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(54) **STEAM PROVIDING SYSTEM AND CO2 RECOVERY FACILITIES PROVIDED WITH SAME**

SYSTEM ZUR DAMPFBEREITSTELLUNG UND EIN SOLCHES SYSTEM UMFASSENDE CO2-RÜCKGEWINNUNGSANLAGEN

SYSTÈME GÉNÉRATEUR DE VAPEUR ET INSTALLATIONS DE RÉCUPÉRATION DE CO2 L'UTILISANT

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Description

{Technical Field}

[0001] The present invention relates to a steam supply system which is preferably used in CO_2 recovery unit in exhaust gas discharged from an industrial facility, for example, and the CO_2 recovery unit including the same.

{Background Art}

[0002] From industrial facilities such as thermal power generation equipment, a large amount of carbon dioxide (hereinafter, referred to as CO_2) is discharged due to combustion of fossil fuel such as coal and fuel oil. Emission limitation of CO_2 has been considered from the viewpoint of prevention of global warming, and as one measure, there has been the CO_2 separation and recovery technology.

[0003] For industrial facilities such as a thermal power plant that uses a large amount of fossil fuel, a method of eliminating and recovering CO_2 in combustion exhaust gas by contacting combustion exhaust gas of a boiler with amine based CO_2 absorbing liquid, for example, and a method of storing the recovered CO_2 without discharging it to the ambient air have been known.

[0004] Moreover, as a step of eliminating and recovering CO_2 from combustion exhaust gas using the CO_2 absorbing liquid as described above, a step of contacting the combustion exhaust gas with the CO_2 absorbing liquid in an absorbing tower and a step of heating the absorbing liquid that absorbed CO_2 in a regeneration tower to release CO_2 as well as regenerate the absorbing liquid for circulation to the absorbing tower to be reused have been adopted.

[0005] Japanese Unexamined Patent Application, Publication No. H5-184866 discloses that, in a regeneration tower, MEA (monoethanolamine) solution is regenerated due to heating by a regenerative heater (reboiler) and cooled by a heat exchanger to be returned to a CO_2 elimination tower.

[0006] Other systems are disclosed in documents JP2011240321 A, US20107050637 A1, US2012/101767 A1, JP 2010253370A, JP2010088982 A, US4160810A.

{Summary of Invention}

{Technical Problem}

[0007] However, in a reboiler provided in such CO_2 recovery apparatus, since the pressure difference between the reboiler and a condensed water drum is small, condensed water in a heat exchanger tube provided in the reboiler is difficult to flow to the condensed water drum, whereby performance of the reboiler and the liquid level of the condensed water drum become unstable, which has been problematic.

[0008] Fig. 5 shows a schematic configuration showing a reference example of a steam supply system. Absorbing liquid (not shown) of a regeneration tower (not shown) is reheated by a circulation route L_4 that circulates the absorbing liquid to the outside of the tower and steam to be provided to a heat exchanger tube 130a of a reboiler 130 provided to a tower bottom portion of the regeneration tower. To the reboiler 130, the steam supply tube 2 is connected, and steam is supplied to the heat exchanger tube 130a in the reboiler. The steam that applied heat to the absorbing liquid by the heat exchanger tube 130a is sent to the condensed water drum 5 and subjected to gas-liquid separation in the condensed water drum. Moreover, condensed water 6 flows from the bottom of the condensed water drum 5 through a drain extraction tube 7, and delivered by a pump 8 via a steam drain tube 9.

[0009] In the steam supply system shown in Fig. 5, differential pressure between the condensed water drum and the heat exchanger tube provided in the reboiler is small. This causes a problem that the condensed water in the heat exchanger tube provided in the reboiler is difficult to flow to the condensed water drum, whereby performance of the reboiler and the liquid level of the condensed water drum become unstable.

[0010] In addition, since performance of the reboiler is lowered, there has been a problem that efficiency of discharging CO_2 from the CO_2 absorbing liquid that absorbed CO_2 in the regeneration tower to regenerate the CO_2 absorbing liquid is lowered.

[0011] The present invention is made considering such circumstances, and an object of the present invention is to provide a steam supply system that reheats CO_2 absorbing liquid without lowering performance of the reboiler by appropriately controlling the inner pressure of the condensed water drum.

{Solution to Problem}

[0012] In order to solve the above problem it is provided a steam supply system according to claims 1, 2, and 3 and CO_2 recovery unit including the same.

[0013] For example, even when the pressure of the condensed water drum is raised to be close to the pressure of the heat exchanger tube of the reboiler, decompression unit that lowers the pressure in the condensed water drum is provided. By this decompression unit, the pressure difference occurs between the reboiler and the condensed water drum, and the condensed water easily flows from the reboiler on the high-pressure side to the condensed water drum on the low-pressure side. This makes performance of the reboiler and the liquid level of the condensed water drum stable. Since the performance of the reboiler is stable, heat can be stably applied to the CO_2 absorbing liquid circulating in the regeneration tower. This ensures separation of CO_2 in the CO_2 absorbing liquid.

[0014] Cooling unit that cools the condensed water in the condensed water drum is provided. In this cooling unit, for example, a part of the condensed water extracted from the condensed water drum is cooled and returned to the condensed water drum again. By doing this, the temperature of the condensed water drum is lowered and the pressure in the condensed water drum can be lowered.

[0015] Steam drain flows in the drain circulation route branched from the steam drain piping that discharges the steam drain from the condensed water drum and passes through the cooler to be returned to the condensed water drum. By returning the steam drain cooled by the cooler to the condensed water drum, saturation temperature and saturation pressure can be lowered. This lowers the pressure in the condensed water drum.

[0016] A steam drain circulation route branched from the downstream side of the cooler is provided to return the steam drain to the condensed water drum. By doing this, providing the cooler to the branched circulation route is unnecessary.

[0017] As cooling unit, a cooler provided on a reboiler exit piping that connects the reboiler and the condensed water drum is provided. This lowers the temperature of steam drain to be recovered by the condensed water drum. Since the steam drain cooled by the cooler is supplied to the condensed water drum, saturation temperature and saturation pressure can be lowered by cooling the condensed water drum. Accordingly, the inner pressure of the condensed water drum can be lowered.

[0018] By providing a vent tube with the condensed water drum, when the inner pressure of the condensed water drum becomes a predetermined value or more for example, the vent tube can be opened to discharge gas phase of the condensed water drum to lower the inner pressure.

[0019] A signal is transmitted from the pressure measuring portion to obtain the pressure difference between the inner pressure of the condensed water drum and the steam pressure to be supplied to the reboiler to the control unit that controls the decompression unit. The control unit that received the signal can regulate the flow rate of a cooling medium flowing in the cooler since the degree of opening of the control unit is determined from the pressure difference between the steam pressure to be supplied to the reboiler and the inner pressure of the condensed water drum.

[0020] Since performance of the reboiler is made stable due to the steam supply system, heat can be stably applied to the CO_2 absorbing liquid circulating in the regeneration tower. This ensures separation of CO_2 in the CO_2 absorbing liquid, so that stable CO_2 recovery can be achieved.

