced into a CO_2 absorber, and CO_2 in the cooled gas and CO_2 absorbent are brought into contact with each other, and thereby CO_2 is removed, a CO_2 absorbent regeneration step in which a rich solution that has absorbed CO_2 is introduced into a CO_2 absorbent regenerator and is regenerated with reboiler steam, and a step in which the CO_2 absorbent is circulated for reuse between the CO_2 absorber and the CO_2 absorbent regenerator through circulation lines.

Advantageous Effects of Invention

[0017] According to the present invention, a gas washing column and a gas cooling column are made to communicate with each other through a gas communication path provided with a sloped plate. The sloped plate is

disposed at a connection opening on the gas washing column side to regulate the flow of gas, so that efficiency of collision of cleaned gas and a fluid bath at the time of entry of the cleaned gas into the communication path can be increased. Furthermore, a condensed water transfer line is provided through which condensed water recovered at the gas cooling column is transferred to the gas washing column, and the condensed water from the gas cooling column is introduced into the gas washing column, thereby making it possible to eliminate the need to supply makeup water to the gas washing column or to reduce the amount of makeup water that is required.

Brief Description of Drawings

[0018]

FIG. 1 is a schematic view of an air pollution control unit according to a first embodiment.
FIG. 2A is a detailed schematic view of a gas washing column according to conventional art.
FIG. 2B is a detailed schematic view of a gas washing column according to the first embodiment.
FIG. 3 is a schematic view of an air pollution control unit according to a second embodiment.
FIG. 4 is a schematic view of an air pollution control unit according to a third embodiment.
FIG. 5 is a schematic view of a CO_2 recovery unit including an air pollution control unit according to a fourth embodiment.

Description of Embodiments

[0019] Preferred embodiments of the present invention will be described in detail with reference to the accompanying drawings. The scope of the present invention is not limited by these embodiments and, where a plurality of embodiments are presented, includes combinations of such embodiments.

First embodiment

[0020] FIG. 1 is a schematic view of an air pollution control unit according to a first embodiment.

[0021] As illustrated in FIG. 1, the air pollution control unit 100A according to the first embodiment is an air pollution control unit configured to bring particle-containing gas 101 and washing liquid 102 into contact with each other to collect particles in the particle-containing gas 101, and the air pollution control unit 100A includes: a gas washing column 104 having a gas cleaning section 103 in which the particle-containing gas 101 and the washing liquid 102 are brought into co-current contact with each other; a gas cooling column 107 disposed downstream of the gas washing column 104 along the gas flow and having a gas cooling section 106 in which the particle-containing gas 101a that has been cleaned (cleaned gas) and cooling liquid 105 are brought into countercurrent contact with each other; and a gas communication path 108 through which the gas washing column 104 and the gas cooling column 107 are made to communicate with each other on a bottom side and through which the cleaned gas 101a that has been cleaned in the gas washing column 104 is introduced into the gas cooling column 107.

[0022] The gas washing column 104 has a top portion from which the particle-containing gas 101 is introduced thereinto through a gas introduction line 104e, so as to make gas flows having a high flow velocities toward the bottom portion of the gas washing column 104.

[0023] Furthermore, the gas washing column 104 has: a washing liquid reservoir section 104a which is disposed downstream of the gas cleaning section 103 along the gas flow and in which the washing liquid 102 is dropped and reserved; a washing liquid circulation line 104b through which the washing liquid 102 from the washing liquid reservoir section 104a is circulated to a top side of the gas washing column 104; and a sloped plate 104c which is disposed at a connection opening 108a of the gas communication path 108 on the gas washing column 104 side and regulates the gas flow.

[0024] On the distal end side of the washing liquid circulation line 104b, a nozzle 104d for spraying the washing liquid 102 that is being circulated is disposed and drops the washing liquid 102 toward the washing liquid reservoir section 104a. The washing liquid circulation line 104b is provided with a fluid circulating pump P_1 which draws the washing liquid 102 from the washing liquid reservoir section 104a and circulates the washing liquid 102 to the nozzle 104d. The excess of the washing liquid 102 is discharged outside as excess fluid 102a.

[0025] The particle-containing gas 101 introduced is brought into co-current gas-liquid contact with the washing liquid 102, and thereby particles are removed, and thus the flow velocity of the gas flowing down in the column can be higher than a countercurrent gas-liquid contact system. It is Preferable that the gas flow velocity be, for example, about 10 to 20 m/s.

[0026] As a result, the particle-containing gas 101 has a relatively high flow velocity (for example, gas flow velocity of about 10 m/s to 20 m/s), and thereby the gas is allowed to collide intensively with the vicinity of the surface of the fluid bath in the washing liquid reservoir section 104a. Thus, enhancements are attained in the performance in collecting the particles in the particle-containing gas 101 into the pool of the washing liquid 102.

[0027] At the connection opening 108a of the gas communication path 108 on the gas washing column 104 side, the sloped plate 104c is disposed on the upper end side of the connection opening 108a and inclines at a predetermined angle to form an open path 108b. The sloped plate 104c is disposed to extend from an inner corner portion of the sidewall of the gas washing column 104 to form the open path 108b, and thus regulates the gas flow of the cleaned gas 101a passing by the inner corner portion of the sidewall of the gas washing column

104.

[0028] FIG. 2A is a detailed schematic view of a gas washing column according to the conventional art. FIG. 2B is a detailed schematic view of the gas washing column according to the first embodiment. In the conventional art illustrated in FIG. 2A, no sloped plate is provided at a connection opening 108a of a gas communication path 108 on the gas washing column 104 side. In this case, cleaned gas 101a simply passes by the inner corner portion without being regulated, and thus has less chances of collision with a washing liquid reservoir section 104a. Consequently, most of the particles flow directly into the gas communication path 108 without being removed by the pool of the washing liquid 102.

[0029] In contrast, as illustrated in FIG. 2B, when the sloped plate 104c is provided at the connection opening 108a of the gas communication path 108 on the gas washing column side, the cleaned gas 101a passing by the inner corner portion first collides with the upper surface of the sloped plate 104c and is guided to the fluid surface in the washing liquid reservoir section 104a to collide intensively with the fluid surface. Thus, enhancements are attained in the performance in collecting the particles in the particle-containing gas 101 into the fluid bath.

[0030] Furthermore, the installation of the sloped plate 104c narrows the flow channel (D1 > D2) passing through the lower portion of the gas washing column 104, and thereby the cleaned gas 101a gains a further increase in gas flow velocity, so that collision efficiency of the cleaned gas 101a and the fluid surface in the washing liquid reservoir section 104a can be increased.

[0031] As discussed above, the installation of the sloped plate 104c allows the cleaned gas 101a to be introduced to the gas cooling column 107 so that the cleaned gas 101a collides directly with the fluid surface in the washing liquid reservoir section 104a, thus making it possible to increase the particle removal efficiency at the fluid surface.

[0032] Here, the pressure loss in the gas washing column 104 which removes the particle-containing gas 101 is preferably in the range of 1,000 to 3,000 Pa.

[0033] Furthermore, in the gas washing column 104, a throat portion narrowing the gas flow channel may be formed above a part where the sloped plate 104c is disposed, thereby further increasing the flow velocity of the cleaned gas 101a and efficiency of collision of the cleaned gas 101a and the fluid surface in the washing liquid reservoir section 104a.

[0034] Furthermore, the gas cooling column 107 has: a condensed water reservoir section 107b in which condensed water 107a that has been condensed from the cleaned gas 101a is reserved; a condensed water circulation line 107c through which the condensed water 107a from the condensed water reservoir section 107b is circulated as the cooling liquid 105 to the gas cooling section 106; a cooling device 107d which is interposed in the condensed water circulation line 107c and cools the condensed water 107a; a demister 110 which is disposed downstream of the gas cooling section 106 along the gas flow; and a condensed water transfer line 107f through which a condensed water discharge 107e from the gas cooling column 107 is transferred to the gas washing column 104.

[0035] The gas cooling column 107 is configured to cool the cleaned gas 101a with cooling water CW that is circulated, and the cooling liquid 105 is obtained with the cooling device 107d interposed in the condensed water circulation line 107c through which the condensed water 107a from the cleaned gas 101a is circulated.

[0036] The condensed water circulation line 107c is provided with a nozzle 107g which sprays the cooling liquid 105 being circulated and drops the cooling liquid 105 toward the condensed water reservoir section 107b, and thereby the water contained in the cleaned gas 101a is condensed. The condensed water circulation line 107c is provided with a fluid circulating pump P_2 which circulates the cooling liquid 105.

