US 20140060459A1

(19) United States
(12) Patent Application Publication
Honjo et al.
(10) Pub. No.: US 2014/0060459 A1
(43) Pub. Date: Mar. 6, 2014

(54) **HEAT RECOVERY SYSTEM AND HEAT RECOVERY METHOD**

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(21) Appl. No.: **13/605,199**

(22) Filed: **Sep. 6, 2012**

Publication Classification

(51) **Int. Cl.**
F22B 33/00 (2006.01)

(52) **U.S. Cl.**
USPC .... **122/1 R**

(57) **ABSTRACT**

A heat recovery system includes a preheater (**4**) in which heat exchange is performed between condensed water generated in a condenser (**3**) and CO2 in a CO2 recovery apparatus, a gas heater (**5**) in which heat exchange is performed between the condensed water heated in the preheater (**4**) and exhaust gas discharged from a boiler (**7**) and the boiler (**7**) to which the condensed water heated in the gas heater (**5**) is supplied as boiler supply water. With this configuration, an amount of steam extracted from a low-pressure steam turbine (**2**) is reduced.

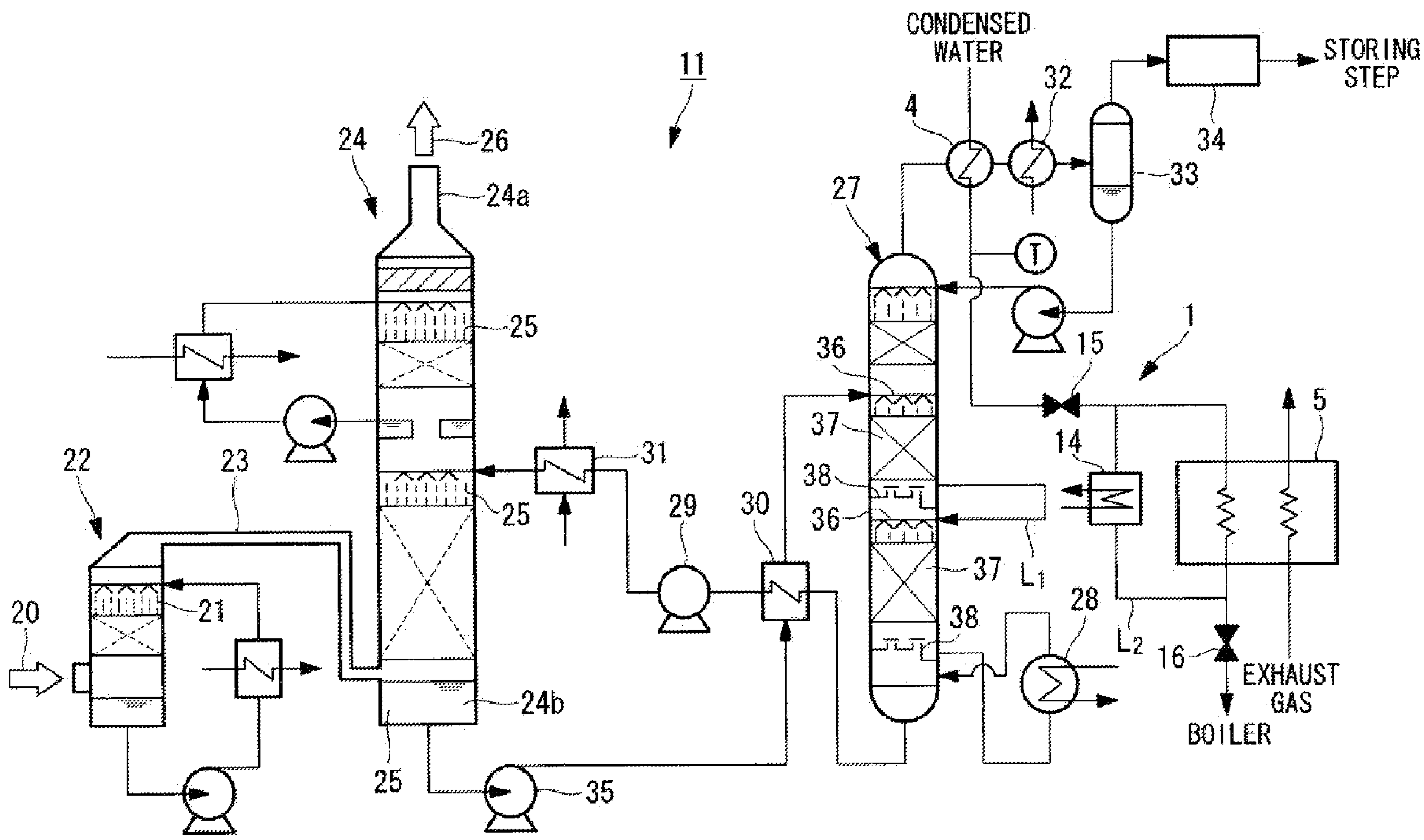


FIG. 1

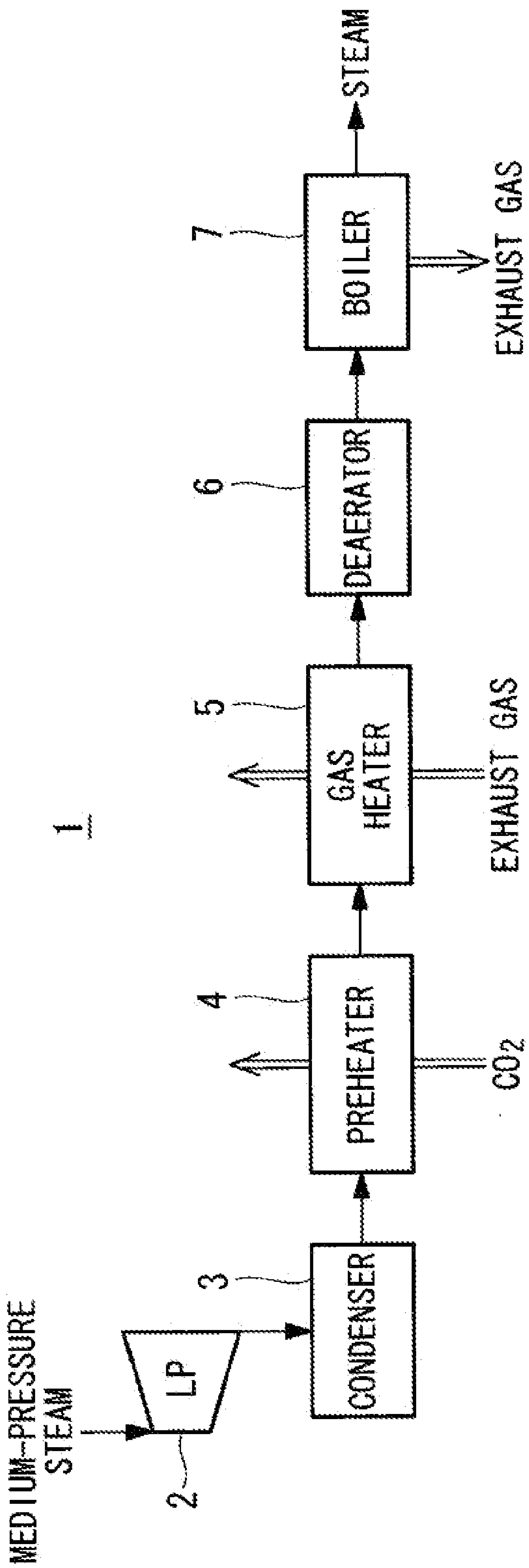
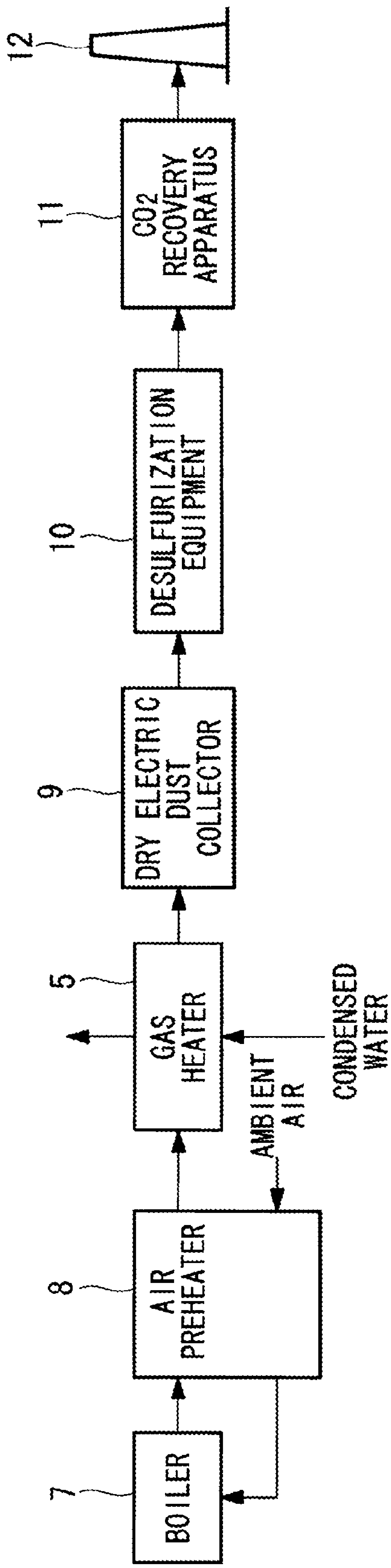
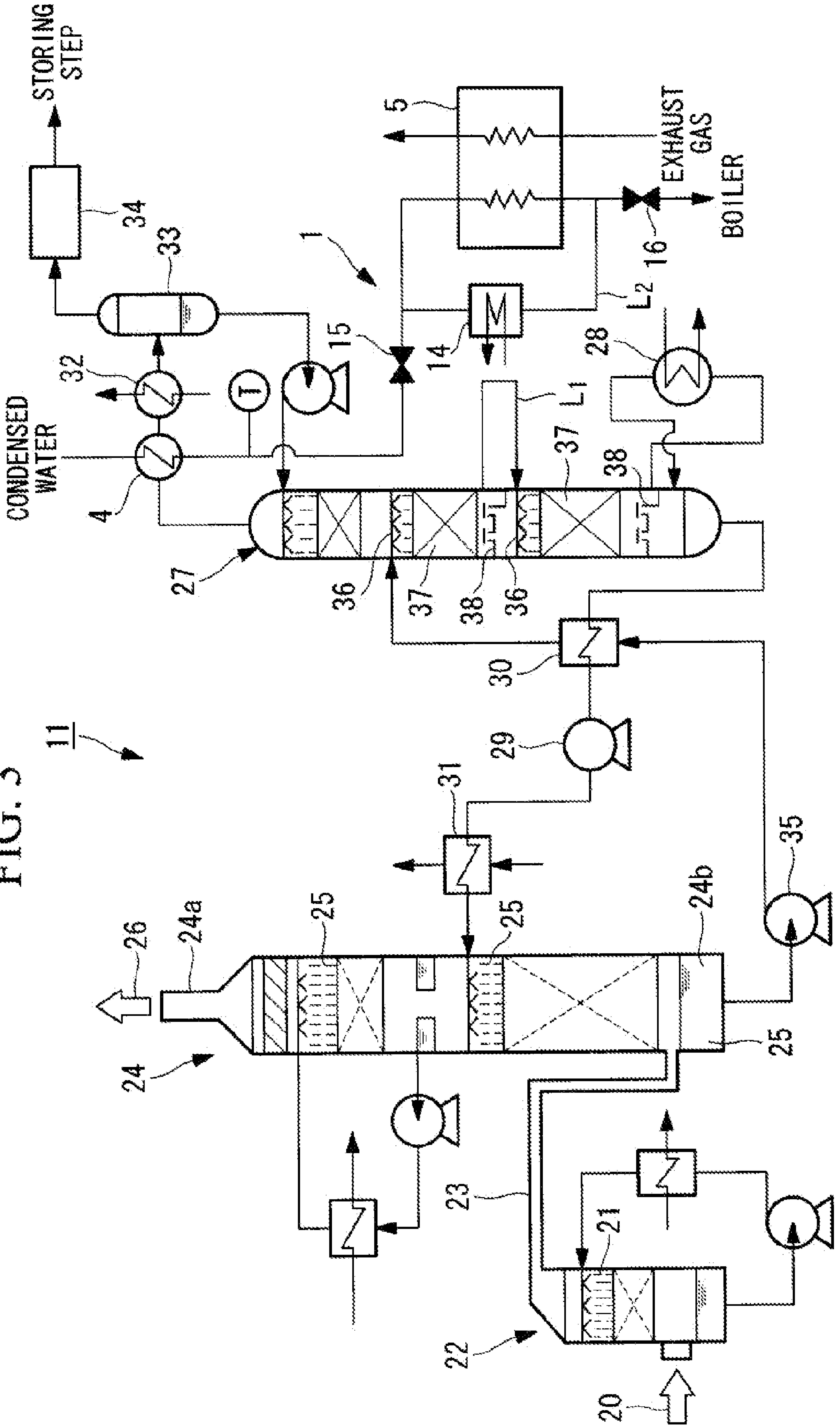