{Advantageous Effects of Invention}

[0021] According to the steam supply system and the CO_2 recovery unit including the same according to the present invention, a decompression unit that lowers the pressure of the condensed water drum to provide the pressure difference between the pressure in the heat exchanger tube of the reboiler and the inner pressure of the condensed water drum provided in the CO_2 recovery unit is provided. By doing this, the condensed water generated in the heat exchanger tube stably flows to the condensed water drum to prevent the condensed water from retaining in the heat exchanger tube. Accordingly, the reboiler can be operated stably, so that CO_2 absorbing liquid circulating in the regeneration tower can be surely reheated.

{Brief Description of Drawings}

[0022]

{Fig. 1}
Fig. 1 is a schematic configuration diagram showing a steam supply system regarding a first embodiment according to the present invention.

{Fig. 2}
Fig. 2 is a schematic configuration diagram showing a steam supply system regarding a second embodiment according to the present invention.

{Fig. 3}
Fig. 3 is a schematic configuration diagram showing a modification of the steam supply system regarding the second embodiment according to the present invention.

{Fig. 4}
Fig. 4 is a schematic configuration diagram showing a steam supply system regarding a third embodiment of the present invention.

{Fig. 5}
Fig. 5 is a schematic configuration diagram showing a reference example of a steam supply system.

{Fig. 6}
Fig. 6 is a schematic configuration diagram of a CO_2 recovery apparatus to which the steam supply system according to the present invention is applied.

{Description of Embodiments}

[0023] Hereinafter, embodiments of a steam supply system and CO_2 recovery unit including the same according to the present invention will be explained with reference to the drawings.

[First Embodiment]

[0024] Hereinafter, a first embodiment of the present invention will be explained.

[0025] Fig. 6 shows a basic configuration of a CO_2 recovery apparatus according to this embodiment.

[0026] As shown in Fig. 6, in the CO_2 recovery apparatus, exhaust gas 100 including CO_2 discharged from an industrial facility such as a boiler and a gas turbine is supplied to a cooling tower 102 by a not shown blower.

The exhaust gas 100 supplied to the cooling tower 102 is cooled by cooling water 101. The cooling water 101 used to cool the exhaust gas 100, by a pump 131, passes through a cooler 132 to be supplied to the cooling tower 102 again, and is sprayed in the tower. Additionally, in the cooler 132, cooling water 101a that cools the cooling water 101 to be supplied to the cooling tower 102 is used.

[0027] The exhaust gas 100 including the cooled CO_2 is supplied from a lower portion of an absorbing tower 104 via an exhaust gas line 103. The absorbing liquid 113 is supplied from an upper portion of the absorbing tower 104 and sprayed to the lower portion. In the absorbing tower 104, for example, alkanolamine-based CO_2 absorbing liquid 113 (amine solution) is countercurrently contacted with the exhaust gas 100 while passing a packing 120. Because of this, CO_2 in the exhaust gas 100 is absorbed in the CO_2 absorbing liquid 113, and CO_2 is eliminated from the exhaust gas 100 discharged from the industrial facility. From a tower top portion 104a of the absorbing tower 104, cleaned gas 150 in which CO_2 is eliminated is discharged.

[0028] The absorbing liquid 113 produces heat and raises its temperature by absorbing CO_2, so that the cleaned gas 150 can include water vapor etc. The water vapor in the cleaned gas 150 is condensed by being cooled through countercurrent contact with cooled water on the packing layer 120 at the upper portion of the absorbing tower 104. A mist eliminator 121 is placed above the packing layer 120 to capture mist in the cleaned gas 150. On the outside of the absorbing tower 104, a cooler 122 and a pump 123 that circulates a part of the condensed water between the cooler 122 and the absorbing tower 104 are placed.

[0029] The absorbing liquid 113 that absorbed CO_2 in the absorbing tower 104 is retained in a tower bottom portion 104b, and supplied by a pump 106 from a liquid sending line L_1 that connects the tower bottom portion 104b of the absorbing tower 104 and an upper portion of a regeneration tower 107 to the regeneration tower 107 to be sprayed to a packing 140. On an intersection of the liquid sending line L_1 and a liquid sending line L_2, a heat exchanger 109 that executes heat exchange between rich solution 113 (absorbing liquid that absorbed CO_2) and lean solution 114 (absorbing liquid in which CO_2 is eliminated) is placed. In the heat exchanger 109, the rich solution 113 is heated and the lean solution 114 is cooled.

[0030] In the CO_2 absorbing liquid 113 that absorbed CO_2 (rich solution), CO_2 is discharged due to endothermic reaction by countercurrent contact during passage through the packing 140 in the regeneration tower 107. Most CO_2 is eliminated until the CO_2 absorbing liquid reaches a tower bottom portion 107b of the regeneration tower 107, and the CO_2 absorbing liquid is regenerated as lean solution 114. The regenerated lean solution 114 is supplied to the absorbing tower 104 again by a pump 108 via a lean solution cooling apparatus 105 as CO_2 absorbing liquid (anime solution), and reused.

[0031] The lean solution 114 which is regenerated by discharging CO_2 in the regeneration tower 107 is refluxed to the absorbing tower 104 by the pump 108 through the liquid sending line L_2 that connects the tower bottom portion 107b of the regeneration tower 107 and the upper portion of the absorbing tower 104, and during that, in the heat exchanger 109, it is subjected to heat exchange with the absorbing liquid 113 to be supplied from the absorbing tower 104 to the regeneration tower 107 to be cooled, and further, fully cooled to the temperature which is suitable for absorbing CO_2 by the water-cooling type cooler 105.

[0032] The reference symbol L_3 denotes a CO_2 discharge line connected to the tower top portion 107a of the regeneration tower 107. CO_2 discharged from the CO_2 absorbing liquid 113 in the regeneration tower 107 by the line L_3 is fully cooled via a cooler 115 using cooling water 101 to be sent to a gas-liquid separator 111. The CO_2 sent to the gas-liquid separator 111 is separated from condensed water 110 which is accompanied after the elimination of CO_2. The separated CO_2 is sent to a not shown CO_2 compression apparatus. After that, the recovered carbon dioxide (CO_2) is compressed by the CO_2 compression apparatus to obtain high-pressure CO_2. The condensed water 110 separated in the gas-liquid separator 111 is refluxed to the upper portion of the regeneration tower 107 by a pump 112.

[0033] The refluxed condensed water 110 cools a condensing portion 141 to prevent discharge of an absorbing agent etc.

[0034] The absorbing liquid 113 including CO_2 in the absorbing tower 104 is supplied to the upper portion of the regeneration tower 107, passes through the packing 140 to be retained in the tower bottom portion 107b. A reboiler 130 is provided to the tower bottom portion 107b of the regeneration tower 107. Moreover, a circulation route L_4 that circulates the absorbing liquid 113 to the outside of the tower and a heat exchanger tube 130a that heats the absorbing liquid 113 are provided. A part of the absorbing liquid 113 of the tower bottom portion 107b is supplied to the reboiler 130 through the circulation route L_4, and refluxed in the tower after it is heated due to heat exchange with high-temperature steam. Due to this heating, CO_2 is discharged from the absorbing liquid 113 in the tower bottom portion 107b, and CO_2 is also discharged from the absorbing liquid 113 during gas-liquid contact on the packing 140 which is indirectly heated.

[0035] Fig. 1 shows a configuration of a part surrounding the reboiler 130 provided to the tower bottom portion 107b of the regeneration tower 107 shown in Fig. 6. In the reboiler 130, a number of heat exchanger tubes 130a connected to a steam supply tube 2 are placed to contact with absorbing liquid flowing in the circulation route L_4. Each heat exchanger tube 130a is connected to a steam discharge tube 4 connected to a condensed water drum 5.