[0037] Furthermore, the gas cooling column 107 has a condensed water transfer line 107f through which the condensed water 107a formed in the column is transferred to the gas washing column 104.

[0038] As discussed above, the gas cooling column 107 is configured to recover water contained in the cleaned gas 101a as the condensed water 107a in the column, and to transfer the condensed water 107a that has been recovered, as the condensed water discharge 107e to the gas washing column 104 through the condensed water transfer line 107f. Thus, the condensed water discharge 107e can be introduced as makeup water for the washing liquid used in the gas washing column. As a result, it becomes possible to eliminate the need to supply makeup water to the gas washing column 104 or to reduce the amount of makeup water that is required.

[0039] Furthermore, it is preferable that the demister 110 disposed in the gas cooling column 107 to collect microparticles remaining in the gas have a pressure loss in the range of 500 to 2,500 Pa. Furthermore, the demister 110 may include a glass fiber layer.

[0040] An air pollution control method according to the present first embodiment is an air pollution control method configured to bring particle-containing gas 101 and washing liquid 102 into contact with each other and thereby to collect particles in the particle-containing gas 101, and the air pollution control method includes: a dedusting step in which the particle-containing gas 101 and the washing liquid 102 are brought into co-current contact with each other in the gas washing column 104, and the cleaned gas 101a flows down and collides with the fluid surface in the washing liquid reservoir section 104a through a gas flow channel which is narrowed by the sloped plate 104c that is a gas flow regulating plate, and thereby the gas is dedusted; a cooling step in which the cleaned gas 101a having been dedusted is cooled in the gas cooling column 107, and at the same time water in the cleaned gas 101a is condensed with the cooling liquid

105 and thereby condensed water 107a is obtained; and a washing liquid replenishing step in which the condensed water 107a obtained is supplied as a condensed water discharge 107e to the gas washing column 104 to replenish the washing liquid 102.

[0041] With this air pollution control method, the gas washing column 104 and the gas cooling column 107 communicate with each other through the gas communication path 108, and the sloped plate 104c which regulates the flow of gas is provided at the connection opening 108a of the gas communication path 108 on the gas washing column 104 side, so that efficiency of collision of the cleaned gas 101a and the fluid bath at the time of entry of the cleaned gas 101a into the gas communication path 108 can be increased. Furthermore, the condensed water 107a recovered in the gas cooling column 107 is transferred as the condensed water discharge 107e to the gas washing column 104. Thus, the method makes it possible to eliminate the need to supply makeup water to the gas washing column 104 or to reduce the amount of makeup water that is required.

Second embodiment

[0042] FIG. 3 is a schematic view of an air pollution control unit according to a second embodiment. The same reference numerals will be used for the same features as in the first embodiment, and overlaps will be omitted in the description of such features. As illustrated in FIG. 3, the air pollution control unit 100B according to the second embodiment includes: a liquid level meter 120 which controls the liquid level in the washing liquid reservoir section 104a; a first pressure meter 121A which measures the pressure at an introduction section of the gas washing column 104; and a second pressure meter 121B which measures the pressure in the gas communication path 108.

[0043] In the gas washing column 104, the liquid level meter 120 is disposed to respond to any change in the gas flow velocity of the particle-containing gas 101 that is being introduced into the gas washing column 104. When a change in the gas volume of the particle-containing gas 101 introduced is detected by the measurement with the first pressure meter 121A and the second pressure meter 121B, the liquid level meter 120 controls the liquid level in the washing liquid reservoir section 104a to control the pressure loss in the gas washing column 104.

[0044] Specifically, when the pressure loss decreases, the liquid level meter 120 is controlled to raise the liquid level of the liquid level meter 120, thus increasing the flow velocity of the gas passing through the open path 108b.

[0045] As a result, the pressure loss in the gas washing column 104 can be maintained substantially constant in despite of the presence of a change in the gas flow velocity of the particle-containing gas 101, and the particle collection performance in the gas washing column 104 can be maintained.

Third embodiment

[0046] FIG. 4 is a schematic view of an air pollution control unit according to a third embodiment. The same reference numerals will be used for the same features as in the first embodiment, and overlaps will be omitted in the description of such features. As illustrated in FIG. 3, the air pollution control unit 100C according to the third embodiment is designed to cope with cases where the gas introduced into the gas washing column 104 contains sulfur oxide in addition to particles.

[0047] In the third embodiment, gas 101A containing particles and sulfur oxide is introduced into the gas washing column 104 through the gas introduction line 104e. Furthermore, a basic compound supply section 133 is disposed on the washing liquid circulation line 104b, and a basic compound (for example, NaOH, Na_2CO_3, $Ca(OH)_2$, or $CaCO_3$) 131 is supplied therefrom through a supply line 132.

[0048] The basic compound 131 is mixed into the washing liquid 102, and the nozzle 104d sprays the liquid of the mixture. The mist sprayed from the nozzle 104d performs both dedusting and desulfurization during gas cleaning.

[0049] The above configuration allows for simultaneous dedusting and desulfurization in the gas washing column 104, and thus eliminates the need to install a separate sulfur oxide removing device.

Fourth embodiment

[0050] FIG. 5 is a schematic view of a CO_2 recovery unit including an air pollution control unit according to a fourth embodiment. The same reference numerals will be used for the same features as in the first embodiment, and overlaps will be omitted in the description of such features. The CO_2 recovery unit 10 of the fourth embodiment includes: the air pollution control unit 100C of the third embodiment into which gas 101A containing particles and sulfur oxide is introduced; a gas exhausting line 12 through which treated gas 101b discharged from the gas cooling column 107 is exhausted; a CO_2 absorber 14 in which the cooled gas is introduced through the gas exhausting line 12 and CO_2 in the cooled gas and CO_2 absorbent (lean solution) 13 are brought into contact with each other, and thereby CO_2 is removed; an absorbent regenerator 17 in which the CO_2 absorbent that has absorbed CO_2 (rich solution) 15 is regenerated with steam from a reboiler 16; a rich solution supply line 18 through which the rich solution 15 is drawn from the CO_2 absorber 14 and is introduced to the absorbent regenerator 17; and a lean solution supply line 20 through which the CO_2 absorbent (lean solution) 19 regenerated by releasing CO_2 in the absorbent regenerator 17 is drawn from the absorbent regenerator 17 and the CO_2 absorbent 19 is introduced into the CO_2 absorber 14 to be reused as the

CO_2 absorbent.

[0051] In a CO_2 recovery method using the CO_2 recovery unit 10, first, gas 101A which contains particles, particles containing CO_2, and sulfur oxide is fed to the gas washing column 104 in the air pollution control unit 100C and is cleaned and dedusted with the washing liquid 102. The cleaned gas 101a is introduced through the gas communication path 108 into the gas cooling column 107, cooled with the cooling liquid 105, and fed as the treated gas 101b to the CO_2 absorber 14 through the gas exhausting line 12.

[0052] In the CO_2 absorber 14, the treated gas 101b is brought into countercurrent contact with the CO_2 absorbent 13 according to the fourth embodiment that is amine-based absorbent, and CO_2 in the treated gas 101b is absorbed in the CO_2 absorbent 13 by chemical reaction. CO_2-free flue gas 101d from which CO_2 has been removed in the CO_2 absorber 14 is brought into gas-liquid contact with cleaning water 22 supplied from a nozzle in a washing section 21 in the CO_2 absorber 14, the cleaning water being circulated and containing the CO_2 absorbent 13, and the CO_2 absorption component entrained with the CO_2-free flue gas 101d is recovered, the gas being then emitted from the column top out of the system. Furthermore, the rich solution 15 that has absorbed CO_2 is pressurized with a rich solution pump 23, heated in a rich-lean solution heat exchanger 24 using the lean solution 19 regenerated in the absorbent regenerator 17, and supplied to the absorbent regenerator 17.

[0053] The rich solution 15 emitted from an upper portion of the absorbent regenerator 17 into the absorbent regenerator 17 is caused to undergo endothermic reaction by water vapor from the reboiler 16 that is supplied through a bottom portion of the absorbent regenerator 17, and releases most of the absorbed CO_2. The CO_2 absorbent that has released part or most of the absorbed CO_2 in the absorbent regenerator 17 is called a semi-lean solution. The semi-lean solution is regenerated to the CO_2 absorbent (lean solution) 19 from which substantially all CO_2 has been completely removed by the time the CO_2 absorbent reaches the bottom portion of the absorbent regenerator 17. Part of the lean solution 19 is heated with the reboiler 16 and supplies water vapor to the inside of the absorbent regenerator 17.