[0036] To the condensed water drum 5, a measuring portion 10b for pressure measuring is provided. Moreover, to the steam supply tube 2, a measuring portion 10a for pressure measuring is provided. Based on the pressure obtained from these measuring portions 10a, 10b, the pressure difference can be obtained at a control portion 10. Further, to the condensed water drum 5, a vent tube 13 (decompression unit) is placed, and the vent tube 13 includes a control valve 12 that regulates the flow rate of the vent tube 13. Via this vent tube 13, gas phase (steam) in the condensed water drum 5 is discharged to the outside (for example, the ambient air).

[0037] To the bottom portion of the condensed water drum 5, a steam drain extraction tube 7 is connected, which is connected to an intake portion of the pump 8.

[0038] A discharge portion of the pump 8 is connected to a steam drain tube 9, and a heater 15 is provided to the steam drain tube 9. In the heater 15, a plurality of heat exchanger tubes are placed to contact with steam drain introduced from the steam drain tube 9. As a heating medium 14 flowing in the heat exchanger tube, for example, the lean solution 114 (see Fig. 6) which is regenerated by discharging CO_2 is used.

[0039] Next, an operation of the steam supply system having the above configuration will be explained.

[0040] A part of the absorbing liquid 113 of the tower bottom portion 107b is supplied to the reboiler 130 through the circulation route L_4, and heated due to heat exchange with the heat exchanger tube 130a in which steam supplied from the steam supply tube 2 flows to be refluxed to the regeneration tower 107.

[0041] The steam after heat exchange is supplied to the condensed water drum 5 and subjected to gas-liquid separation in the condensed water drum 5.

[0042] By the measuring portion 10b of the control portion 10 provided in the condensed water drum 5, the inner pressure of the condensed water drum 5 is measured. The control portion 10 is controlled such that the measuring portions 10a and 10b that measure in-tube pressure of the steam supply tube 2 provide the pressure difference. The control portion 10 transmits a signal 11 to the control valve 12 provided on the vent tube 13 when the pressure in the measuring portion 10b is raised so that the pressure difference between the measuring portions 10a and 10b exceeds a predetermined value to be close to pressure equalization. In the control valve 12 that received the signal 11, the degree of opening of the control valve 12 is determined based on the pressure difference.

[0043] The condensed water 6 subjected to gas-liquid separation by the condensed water drum 5 is supplied to the pump 8 via the steam drain extraction tube 7. The condensed water 6 supplied to the pump 8 is sent passing through the steam drain tube 9. Moreover, the condensed water 6 is indirectly heated by a heating medium 14 (for example, lean solution) flowing in the heat exchanger tube penetrating through the heater 15 provided on the steam drain tube 9.

[0044] According to this embodiment, the following operation and effect are provided.

[0045] In a case where the pressure in the condensed water drum 5 is raised to be close to pressure equalization with the pressure of the heat exchanger tube 130a of the reboiler 130, the vent tube 13 is provided as decompression unit that lowers the pressure of the condensed water drum 5. By the vent tube 13, the pressure difference is generated between the reboiler 130 and the condensed water drum 5, and the condensed water 6 easily flows from the reboiler 130 on the high-pressure side to the condensed water drum 5 on the low-pressure side. This makes performance of the reboiler 130 and the liquid level of the condensed water drum 5 stable.

[0046] Since the performance of the reboiler 130 can be stabled, heat can be stably applied to the CO_2 absorbing liquid 113 circulating in the regeneration tower 107. This ensures separation of CO_2 in the CO_2 absorbing liquid.

[0047] By the control portion 10, the control valve 12 provided on the vent tube 13 is automatically opened and closed. This eliminates handle operation of the control valve 12 for regulating the pressure of the condensed water drum 5. Accordingly, the time or labor spent by an operator etc. for operating the valve can be lowered.

[Second Embodiment]

[0048] Next, a second embodiment according to the present invention will be explained with reference to Figs. 2 and 3.

[0049] In this embodiment, instead of the vent tube 13 which is the decompression unit of the condensed water drum 5 shown in the first embodiment, the condensed water drum 5 is decompressed by cooling unit that cools the condensed water 6 in the condensed water drum 5. Accordingly, the same components as those in the first embodiment are applied the same reference numerals, and their explanation is omitted.

[0050] As shown in Fig. 2, a drain circulation route 20 branched from a steam drain piping 9 that discharges the condensed water 6 from the condensed water drum 5 to return the condensed water 6 to the condensed water drum 5 is provided. This drain circulation route 20 is provided with a cooler 21 (cooling unit) that cools the condensed water 6. The condensed water 6 discharged from the condensed water drum 5 flows in the steam drain piping 9 by the pump 8. Since the drain circulation route 20 that returns the condensed water 6 to the condensed water drum 5 is branched from the steam drain piping 9, a part of the condensed water 6 is indirectly cooled by a cooling medium 22 (for example, rich solution) flowing in a plurality of heat exchanger tubes provided in the cooler 21 when it passes through the cooler 21 to be supplied to the condensed water drum 5.

[0051] The cooling medium 22 flowing in the cooler 21 is controlled by the control portion 10. The control portion 10 obtains the pressure difference between the measuring portion 10b that measures the inner pressure of the condensed water drum 5 and the measuring portion 10a that measures the steam pressure to be supplied to the reboiler 130 and controls the control valve 12a such that the obtained pressure difference is a desired value. The control portion 10 transmits a signal 11 to the control valve 12a provided on the drain circulation route 20. In the control valve 12a that received the signal 11, the degree of opening of the control valve 12a is determined based on the pressure difference, and the amount of condensed water 6 cooled by the cooler 21 to be returned to the condensed water drum 5 is controlled.

[0052] According to this embodiment, the condensed water 6 flows in the drain circulation route 20 branched from the steam drain piping 9 that discharges the condensed water 6 from the condensed water drum 5, passes through the cooler 21 to be cooled, and is returned to the condensed water drum 5. By returning the condensed water 6 cooled by the cooler 21 to the condensed water drum 5, saturation temperature and saturation pressure can be lowered. This lowers the pressure of the condensed water drum 5.

[0053] Fig. 3 shows a schematic configuration showing a modification of the steam supply system according to the second embodiment of the present invention. As shown in Fig. 3, the cooler 21 provided on the steam drain piping 9 that discharges the condensed water 6 from the condensed water drum 5 and the steam drain circulation route 20 branched from the downstream side of the cooler 21 to return the condensed water 6 to the condensed water drum 5 are provided.

[0054] According to the modification of this embodiment, the steam drain circulation route 20 branched from the downstream side of the cooler 21 to return the condensed water 6 to the condensed water drum 5 is provided. Because of this, providing the cooler to the branched circulation route 20 is unnecessary.

[Third Embodiment]

[0055] Next, a third embodiment of the present invention will be explained with reference to Fig. 4.

[0056] The present embodiment decompresses the condensed water drum 5 by cooling unit that cools the condensed water 6 in the condensed water drum 5, instead of the decompression unit of condensed water drum 5 shown in the first and second embodiments. Accordingly, the same components as in the first and second embodiments are applied the same reference numerals and their explanation is omitted.

[0057] As shown in Fig. 4, the cooler 21 (cooling unit) is provided on an exit piping 4 of the reboiler 130 that connects the reboiler 130 and the condensed water drum 5.

[0058] In this embodiment, since the cooler 21 is provided on the exit piping 4, pressure loss is generated in the flow of the exit piping 4.

[0059] Fluid in which the steam flowing in the heat exchanger tube 130a of the reboiler 130 and the condensed water 6 are mixed flows in the exit piping 4 to be cooled by the cooler 21 provided on the exit piping 4. The cooled fluid in which the steam and the condensed water 6 are mixed is supplied to the condensed water drum 5.

[0060] The cooling medium 22 (for example, rich solution) flowing in the plurality of heat exchanger tubes provided in the cooler 21 is controlled by the control portion 10. The control portion 10 obtains the pressure difference between the measuring portion 10b that measures the inner pressure of the condensed water drum 5 and the measuring portion 10a that measures the steam pressure to be supplied to the reboiler 130, and controls the control valve 12b such that the pressure difference obtained at the measuring portions 10a and 10b is a desired value.

[0061] According to this embodiment, the temperature of the condensed water 6 recovered by the condensed water drum 5 can be lowered. To the condensed water drum 5, mixed fluid of the steam cooled by the cooler 21 and the condensed water 6 is supplied. By cooling the condensed water drum 5, saturation temperature and saturation pressure can be lowered. Accordingly, the inner pressure of the condensed water drum 5 can be lowered.

[0062] Moreover, while the cooler 21 is provided on the exit piping 4 in this embodiment, not limited to this, it may be provided on the steam drain extraction piping 7. Further, a recycle line may be formed to circulate the condensed water 6 by providing another extraction port separated from the steam drain extraction piping 7 of the condensed water drum 5, and the cooler 21 may be placed on the recycle line.

{Reference Signs List}

[0063]

2	steam supply tube
4	exit piping
5	condensed water drum
6	condensed water
7	steam drain extraction piping
8	pump
9	steam drain piping
10	control portion
10a, b	measuring portion
11	signal
12, 12a, 12b	control valve
13	vent tube
14	heating medium
15	heater
20	circulation route
21	cooler
22	cooling medium
130	reboiler
130a	heat exchanger tube
L_4	circulation route

Claims

1. A steam supply system comprising:
a reboiler (130) that raises a temperature of absorbing liquid contacted with exhaust gas discharged from a boiler to absorb CO_2 in the exhaust gas and heated to eliminate CO_2, the reboiler(130) including:

   a heat exchanger tube (130a) to which steam for heating is supplied;
   a condensed water drum (5) that recovers condensed water of the steam introduced from the heat exchanger tube (130a) as steam drain; and
   a decompression unit which is provided with the condensed water drum (5) and which lowers pressure in the condensed water drum (5), wherein the decompression unit is a vent tube (13) that discharges gas phase in the condensed water drum (5), a control valve (12) adapted to control flow rate of the gas phase in the vent tube is provided in the vent tube,
   wherein the steam supply system further comprising
   a pressure measuring portion (10a;10b) adapted to obtain a pressure difference between an inner pressure of the condensed water drum and a steam pressure supplied to the reboiler; and
   a control unit (10) adapted to control the decompression unit so as to adjust the pressure difference obtained in the pressure measuring portion to a desired value when a pressure difference measured by the pressure measuring portion exceeds a predetermined value to be close to pressure equalization, and
   wherein the control unit (10) determines a degree of opening the control valve (12) based on the pressure difference.

2. A steam supply system comprising:

   a reboiler (130) that raises a temperature of absorbing liquid contacted with exhaust gas discharged from a boiler to absorb CO_2 in the exhaust gas and heated to eliminate CO_2,
   the reboiler(130) including:

      a heat exchanger tube (130a) to which steam for heating is supplied;
      a condensed water drum (5) that recovers condensed water of the steam introduced from the heat exchanger tube (130a) as steam drain; and
      a decompression unit which is provided with the condensed water drum (5) and which lowers pressure in the condensed water drum (5),
      wherein the decompression unit is a cooling unit that cools condensed water in the condensed water drum (5),
      wherein the cooling unit includes:

         a) a drain circulation route (20) branched from a steam drain piping (9) that discharges the steam drain from the condensed water drum (5), the drain circulation route (20) returning the steam drain to the condensed water drum (5); and
         a cooler (21) that cools the steam drain branched to the drain circulation route side, or
         b) a cooler (21) provided on a steam drain piping (9) that discharges the steam drain from the condensed water drum; and a drain circulation route (20) branched from the downstream side of the cooler (21), the steam drain circulation route (20) returning the steam drain to the condensed water drum (5),

      wherein the condensed water is returned to the condensed water drum (5) through the cooler (21),
      wherein a control valve (12a) is provided in the drain circulation route (20),
      wherein the steam supply system further comprising

         a pressure measuring portion (10a;10b) adapted to obtain a pressure difference between an inner pressure of the condensed water drum and a steam pressure supplied to the reboiler; and
         a control unit (10) adapted to control the decompression unit so as to adjust the pressure difference obtained in the pressure measuring portion to a desired value, and

      wherein the control unit (10) determines a degree of opening the control valve (12a) based on the pressure difference.

3. A steam supply system comprising:

   a reboiler (130) that raises a temperature of absorbing liquid contacted with exhaust gas discharged from a boiler to absorb CO_2 in the exhaust gas and heated to eliminate CO_2,
   the reboiler(130) including:

      a heat exchanger tube (130a) to which steam for heating is supplied;
      a condensed water drum (5) that recovers condensed water of the steam introduced

from the heat exchanger tube (130a) as steam drain; and
a decompression unit which is provided with the condensed water drum (5) and which lowers pressure in the condensed water drum (5),

wherein the cooling unit includes a cooler (21) provided on a reboiler exit piping that connects the reboiler (130) and the condensed water drum (5) a control valve (12b) which controls a cooling medium (22) flowing in a plurality of heat exchanger tubes provided in the cooler (21).
wherein the steam supply system further comprising

a pressure measuring portion (10a;10b) adapted to obtain a pressure difference between an inner pressure of the condensed water drum and a steam pressure supplied to the reboiler; and
a control unit (10) adapted to control the decompression unit so as to adjust the pressure difference obtained in the pressure measuring portion to a desired value, and

wherein the control unit (10) determines a degree of opening the control valve (12b) based on the pressure difference.

4. CO_2 recovery unit comprising:

an absorbing tower (104) that contacts CO_2 in exhaust gas with the absorbing liquid to absorb CO_2; and
a regeneration tower (107) that discharges CO_2 absorbed in the absorbing tower from the absorbing liquid,
wherein the regeneration tower (107) includes a reboiler (130) having the steam supply system according to any of Claims 1 to 3.