[0054] On the other hand, CO_2-containing gas 31 released from the rich solution 15 and the semi-lean solution in the regenerator is led out through the top portion of the absorbent regenerator 17 together with the water vapor, the water vapor being condensed with a condenser 32, and the condensed water 34 and the CO_2 gas 35 are separated from each other in a separation drum 33. The CO_2 gas 35 separated is passed through a separation drum which is not illustrated, and is thereafter injected into oilfields using enhanced oil recovery (EOR) or is reserved into aquifers to address global warming. The condensed water 34, which has been separated from the CO_2-containing gas 31 entraining water vapor and been refluxed at the separation drum 33, is supplied to the upper portion of the absorbent regenerator 17 by a reflux water circulation pump 36 and is also added to the cleaning water 22 to be supplied to the absorber 14. The regenerated CO_2 absorbent (lean solution) 19 is cooled in the rich-lean solution heat exchanger 24 using the rich solution 15, subsequently pressurized with a lean solution pump 37, further cooled in a lean solution cooler 38, and thereafter supplied into the CO_2 absorber 14. The description of the embodiment is only illustrative of the overview of the embodiment, and omits some of the accompanying devices.

[0055] In the fourth embodiment, dedusting and desulfurization can be performed simultaneously in the gas washing column 104. Furthermore, because the treated gas 101b that has been cooled in the gas cooling column 107 and flows into the CO_2 absorber 14 contains a reduced amount of particles, an accumulation rate of collected particles in the CO_2 absorbent 13 used in the CO_2 absorber 14 (the CO_2 absorbent 13 is circulated and is used repeatedly while absorbing and releasing CO_2) is reduced. As a result, the CO_2 recovery unit 10 can prevent problems, such as fouling and clogging, caused by particles attached to the equipment.

[0056] In the fourth embodiment, the gas that flows into the CO_2 absorber 14 contains a reduced amount of particles, and thus the emission of CO_2 absorbent components, being absorbed in water attached around the particles, that are entrained with the outlet gas from the CO_2 absorber 14 is reduced.

[0057] The fourth embodiment that involves the air pollution control unit 100C illustrated in FIG. 4 may further include the liquid level meter 120 of the second embodiment to cope with changes in gas flow velocity.

[0058] A CO_2 recovery method according to the fourth embodiment includes: a cleaning and desulfurization step in which particle-containing gas 101 containing sulfur oxide and CO_2 is introduced into the gas washing column 104, a basic compound 131 is supplied into the washing liquid 102 that is being circulated, and the particle-containing gas 101 is dedusted and desulfurized; a cooling step in which the cleaned gas 101a resulting from the dedusting and desulfurization is cooled in the gas cooling column 107, and at the same time water in the cleaned gas 101a is condensed with cooling liquid 105 and thereby condensed water 107a is obtained; a washing liquid replenishing step in which the condensed water 107a obtained is supplied to the gas washing column 104 to replenish the washing liquid 102; a CO_2 absorbing step in which the treated gas resulting from the gas cooling is introduced into the CO_2 absorber 14, and CO_2 in the cooled gas and CO_2 absorbent 13 are brought into contact with each other, and thereby CO_2 is removed; a CO_2 absorbent regeneration step in which the rich solution 15 that has absorbed CO_2 is regenerated with steam from the reboiler; and a step in which the CO_2 absorbent is circulated for reuse between the CO_2 absorber 14 and the absorbent regenerator 17 through circulation lines.

[0059] With this CO_2 recovery method, dedusting and

desulfurization can be performed simultaneously in the gas washing column 104.

[0060] Furthermore, because the treated gas 101b that has been cooled in the gas cooling column 107 and flows into the CO_2 absorber 14 contains a reduced amount of particles, an accumulation rate of collected particles in the CO_2 absorbent 13 used in the CO_2 absorber 14 is reduced. As a result, the CO_2 recovery unit 10 can prevent problems, such as fouling and clogging, caused by particles attached to the equipment.

Reference Signs List

[0061]

10	CO_2 RECOVERY UNIT
12	GAS EXHAUSTING LINE
13	CO_2 ABSORBENT (LEAN SOLUTION)
14	CO_2 ABSORBER
15	CO_2 ABSORBENT (RICH SOLUTION)
16	REBOILER
17	ABSORBENT REGENERATOR
18	RICH SOLUTION SUPPLY LINE
19	CO_2 ABSORBENT (LEAN SOLUTION)
20	LEAN SOLUTION SUPPLY LINE
100A-100C	AIR POLLUTION CONTROL UNITS
101	PARTICLE-CONTAINING GAS
101A	GAS CONTAINING PARTICLES AND SULFUR OXIDE
102	WASHING LIQUID
103	GAS CLEANING SECTION
104	GAS WASHING COLUMN
105	COOLING LIQUID
106	GAS COOLING SECTION
107	GAS COOLING COLUMN
108	GAS COMMUNICATION PATH

Claims

1. An air pollution control unit (100A) configured to bring particle-containing gas (101) and washing liquid (102) into contact with each other to collect particles in the particle-containing gas (101), the air pollution control unit (100A) comprising:

a gas washing column (104) having a gas cleaning section (103) in which the particle-containing gas (101) and the washing liquid (102) are brought into co-current contact with each other,
a gas cooling column (107) which is disposed downstream of the gas washing column (104) along a gas flow and in which the particle-containing gas (101) that has been cleaned and cooling liquid (105) are brought into countercurrent contact with each other, and
a gas communication path (108) through which the gas washing column (104) and the gas cooling column (107) are made to communicate with each other on a bottom side and through which the cleaned gas (101a) that has been cleaned in the gas washing column (104) is introduced into the gas cooling column (107); wherein
the gas washing column (104) comprises:

a washing liquid reservoir section (104a) which is disposed downstream of the gas cleaning section (103) along the gas flow and in which the washing liquid (102) is dropped and reserved;
a washing liquid circulation line (104b) through which the washing liquid (102) from the washing liquid reservoir section (104a) is circulated to a top side of the gas washing column (104); and
a sloped plate (104c) which is disposed at a connection opening of the gas communication path (108) on the gas washing column (104) side and regulates the gas flow,

the gas cooling column (107) comprises:

a condensed water reservoir section (107b) in which condensed water (107a) that has been condensed from the cleaned gas (101a) is reserved;
a condensed water circulation line (107c) through which the condensed water (34) from the condensed water reservoir section (107b) is circulated to a gas cooling section (106);
a cooling device (107d) which is interposed in the condensed water circulation line (107c) and cools the condensed water (34);
a demister (110) which is disposed downstream of the gas cooling section (106) along the gas flow; and
a condensed water transfer line (107f) through which the condensed water (34) from the gas cooling column (107) is transferred to the gas washing column (104),

characterized in that,
the air pollution control unit further comprises a liquid level meter (120) which measures the amount of the washing liquid (102) reserved at the washing liquid reservoir section (104a);
a first pressure meter (121A) which measures a pressure at an introduction section of the gas washing column (104); and
a second pressure meter (121B) which measures a pressure in the gas communication path (108), wherein
the sloped plate (104c) of the gas communication path (108) on the gas washing column (104) side is disposed on an upper end side of a con-

nection opening (108a) and inclines at a predetermined angle to form an open path (108b) at the connection opening (108a).

2. The air pollution control unit (100C) according to claim 1, wherein

the particle-containing gas (101) contains sulfur oxide, and
the air pollution control unit (100C) comprises a basic compound supply section (133) disposed on the washing liquid circulation line (104b) is configured to supply a basic compound (131) into the washing liquid (102) therefrom through a supply line (132).

3. A CO_2 recovery unit (10) comprising:

the air pollution control unit (100C) according to claim 2,
a gas exhausting line (12) through which treated gas (101b) discharged from the gas cooling column (107) is exhausted,
a CO_2 absorber (14) in which the cooled gas is introduced through the gas exhausting line (12), and CO_2 in the cooled gas and CO_2 absorbent (13) are brought into contact with each other, and thereby CO_2 is removed,
a CO_2 absorbent regenerator (17) in which a rich solution (15) that has absorbed CO_2 is regenerated with steam from a reboiler,
a rich solution supply line (18) through which the rich solution (15) is drawn from the CO_2 absorber (14) and is introduced to the CO_2 absorbent regenerator (17), and
a lean solution supply line (20) through which a lean solution (19) that has released CO_2 and has been regenerated in the CO_2 absorbent regenerator (17) is drawn from the CO_2 absorbent regenerator (17) and is introduced into the CO_2 absorber (14) to be reused as the CO_2 absorbent (13).