Patentansprüche

1. Dampfbereitstellungssystem, umfassend:
einen Verdampfer (130), der eine Temperatur der absorbierenden Flüssigkeit erhöht, die mit dem aus einem Dampfkessel abgeführten Abgas in Kontakt gebracht wird, um CO_2 in dem Abgas zu absorbieren, und die erhitzt wird, um CO_2 zu entfernen, wobei der Verdampfer (130) enthält:

ein Wärmetauscherrohr (130a), dem Dampf zum Erhitzen bereitgestellt wird; und
einen Kondenswasserbehälter (5), der das Kondenswasser des aus dem Wärmetauscherrohr (130a) eingebrachten Dampfs als Dampfabfluss rückgewinnt; und
eine Dekompressionseinheit, die mit dem Kondenswasserbehälter (5) versehen ist und die den Druck in dem Kondenswasserbehälter (5) verringert,
wobei die Dekompressionseinheit ein Entlüftungsrohr (13) ist, das die Gasphase in den Kondenswasserbehälter (5) abführt,
ein Steuerventil (12), das eingerichtet ist, um die Flussrate der Gasphase in dem Entlüftungsrohr zu steuern, ist in dem Entlüftungsrohr vorgesehen,
wobei das Dampfbereitstellungssystem ferner einen Druckmessabschnitt (10a; 10b) umfasst, der eingerichtet ist, um eine Druckdifferenz zwischen einem Innendruck des Kondenswasserbehälters und einem Dampfdruck, der dem Verdampfer bereitgestellt wird, zu erhalten; und
eine Steuereinheit (10), die eingerichtet ist, um die Dekompressionseinheit zu steuern, um die in dem Druckmessabschnitt erhaltene Druckdifferenz auf einen gewünschten Wert einzustellen, wenn eine von dem Druckmessabschnitt gemessene Druckdifferenz einen vorbestimmten Wert übersteigt, um nahe am Druckausgleich zu sein, und
wobei die Steuereinheit (10) einen Öffnungsgrad des Steuerventils (12) auf Basis der Druckdifferenz bestimmt.

2. Dampfbereitstellungssystem, umfassend:

einen Verdampfer (130), der eine Temperatur der absorbierenden Flüssigkeit erhöht, die mit dem aus einem Dampfkessel abgeführten Abgas in Kontakt gebracht wird, um CO_2 in dem Abgas zu absorbieren und erhitzt wird, um CO_2 zu entfernen,
wobei der Verdampfer (130) enthält:

ein Wärmetauscherrohr (130a), dem Dampf zum Erhitzen bereitgestellt wird;
einen Kondenswasserbehälter (5), der das Kondenswasser des aus dem Wärmetauscherrohr (130a) eingebrachten Dampfs als Dampfabfluss rückgewinnt; und
eine Dekompressionseinheit, die mit dem Kondenswasserbehälter (5) versehen ist und die den Druck in dem Kondenswasserbehälter (5) verringert,
wobei die Dekompressionseinheit eine Kühleinheit ist, die Kondenswasser in dem Kondenswasserbehälter (5) kühlt,
wobei die Kühleinheit enthält:

a) einen Abflussumlaufweg (20), der von einer Dampfabflussleitung (9) abzweigt, die den Dampfabfluss aus dem

Kondenswasserbehälter (5) abführt, wobei der Abflussumlaufweg (20) den Dampfabfluss in den Kondenswasserbehälter (5) zurückführt; und einen Kühler (21), der den zur Seite des Abflussumlaufwegs verzweigten Dampfabfluss kühlt, oder
b) einen Kühler (21), der auf einer Dampfabflussleitung (9) vorgesehen ist, die den Dampfabfluss aus dem Kondenswasserbehälter abführt; und einen Abflussumlaufweg (20), der von der stromabwärtigen Seite des Kühlers (21) verzweigt ist, wobei der Dampfabflussumlaufweg (20) den Dampfabfluss in den Kondenswasserbehälter (5) zurückführt,

wobei das Kondenswasser durch den Kühler (21) zu dem Kondenswasserbehälter (5) zurückgeführt wird,
wobei ein Steuerventil (12a) in dem Abflussumlaufweg (20) vorgesehen ist,
wobei das Dampfbereitstellungssystem ferner einen Druckmessabschnitt (10a; 10b) umfasst, der eingerichtet ist, um eine Druckdifferenz zwischen einem Innendruck des Kondenswasserbehälters und einem Dampfdruck, der dem Verdampfer bereitgestellt wird, zu erhalten; und
eine Steuereinheit (10), die eingerichtet ist, um die Dekompressionseinheit zu steuern, um die in dem Druckmessabschnitt erhaltene Druckdifferenz auf einen gewünschten Wert einzustellen, und
wobei die Steuereinheit (10) einen Öffnungsgrad des Steuerventils (12a) auf Basis der Druckdifferenz bestimmt.

3. Dampfbereitstellungssystem, umfassend:

einen Verdampfer (130), der eine Temperatur der absorbierenden Flüssigkeit erhöht, die mit dem aus einem Dampfkessel abgeführten Abgas in Kontakt gebracht wird, um CO_2 in dem Abgas zu absorbieren und erhitzt wird, um CO_2 zu entfernen,
wobei der Verdampfer (130) enthält:

ein Wärmetauscherrohr (130a), dem Dampf zum Erhitzten bereitgestellt wird;
einen Kondenswasserbehälter (5), der das Kondenswasser des aus dem Wärmetauscherrohr (130a) eingebrachten Dampfs als Dampfabfluss rückgewinnt; und
eine Dekompressionseinheit, die mit dem Kondenswasserbehälter (5) versehen ist und die den Druck in dem Kondenswasserbehälter (5) verringert,
wobei die Kühleinheit einen Kühler (21) enthält, der auf einer Verdampferauslassleitung vorgesehen ist, die den Verdampfer (130) und den Kondenswasserbehälter (5) mit einem Steuerventil (12b) verbindet, das ein Kühlmedium (22) steuert, das in mehreren Wärmetauscherohren fließt, die in dem Kühler (21) vorgesehen sind,
wobei das Dampfbereitstellungssystem ferner umfasst einen Druckmessabschnitt (10a; 10b), der eingerichtet ist, um eine Druckdifferenz zwischen einem Innendruck des Kondenswasserbehälters und einem Dampfdruck, der dem Verdampfer bereitgestellt wird, zu erhalten; und
eine Steuereinheit (10), die eingerichtet ist, um die Dekompressionseinheit zu steuern, um die in dem Druckmessabschnitt erhaltene Druckdifferenz auf einen gewünschten Wert einzustellen, und
wobei die Steuereinheit (10) einen Öffnungsgrad des Steuerventils (12b) auf Basis der Druckdifferenz bestimmt.

4. CO_2-Rückgewinnungseinheit, umfassend:

einen Absorptionsturm (104), der CO_2 in Abgas mit der absorbierenden Flüssigkeit in Kontakt bringt, um CO_2 zu absorbieren; und
einen Regenerationsturm (107), der CO_2 abführt, das in dem Absorptionsturm aus der absorbierenden Flüssigkeit absorbiert wird,
wobei der Regenerationsturm (107) einen Verdampfer (130) enthält, der das Dampfbereitstellungssystem nach einem der Ansprüche 1 bis 3 aufweist.

Revendications

1. Système d'alimentation en vapeur comprenant :
un rebouilleur (130) qui augmente une température d'un liquide d'absorption qui est mis en contact avec des gaz d'échappement qui sont déchargés depuis un bouilleur de manière à ce qu'il absorbe le CO_2 dans les gaz d'échappement et qu'il soit chauffé de manière à ce qu'il élimine le CO_2, le rebouilleur (130) incluant :

un tube d'échangeur thermique (130a) sur lequel de la vapeur pour le chauffage est alimentée ;
un tambour d'eau condensée (5) qui récupère l'eau condensée de la vapeur qui est introduite depuis le tube d'échangeur thermique (130a) en tant que drainage de vapeur ; et
une unité de décompression qui est munie du

tambour d'eau condensée (5) et qui abaisse la pression à l'intérieur du tambour d'eau condensée (5) ; dans lequel l'unité de décompression est un tube d'évent (13) qui décharge une phase gazeuse dans le tambour d'eau condensée (5) ; une vanne de commande (12) qui est adaptée de manière à ce qu'elle commande le débit d'écoulement de la phase gazeuse dans le tube d'évent est prévue à l'intérieur du tube d'évent ; dans lequel :
le système d'alimentation en vapeur comprend en outre :

une section de mesure de pression (10a ; 10b) qui est adaptée de manière à ce qu'elle obtienne une différence de pression entre une pression interne du tambour d'eau condensée et une pression de vapeur qui est alimentée sur le rebouilleur ; et
une unité de commande (10) qui est adaptée de manière à ce qu'elle commande l'unité de décompression de manière à ce qu'elle règle la différence de pression qui est obtenue dans la section de mesure de pression à une valeur souhaitée lorsqu'une différence de pression qui est mesurée par la section de mesure de pression excède une valeur prédéterminée de telle sorte qu'elle soit proche d'une égalisation de pression ; et dans lequel :
l'unité de commande (10) détermine un degré d'ouverture de la vanne de commande (12) sur la base de la différence de pression.

2. Système d'alimentation en vapeur comprenant :
un rebouilleur (130) qui augmente une température d'un liquide d'absorption qui est mis en contact avec des gaz d'échappement qui sont déchargés depuis un bouilleur de manière à ce qu'il absorbe le CO_2 dans les gaz d'échappement et qu'il soit chauffé de manière à ce qu'il élimine le CO_2, le rebouilleur (130) incluant :

un tube d'échangeur thermique (130a) sur lequel de la vapeur pour le chauffage est alimentée ;
un tambour d'eau condensée (5) qui récupère l'eau condensée de la vapeur qui est introduite depuis le tube d'échangeur thermique (130a) en tant que drainage de vapeur ; et
une unité de décompression qui est munie du tambour d'eau condensée (5) et qui abaisse la pression à l'intérieur du tambour d'eau condensée (5) ; dans lequel l'unité de décompression est une unité de refroidissement qui refroidit l'eau condensée dans le tambour d'eau condensée (5) ; dans lequel :
l'unité de refroidissement inclut :

a) une voie de circulation de drainage (20) qui est dérivée à partir d'un tubage de drainage de vapeur (9) qui décharge le drainage de vapeur en provenance du tambour d'eau condensée (5), la voie de circulation de drainage (20) retournant le drainage de vapeur sur le tambour d'eau condensée (5); et
un moyen de refroidissement (21) qui refroidit le drainage de vapeur qui est dérivé sur le côté de la voie de circulation de drainage ; ou
b) un moyen de refroidissement (21) qui est prévu sur un tubage de drainage de vapeur (9) qui décharge le drainage de vapeur en provenance du tambour d'eau condensée ; et

une voie de circulation de drainage (20) qui est dérivée à partir du côté aval du moyen de refroidissement (21), la voie de circulation de drainage de vapeur (20) retournant le drainage de vapeur sur le tambour d'eau condensée (5) ; dans lequel l'eau condensée est retournée sur le tambour d'eau condensée (5) par l'intermédiaire et au travers du moyen de refroidissement (21) ; dans lequel :
une vanne de commande (12a) est prévue dans la voie de circulation de drainage (20) ; dans lequel :
le système d'alimentation en vapeur comprend en outre :

une section de mesure de pression (10a ; 10b) qui est adaptée de manière à ce qu'elle obtienne une différence de pression entre une pression interne du tambour d'eau condensée et une pression de vapeur qui est alimentée sur le rebouilleur ; et
une unité de commande (10) qui est adaptée de manière à ce qu'elle commande l'unité de décompression de manière à ce qu'elle règle la différence de pression qui est obtenue dans la section de mesure de pression à une valeur souhaitée ; et dans lequel :
l'unité de commande (10) détermine un degré d'ouverture de la vanne de commande (12a) sur la base de la différence de pression.

3. Système d'alimentation en vapeur comprenant :
un rebouilleur (130) qui augmente une température d'un liquide d'absorption qui est mis en contact avec des gaz d'échappement qui sont déchargés depuis un bouilleur de manière à ce qu'il absorbe le CO_2 dans les gaz d'échappement et qu'il soit chauffé de manière à ce qu'il élimine le CO_2, le rebouilleur (130) incluant :

un tube d'échangeur thermique (130a) sur lequel de la vapeur pour le chauffage est alimentée ;

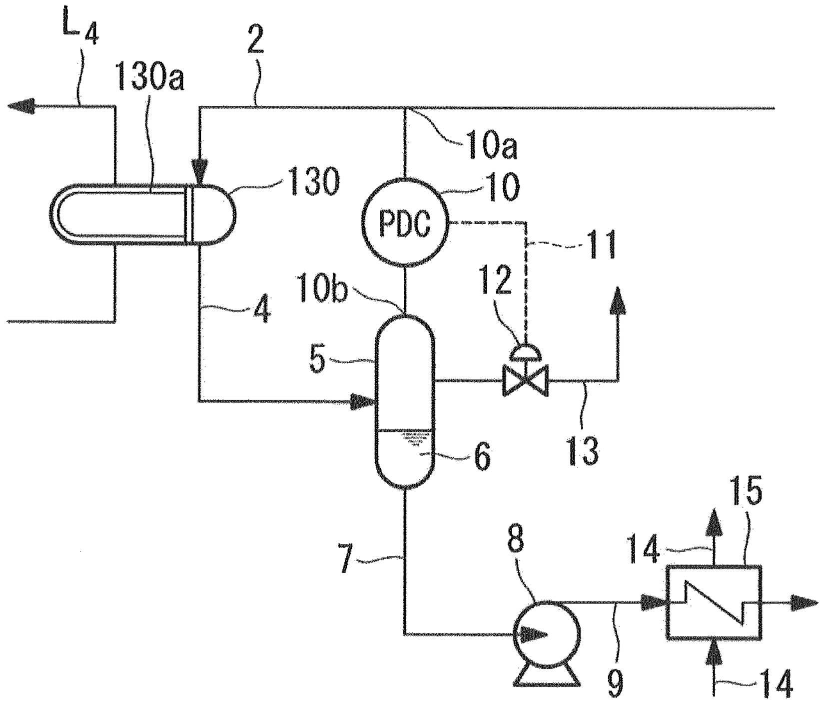
un tambour d'eau condensée (5) qui récupère l'eau condensée de la vapeur qui est introduite depuis le tube d'échangeur thermique (130a) en tant que drainage de vapeur ; et
une unité de décompression qui est munie du tambour d'eau condensée (5) et qui abaisse la pression à l'intérieur du tambour d'eau condensée (5) ; dans lequel l'unité de refroidissement inclut un moyen de refroidissement (21) qui est prévu sur un tubage de sortie de rebouilleur qui connecte le rebouilleur (130) et le tambour d'eau condensée (5), une vanne de commande (12b) qui commande un milieu de refroidissement (22) qui s'écoule à l'intérieur d'une pluralité de tubes d'échangeur thermique qui sont prévus dans le moyen de refroidissement (21) ; dans lequel :
le système d'alimentation en vapeur comprend en outre :

une section de mesure de pression (10a ; 10b) qui est adaptée de manière à ce qu'elle obtienne une différence de pression entre une pression interne du tambour d'eau condensée et une pression de vapeur qui est alimentée sur le rebouilleur ; et
une unité de commande (10) qui est adaptée de manière à ce qu'elle commande l'unité de décompression de manière à ce qu'elle règle la différence de pression qui est obtenue dans la section de mesure de pression à une valeur souhaitée; et dans lequel :
l'unité de commande (10) détermine un degré d'ouverture de la vanne de commande (12b) sur la base de la différence de pression.