4. An air pollution control method configured to bring particle-containing gas (101) and washing liquid (102) into contact with each other and thereby to collect particles in the particle-containing gas (101), the air pollution control method comprising:

a using step in which the air pollution control unit according to claim 1;
a dedusting step in which the particle-containing gas (101) and the washing liquid (102) are brought into co-current contact with each other in a gas washing column (104), and gas after gas cleaning (101a) flows down and collides with a fluid surface in a washing liquid reservoir section (104a) through a gas flow channel which is narrowed by a gas flow regulating plate (104c), and thereby the gas is dedusted;
a cooling step in which the cleaned gas (101a) resulting from the dedusting is cooled in a gas cooling column (107), and at the same time water in the cleaned gas (101a) is condensed with cooling water (CW) and thereby condensed water (34) is obtained; and
a washing liquid replenishing step in which the condensed water (34) obtained is supplied to the gas washing column (104) to replenish the washing liquid (102),
characterized in that
the air pollution control method is further comprising
a first pressure measuring step in which a pressure at an introduction section of the gas washing column (104) is measured by the first pressure meter (121A);
a second pressure measuring step in which a pressure in the gas communication path (108) is measured by the second pressure meter(121B); and
a controlling step in which a pressure loss in the gas washing column 104) is controlled by controlling a liquid level in the washing liquid reservoir section (104a) by the liquid level meter (120) when a change in the gas volume of the particle-containing gas (101) introduced is detected by the first pressure meter (121A) and the second pressure meter (121B).

5. The air pollution control method according to claim 4, wherein

the particle-containing gas (101) contains sulfur oxide, and
a basic compound (131) is supplied into the washing liquid (102) to perform desulfurization.

6. A CO_2 recovery method comprising:

a step in which the air pollution control method according to claim 4 is performed;
a CO_2 absorbing step in which treated gas (101b) resulting from the gas cooling is introduced into a CO_2 absorber (14), and CO_2 in the cooled gas and CO_2 absorbent (13) are brought into contact with each other, and thereby CO_2 is removed;
a CO_2 absorbent regeneration step in which a rich solution (15) that has absorbed CO_2 is introduced into a CO_2 absorbent regenerator (17) and is regenerated with reboiler (16) steam; and
a step in which the CO_2 absorbent (13) is circulated for reuse between the CO_2 absorber (14) and the CO_2 absorbent regenerator (17) through circulation lines, wherein

the cleaning step is a cleaning and desulfurization step in which the particle-containing gas (101) containing sulfur oxide and CO_2 is introduced into the gas washing column (104), a basic compound is supplied into the washing liquid (102) that is being circulated, and the particle-containing gas (101) is dedusted and desulfurized.

Patentansprüche

1. Luftverschmutzungssteuereinheit (100A), die konfiguriert ist, ein partikelhaltiges Gas (101) und eine Waschflüssigkeit (102) miteinander in Kontakt zu bringen, um Partikel im partikelhaltigen Gas (101) zu sammeln, wobei die Luftverschmutzungssteuereinheit (100A) Folgendes umfasst:

   eine Gaswaschsäule (104), die einen Gasreinigungsabschnitt (103) aufweist, in dem das partikelhaltige Gas (101) und die Waschflüssigkeit (102) in Gleichstromkontakt miteinander gebracht werden,
   eine Gaskühlsäule (107), die stromabwärts der Gaswaschsäule (104) entlang eines Gasdurchflusses angeordnet ist und in der das partikelhaltige Gas (101), das gereinigt wurde, und Kühlflüssigkeit (105) in Gegenstromkontakt miteinander gebracht werden, und
   einen Gaskommunikationspfad (108), durch den die Gaswaschsäule (104) und die Gaskühlsäule (107) auf einer Bodenseite miteinander verbunden sind und durch den das gereinigte Gas (101a), das in der Gaswaschsäule (104) gereinigt wurde, in die Gaskühlsäule (107) eingebracht wird; wobei
   die Gaswaschsäule (104) Folgendes umfasst:

      einen Waschflüssigkeitsbehälterabschnitt (104a), der stromabwärts des Gasreinigungsabschnitts (103) entlang des Gasdurchflusses angeordnet ist und in den die Waschflüssigkeit (102) getropft und bevorratet wird;
      eine Waschflüssigkeitszirkulationsleitung (104b), durch die die Waschflüssigkeit (102) aus dem Waschflüssigkeitsbehälterabschnitt (104a) zu einer Oberseite der Gaswaschsäule (104) zirkuliert wird; und
      eine schräge Platte (104c), die bei einer Verbindungsöffnung des Gaskommunikationspfads (108) auf der Seite der Gaswaschsäule (104) angeordnet ist und den Gasdurchfluss steuert, wobei
      die Gaskühlsäule (107) Folgendes umfasst:

         einen Kondenswasserbehälterabschnitt (107b), in dem Kondenswasser (107a), das aus dem gereinigten Gas (101a) kondensiert wurde, bevorratet wird,
         eine Kondenswasserzirkulationsleitung (107c), durch die das Kondenswasser (34) aus dem Kondenswasserbehälterabschnitt (107b) zu einem Gaskühlabschnitt (106) zirkuliert wird;
         eine Kühlvorrichtung (107d), die in der Kondenswasserzirkulationsleitung (107c) zwischengeschaltet ist und das Kondenswasser (34) kühlt;
         einen Tropfenabscheider (110), der stromabwärts des Gaskühlabschnitts (106) entlang des Gasdurchflusses angeordnet ist; und
         eine Kondenswasserübertragungsleitung (107f), durch die das Kondenswasser (34) von der Gaskühlsäule (107) zur Gaswaschsäule (104) übertragen wird,
         dadurch gekennzeichnet, dass
         die Luftverschmutzungssteuereinheit ferner Folgendes umfasst: einen Flüssigkeitspegelmesser (120), der die Menge der Waschflüssigkeit (102), die im Waschflüssigkeitsbehälterabschnitt (104a) bevorratet ist, misst;
         einen ersten Druckmesser (121A), der einen Druck bei einem Einbringungsabschnitt der Gaswaschsäule (104) misst; und
         einen zweiten Druckmesser (121B), der einen Druck im Gaskommunikationspfad (108) misst, wobei
         die schräge Platte (104c) des Gaskommunikationspfads (108) auf der Seite der Gaswaschsäule (104) auf einer oberen Stirnseite einer Verbindungsöffnung (108a) angeordnet ist und sich in einem vorgegebenen Winkel neigt, um einen offenen Pfad (108b) bei der Verbindungsöffnung (108a) zu bilden.

2. Luftverschmutzungssteuereinheit (100C) nach Anspruch 1, wobei

   das partikelhaltige Gas (101) Schwefeloxid enthält und
   die Luftverschmutzungssteuereinheit (100C) einen Zufuhrabschnitt (133) für basische Verbindungen umfasst, der an der Waschflüssigkeitszirkulationsleitung (104b) angeordnet ist und konfiguriert ist, über eine Zufuhrleitung (132) eine basische Verbindung (131) in ihre Waschflüssigkeit (102) zuzuführen.

3. CO_2-Rückgewinnungseinheit (10), die Folgendes umfasst:

die Luftverschmutzungssteuereinheit (100C) nach Anspruch 2,
eine Gasauslassleitung (12), durch die behandeltes Gas (101b), das von der Gaskühlsäule (107) abgegeben wird, ausgelassen wird,
einen CO_2-Absorber (14), in den das gekühlte Gas durch die Gasauslassleitung (12) eingebracht wird und CO_2 im gekühlten Gas und CO_2-Absorptionsmittel (13) miteinander in Kontakt gebracht werden und dadurch CO_2 entfernt wird,
einen CO_2-Absorptionsmittelregenerator (17), in dem eine fette Lösung (15), die CO_2 absorbiert hat, mit Dampf aus einem Nachverdampfer regeneriert wird,
eine Zufuhrleitung (18) für fette Lösungen, durch die die fette Lösung (15) aus dem CO_2-Absorber (14) entnommen wird und in den CO_2-Absorptionsmittelregenerator (17) eingebracht wird, und
eine Zufuhrleitung (20) für magere Lösungen, durch die eine magere Lösung (19), die CO_2 freigegeben hat und im CO_2-Absorptionsmittelregenerator (17) regeneriert wurde, aus dem CO_2-Absorptionsmittelregenerator (17) entnommen wird und in den CO_2-Absorber (14) eingebracht wird, um als das CO_2-Absorptionsmittel (13) wiederverwendet zu werden.