4. Unité de récupération de CO_2 comprenant :

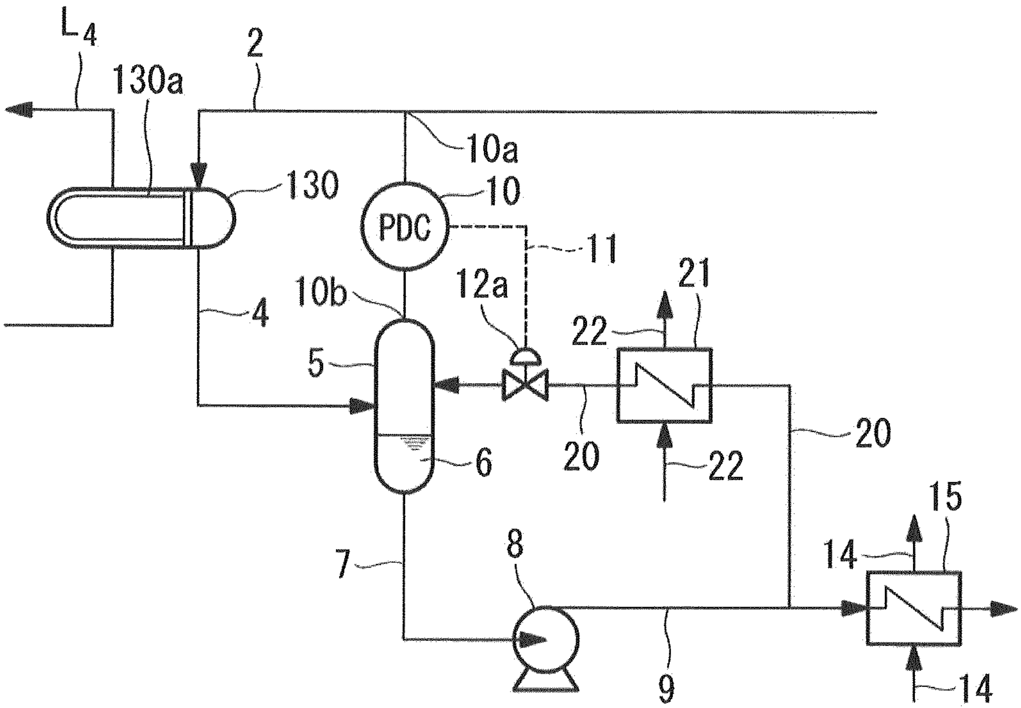
une tour d'absorption (104) qui met en contact le CO_2 dans des gaz d'échappement avec le liquide d'absorption de manière à ce qu'il absorbe le CO_2; et
une tour de régénération (107) qui décharge le CO_2 qui est absorbé à l'intérieur de la tour d'absorption hors du liquide d'absorption, dans laquelle :
la tour de régénération (107) inclut un rebouilleur (130) qui comporte le système d'alimentation en vapeur selon l'une quelconque des revendications 1 à 3.

FIG. 1



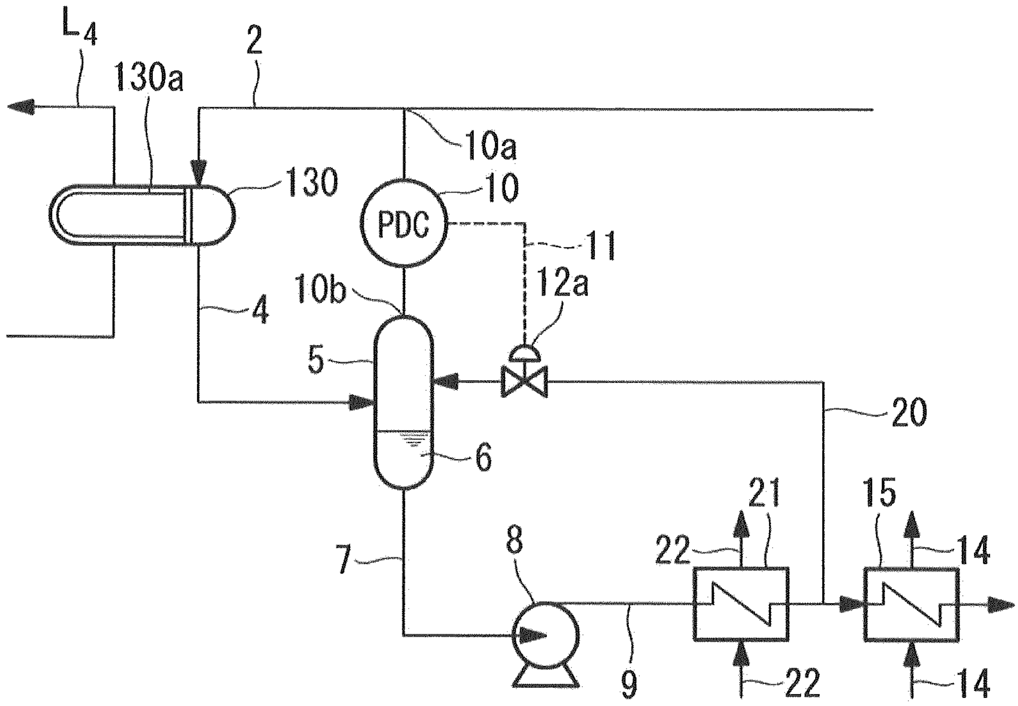
L_4
130a
2
10a
130
10
PDC
11
12
10b
4
5
6
13
15
8
14
7
9
14