4. Luftverschmutzungssteuerverfahren, das konfiguriert ist, ein partikelhaltiges Gas (101) und eine Waschflüssigkeit (102) miteinander in Kontakt zu bringen und dadurch Partikel im partikelhaltigen Gas (101) zu sammeln, wobei das Luftverschmutzungssteuerverfahren Folgendes umfasst:

einen Verwendungsschritt, in dem die Luftverschmutzungssteuereinheit nach Anspruch 1;
einen Entstaubungsschritt, in dem das partikelhaltige Gas (101) und die Waschflüssigkeit (102) in einer Gaswaschsäule (104) in Gleichstromkontakt miteinander gebracht werden und Gas nach einer Gasreinigung (101a) durch einen Gasdurchflusskanal, der durch eine Gasdurchflusssteuerplatte (104c) beschränkt ist, herunterströmt und in einem Waschflüssigkeitsbehälterabschnitt (104a) mit einer Fluidoberfläche kollidiert und dadurch das Gas entstaubt wird;
einen Kühlschritt, in dem das gereinigte Gas (101a), das aus der Entstaubung resultiert, in einer Gaskühlsäule (107) gekühlt wird und gleichzeitig Wasser im gereinigten Gas (101a) mit Kühlwasser (CW) kondensiert wird und dadurch Kondenswasser (34) erhalten wird; und
einen Waschflüssigkeitsauffüllschritt, in dem das Kondenswasser (34), das erhalten wurde, zur Gaswaschsäule (104) zugeführt wird, um die Waschflüssigkeit (102) aufzufüllen,
dadurch gekennzeichnet, dass
das Luftverschmutzungssteuerverfahren ferner Folgendes umfasst:

einen ersten Druckmessschritt, in dem ein Druck bei einem Einbringungsabschnitt der Gaswaschsäule (104) durch den ersten Druckmesser (121A) gemessen wird;
einen zweiten Druckmessschritt, in dem ein Druck im Gaskommunikationspfad (108) durch den zweiten Druckmesser (121B) gemessen wird; und
einen Steuerungsschritt, in dem ein Druckverlust in der Gaswaschsäule (104) durch Steuern eines Flüssigkeitspegels im Waschflüssigkeitsbehälterabschnitt (104a) durch den Flüssigkeitspegelmesser (120) gesteuert wird, wenn durch den ersten Druckmesser (121A) und den zweiten Druckmesser (121B) eine Änderung des Gasvolumens des partikelhaltigen Gases (101), das eingebracht wird, detektiert wird.

5. Luftverschmutzungssteuerverfahren nach Anspruch 4, wobei

das partikelhaltige Gas (101) Schwefeloxid enthält und
eine basische Verbindung (131) in die Waschflüssigkeit (102) zugeführt wird, um eine Entschwefelung durchzuführen.

6. CO_2-Rückgewinnungsverfahren, das Folgendes umfasst:

einen Schritt, in dem das Luftverschmutzungssteuerverfahren nach Anspruch 4 durchgeführt wird;
einen CO_2-Absorptionsschritt, in dem behandeltes Gas (101b), das aus der Gaskühlung resultiert, in einen CO_2-Absorber (14) eingebracht wird und CO_2 im gekühlten Gas und CO_2-Absorptionsmittel (13) in Kontakt miteinander gebracht werden und dadurch CO_2 entfernt wird;
einen CO_2-Absorptionsmittelregenerationsschritt, in dem eine fette Lösung (15), die CO_2 absorbiert hat, in einen CO_2-Absorptionsmittelregenerator (17) eingebracht wird und mit Dampf eines Nachverdampfers (16) regeneriert wird; und
einen Schritt, in dem das CO_2-Absorptionsmittel (13) zur Wiederverwendung zwischen dem CO_2-Absorber (14) und dem CO_2-Absorptionsmittelregenerator (17) durch Zirkulationsleitun-

gen zirkuliert wird, wobei
der Reinigungsschritt ein Reinigungs- und Entschwefelungsschritt ist, in dem das partikelhaltige Gas (101), das Schwefeloxid und CO_2 enthält, in die Gaswaschsäule (104) eingebracht wird, eine basische Verbindung in die Waschflüssigkeit (102), die zirkuliert wird, zugeführt wird und das partikelhaltige Gas (101) entstaubt und entschwefelt wird.

Revendications

1. Unité (100A) de lutte contre la pollution de l'air configurée pour amener un gaz (101) contenant des particules et un liquide de nettoyage (102) en contact l'un avec l'autre pour collecter des particules dans le gaz (101) contenant des particules, l'unité (100A) de lutte contre la pollution de l'air comprenant :

une colonne (104) de nettoyage de gaz ayant une section (103) de nettoyage de gaz dans laquelle le gaz (101) contenant des particules et le liquide de nettoyage (102) sont amenés en contact cocourant l'un avec l'autre,
une colonne (107) de refroidissement de gaz qui est disposée en aval de la colonne (104) de nettoyage de gaz le long d'un écoulement de gaz et dans laquelle le gaz (101) contenant des particules qui a été nettoyé et le liquide de refroidissement (105) sont amenés en contact à contre-courant l'un avec l'autre, et
un trajet (108) de communication gazeuse à travers lequel la colonne (104) de nettoyage de gaz et la colonne (107) de refroidissement de gaz sont amenées à communiquer l'une avec l'autre sur un côté inférieur et à travers lequel le gaz nettoyé (101a) qui a été nettoyé dans la colonne (104) de nettoyage de gaz est introduit dans la colonne (107) de refroidissement de gaz ; dans laquelle
la colonne (104) de nettoyage de gaz comprend :

une section (104a) réservoir de liquide de nettoyage qui est disposée en aval de la section (103) de nettoyage de gaz le long de l'écoulement de gaz et dans laquelle le liquide de nettoyage (102) est lâché et réservé ;
une conduite (104b) de circulation de liquide de nettoyage à travers laquelle le liquide de nettoyage (102) provenant de la section (104a) réservoir de liquide de nettoyage est mis en circulation vers un côté supérieur de la colonne (104) de nettoyage de gaz ; et
une plaque inclinée (104c) qui est disposée au niveau d'une ouverture de raccordement du trajet (108) de communication gazeuse sur le côté colonne (104) de nettoyage de gaz et régule l'écoulement de gaz,
la colonne (107) de refroidissement de gaz comprend :

une section (107b) réservoir d'eau condensée dans laquelle de l'eau condensée (107a) qui a été condensée à partir du gaz nettoyé (101a) est réservée ;
une conduite (107c) de circulation d'eau condensée à travers laquelle l'eau condensée (34) provenant de la section (107b) réservoir d'eau condensée est mise en circulation vers une section (106) de refroidissement de gaz ;
un dispositif de refroidissement (107d) qui est interposé dans la conduite (107c) de circulation d'eau condensée et refroidit l'eau condensée (34) ;
un dévésiculeur (110) qui est disposé en aval de la section (106) de refroidissement de gaz le long de l'écoulement de gaz ; et
une conduite (107f) de transfert d'eau condensée à travers laquelle l'eau condensée (34) provenant de la colonne (107) de refroidissement de gaz est transférée vers la colonne (104) de nettoyage de gaz,
caractérisée en ce que,
l'unité de lutte contre la pollution de l'air comprend en outre un mesureur (120) de niveau de liquide qui mesure la quantité du liquide de nettoyage (102) réservé au niveau de la section (104a) réservoir de liquide de nettoyage ;
un premier mesureur (121A) de pression qui mesure une pression au niveau d'une section d'introduction de la colonne (104) de nettoyage de gaz ; et
un deuxième mesureur (121B) de pression qui mesure une pression dans le trajet (108) de communication gazeuse, dans laquelle
la plaque inclinée (104c) du trajet (108) de communication gazeuse sur le côté colonne (104) de nettoyage de gaz est disposée sur un côté d'extrémité supérieure d'une ouverture de raccordement (108a) et est inclinée selon un angle prédéterminé pour former un trajet ouvert (108b) au niveau de l'ouverture de raccordement (108a).

2. Unité (100C) de lutte contre la pollution de l'air selon la revendication 1, dans laquelle

le gaz (101) contenant des particules contient de l'oxyde de soufre, et
l'unité (100C) de lutte contre la pollution de l'air comprend une section (133) d'amenée de composé basique disposée sur la conduite (104b) de circulation de liquide de nettoyage configurée pour amener un composé basique (131) dans le liquide de nettoyage (102) à partir de celle-ci à travers une conduite d'amenée (132).

3. Unité (10) de récupération de CO_2 comprenant :

l'unité (100C) de lutte contre la pollution de l'air selon la revendication 2,
une conduite (12) d'évacuation de gaz à travers laquelle le gaz traité (101b) déchargé à partir de la colonne (107) de refroidissement de gaz est évacué,
un absorbeur (14) de CO_2 dans lequel le gaz refroidi est introduit à travers la conduite (12) d'évacuation de gaz, et le CO_2 dans le gaz refroidi et l'absorbeur (13) de CO_2 sont amenés en contact l'un avec l'autre, et ainsi le CO_2 est éliminé,
un régénérateur (17) d'absorbeur de CO_2 dans lequel une solution riche (15) qui a absorbé le CO_2 est régénérée avec de la vapeur provenant d'un rebouilleur,
une conduite (18) d'amenée en solution riche à travers laquelle la solution riche (15) est aspirée à partir de l'absorbeur (14) de CO_2 et est introduite dans le régénérateur (17) d'absorbeur de CO_2, et
une conduite (20) d'amenée en solution pauvre à travers laquelle une solution pauvre (19) qui a libéré du CO_2 et a été régénérée dans le régénérateur (17) d'absorbeur de CO_2 est aspirée à partir du régénérateur (17) d'absorbeur de CO_2 et est introduite dans l'absorbeur (14) de CO_2 pour être réutilisée en tant qu'absorbeur (13) de CO_2.

4. Méthode de lutte contre la pollution de l'air configurée pour amener un gaz (101) contenant des particules et un liquide de nettoyage (102) en contact l'un avec l'autre et ainsi pour collecter des particules dans le gaz (101) contenant des particules, la méthode de lutte contre la pollution de l'air comprenant :

une étape d'utilisation dans laquelle l'unité de lutte contre la pollution de l'air selon la revendication 1 ;
une étape de dépoussiérage dans laquelle le gaz (101) contenant des particules et le liquide de nettoyage (102) sont amenés en contact co-courant l'un avec l'autre dans une colonne (104) de nettoyage de gaz, et le gaz après le nettoyage de gaz (101a) s'écoule vers le bas et entre en collision avec une surface de fluide dans une section (104a) réservoir de liquide de nettoyage à travers un canal d'écoulement de gaz qui est rétréci par une plaque (104c) régulatrice d'écoulement de gaz, et ainsi le gaz est dépoussiéré ;
une étape de refroidissement dans laquelle le gaz nettoyé (101a) résultant du dépoussiérage est refroidi dans une colonne (107) de refroidissement de gaz, et en même temps l'eau dans le gaz nettoyé (101a) est condensée avec de l'eau de refroidissement (CW) et ainsi de l'eau condensée (34) est obtenue ; et
une étape de réapprovisionnement en liquide de nettoyage dans laquelle l'eau condensée (34) obtenue est amenée dans la colonne (104) de nettoyage de gaz pour réapprovisionner le liquide de nettoyage (102),
caractérisée en ce que
la méthode de lutte contre la pollution de l'air comprend en outre
une première étape de mesure de pression dans laquelle une pression au niveau d'une section d'introduction de la colonne (104) de nettoyage de gaz est mesurée par le premier mesureur de pression (121A) ;
une deuxième étape de mesure de pression dans laquelle une pression dans le trajet (108) de communication gazeuse est mesurée par le deuxième mesureur de pression (121B) ; et
une étape de contrôle dans laquelle une perte de pression dans la colonne (104) de nettoyage de gaz est contrôlée en contrôlant un niveau de liquide dans la section (104a) réservoir de liquide de nettoyage par le mesureur (120) de niveau de liquide lorsqu'un changement du volume gazeux du gaz (101) contenant des particules introduit est détecté par le premier mesureur (121A) de pression et le deuxième mesureur (121B) de pression.

5. Méthode de lutte contre la pollution de l'air selon la revendication 4, dans laquelle

le gaz (101) contenant des particules contient de l'oxyde de soufre, et
un composé basique (131) est amené dans le liquide de nettoyage (102) pour réaliser une désulfurisation.

6. Méthode de récupération de CO_2 comprenant :

une étape dans laquelle la méthode de lutte contre la pollution de l'air selon la revendication 4 est réalisée ;
une étape d'absorption de CO_2 dans laquelle le gaz traité (101b) résultant du refroidissement de gaz est introduit dans un absorbeur (14) de CO_2, et le CO_2 dans le gaz refroidi et l'absorbeur (13)

de CO_2 sont amenés en contact l'un avec l'autre, et ainsi le CO_2 est éliminé ;
une étape de régénération d'absorbeur de CO_2 dans laquelle une solution riche (15) qui a absorbé le CO_2 est introduite dans un régénérateur (17) d'absorbeur de CO_2 et est régénérée avec une vapeur de rebouilleur (16) ; et
une étape dans laquelle l'absorbeur (13) de CO_2 est mis en circulation pour une réutilisation entre l'absorbeur (14) de CO_2 et le régénérateur (17) d'absorbeur de CO_2 à travers des conduites de circulation, dans laquelle
l'étape de nettoyage est une étape de nettoyage et de désulfurisation dans laquelle le gaz (101) contenant des particules contenant de l'oxyde de soufre et du CO_2 est introduit dans la colonne (104) de nettoyage de gaz, un composé basique est amené dans le liquide de nettoyage (102) qui est en circulation, et le gaz (101) contenant des particules est dépoussiéré et désulfurisé.