FIG. 2



L_4
130a
2
10a
130
10
PDC
11
21
12a
10b
22
4
5
20
20
6
22
15
8
14
7
9
14

FIG. 3


L4
130a
2
10a
130
10
PDC
11
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10b
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20
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15
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7
8
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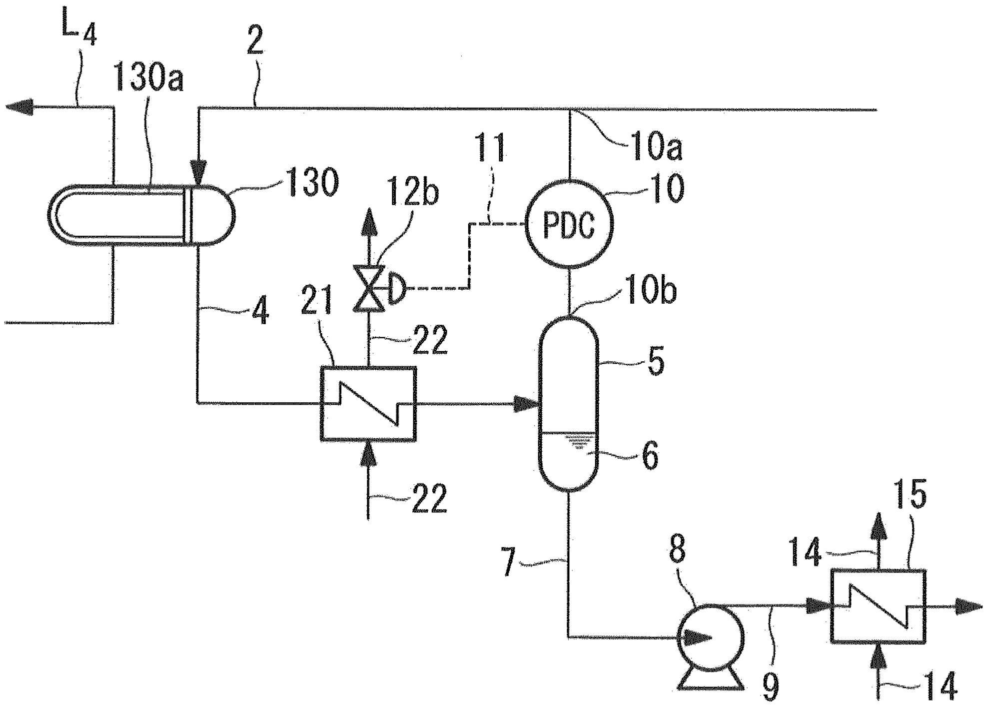
22
14

FIG. 4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2
10a
11
130
12b
10
PDC
10b
4
21
22
5
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7
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14
9
14

FIG. 5

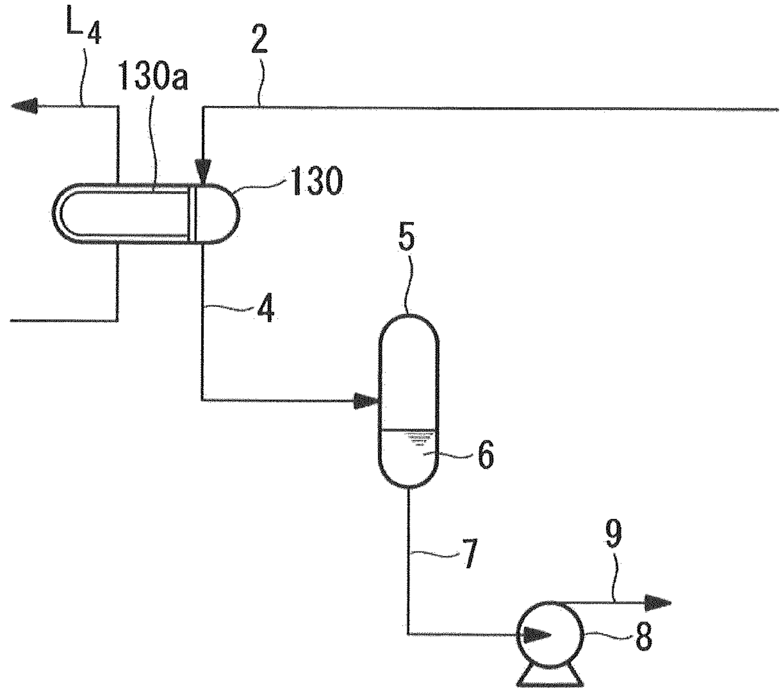
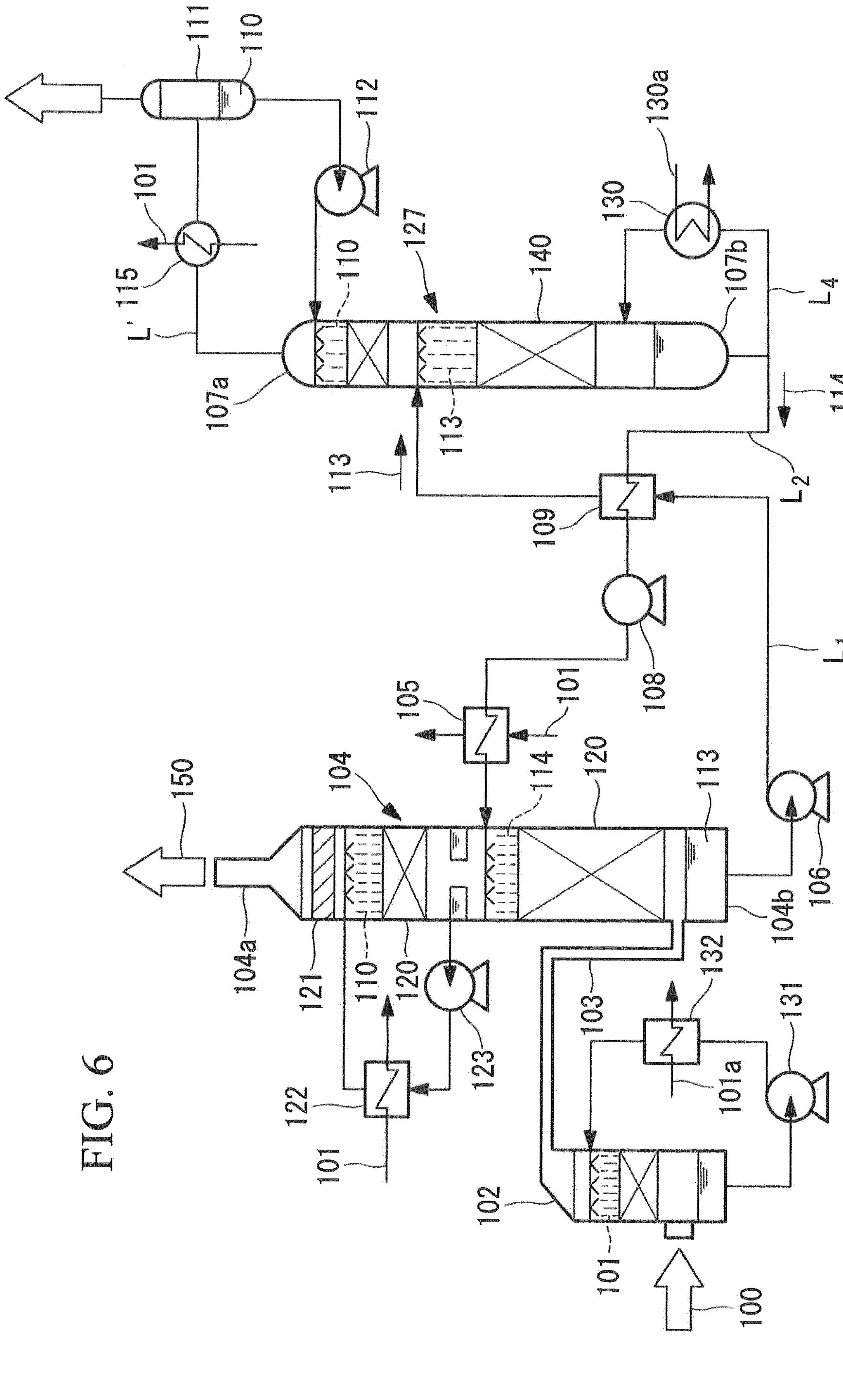


FIG. 6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104b
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107a
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120
121
122
123
127
130
130a
131
132
140
150
101a
L'
L_1
L_2
L_4

REFERENCES CITED IN THE DESCRIPTION

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