FIG.1

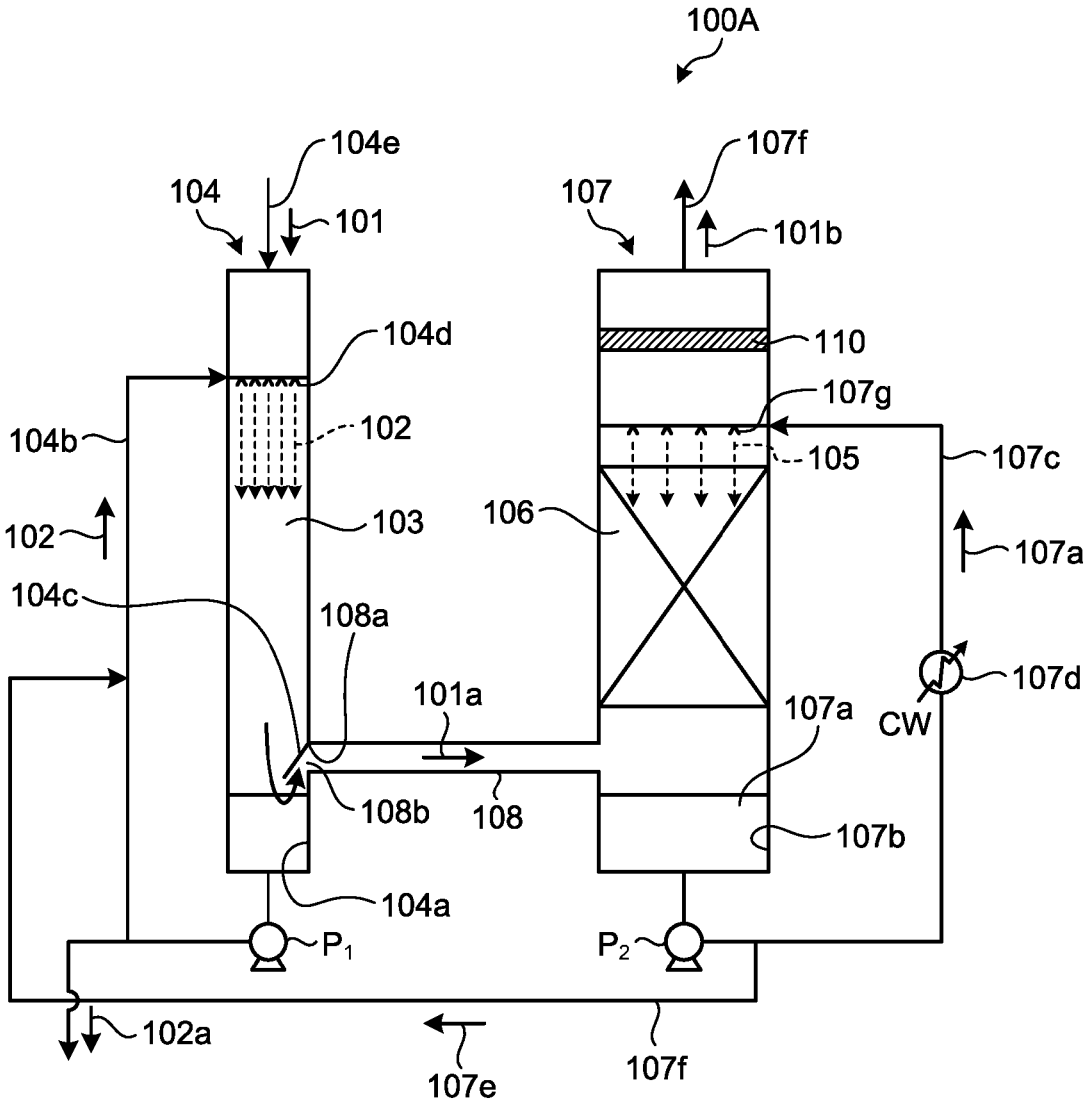

100A
104e
104
101
107f
107
101b
104d
110
107g
104b
102
105
107c
102
103
106
107a
104c
108a
101a
107a
107d
CW
108b
108
107b
104a
P1
P2
102a
107e
107f

FIG.2A

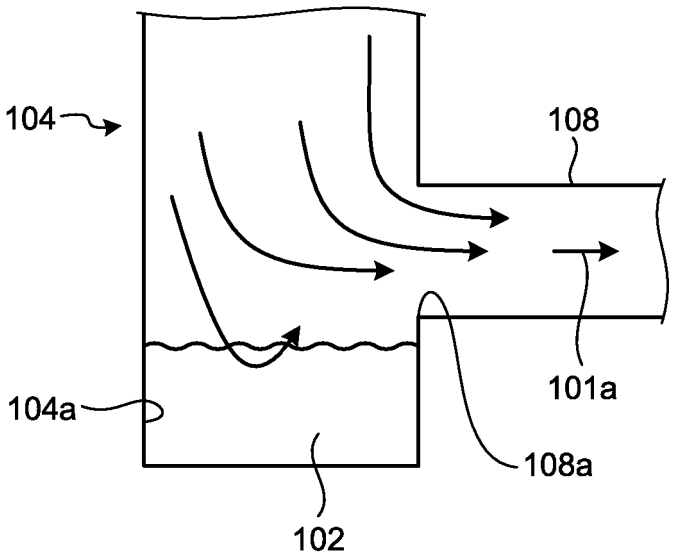

104
108
101a
104a
108a
102

FIG.2B

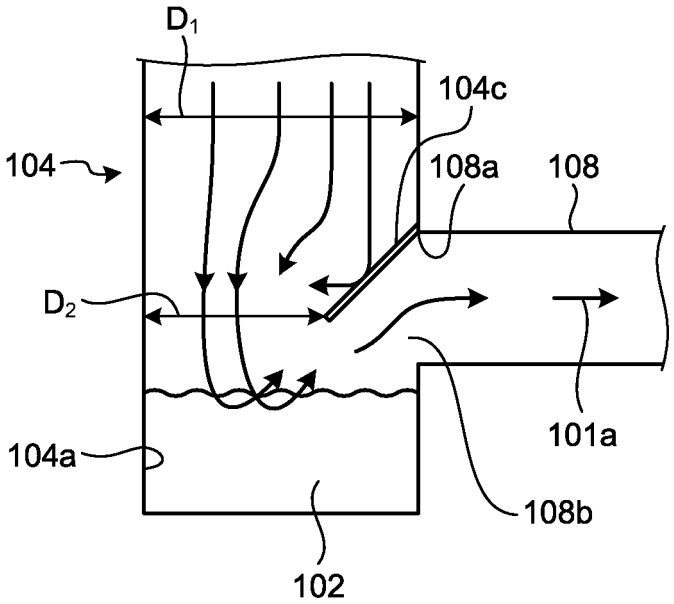

D1
104c
104
108a
108
D2
101a
104a
108b
102

FIG.3

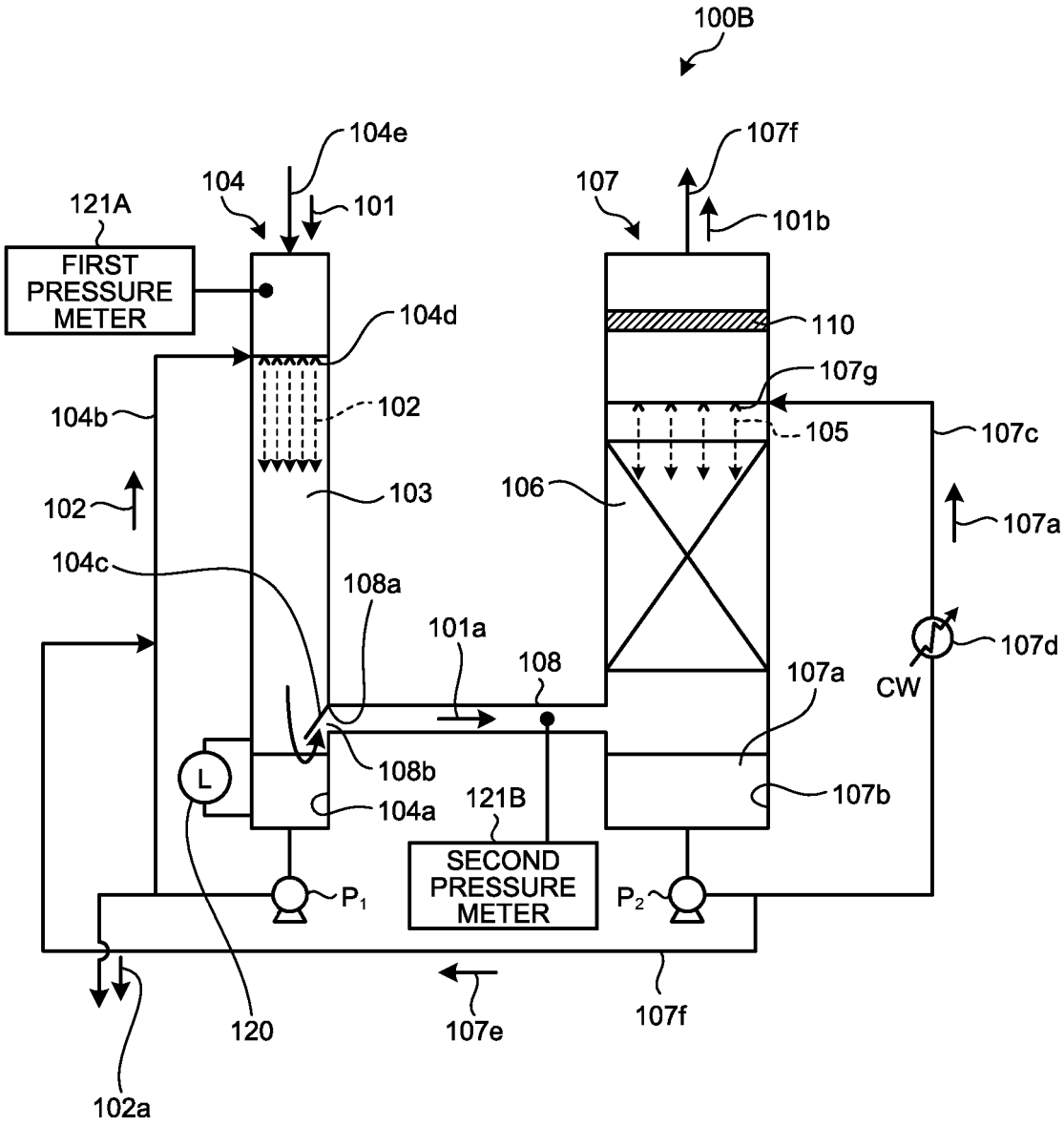

100B
104e
104
101
121A
FIRST PRESSURE METER
104d
104b
102
103
102
104c
108a
101a
108
108b
104a
121B
SECOND PRESSURE METER
P1
P2
120
107e
107f
102a
107
107f
101b
110
107g
105
107c
106
107a
107d
CW
107a
107b
L

FIG.4

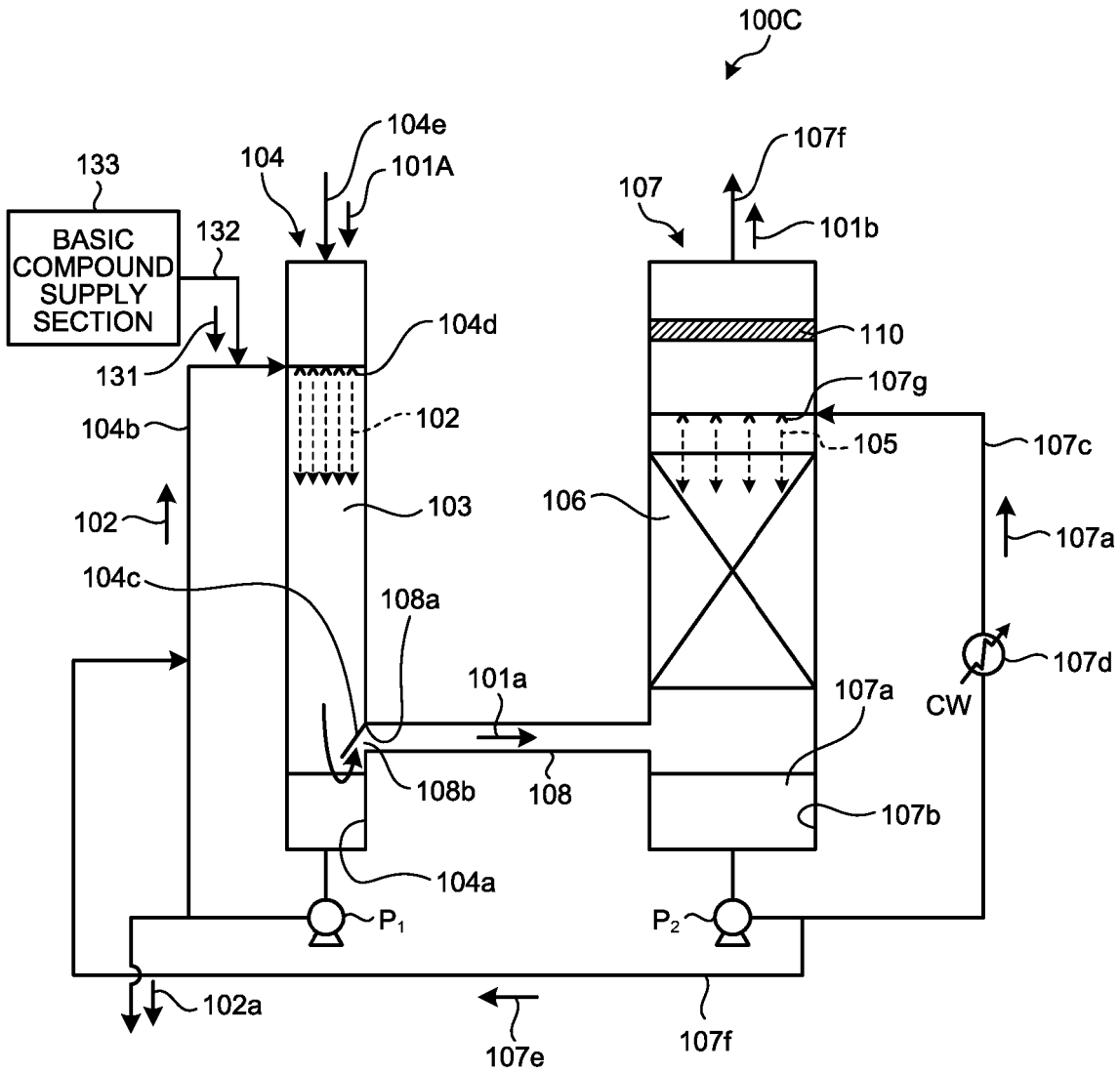
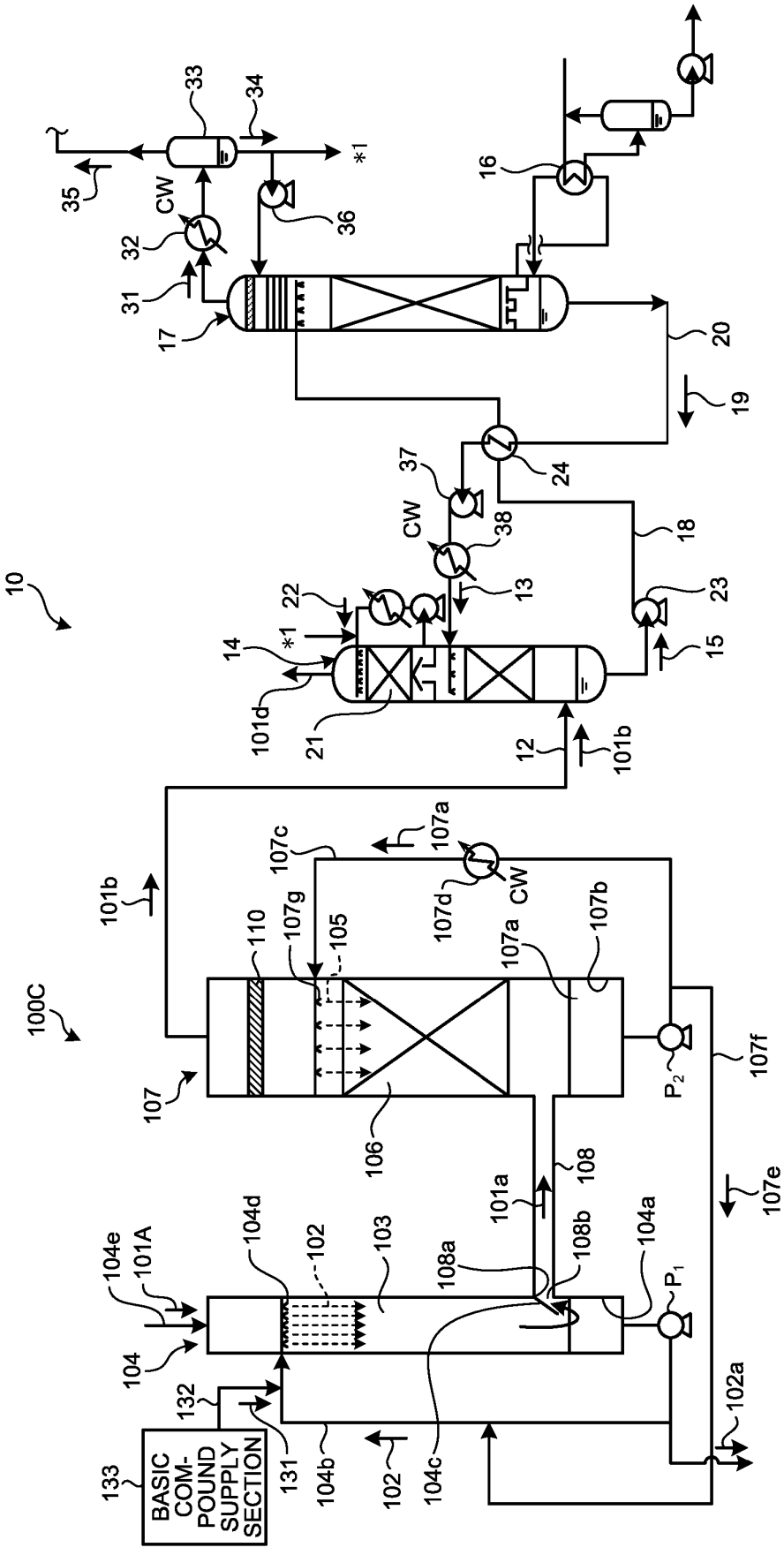

100C
133
BASIC COMPOUND SUPPLY SECTION
132
131
104
104e
101A
104d
104b
102
103
104c
108a
101a
108b
108
104a
P_1
102a
107e
107
107f
101b
110
107g
105
107c
106
107a
107d
CW
107a
107b
P_2
107f

FIG.5



REFERENCES CITED IN THE DESCRIPTION

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