1
MEDIUM-PRESSURE STEAM
LP
2
CONDENSER
3
PREHEATER
4
CO2
GAS HEATER
5
EXHAUST GAS
DEAERATOR
6
BOILER
7
EXHAUST GAS
STEAM

FIG. 2



12
11
CO2 RECOVERY APPARATUS
10
DESULFURIZATION EQUIPMENT
9
DRY ELECTRIC DUST COLLECTOR
5
GAS HEATER
CONDENSED WATER
AMBIENT AIR
8
AIR PREHEATER
7
BOILER

FIG. 3


STORING STEP
EXHAUST GAS
BOILER
CONDENSED WATER
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1
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11
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21
22
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24
24a
24b
25
26
27
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31
32
33
34
35
36
37
38
L_1
L_2

FIG. 4

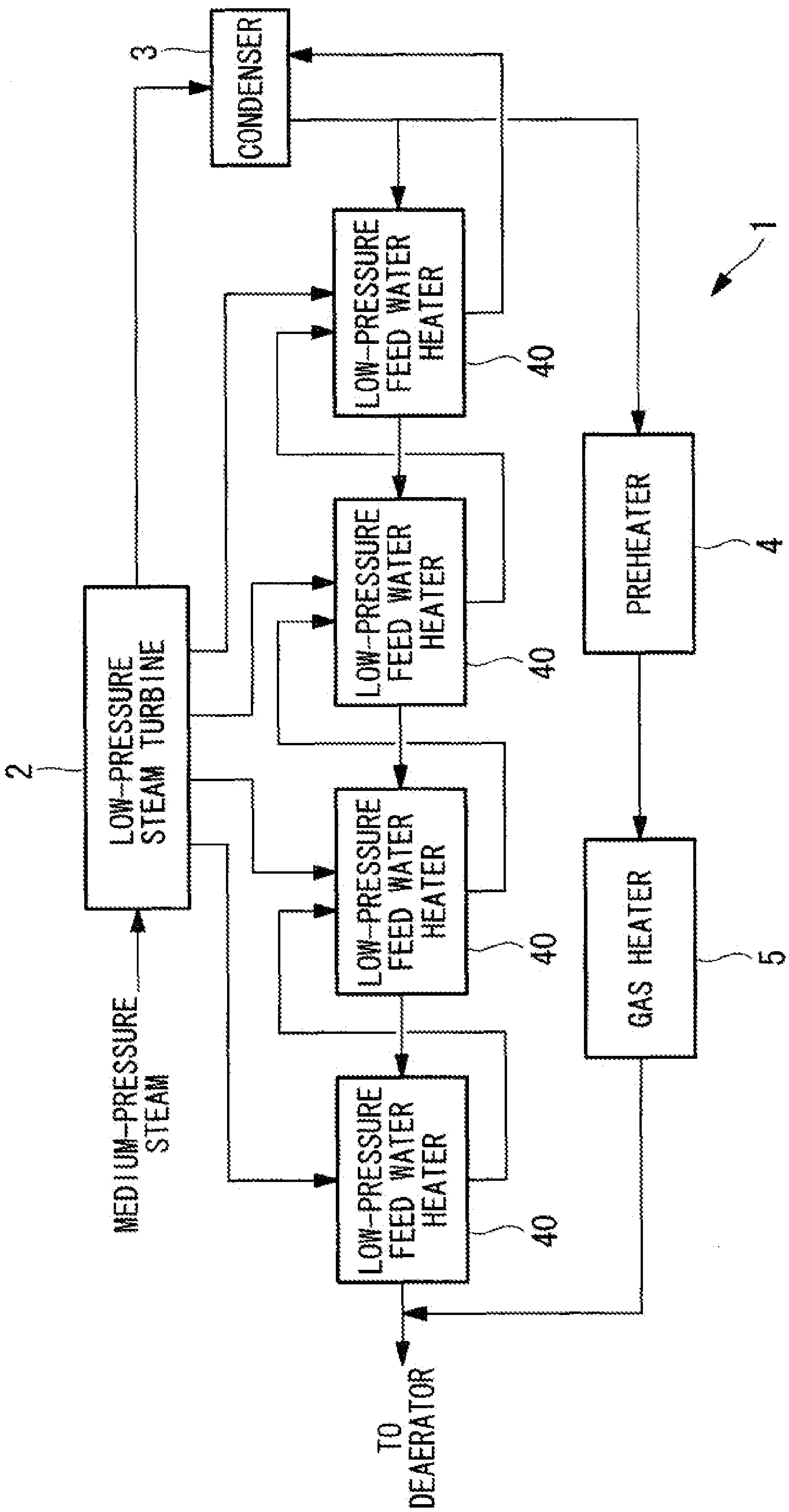
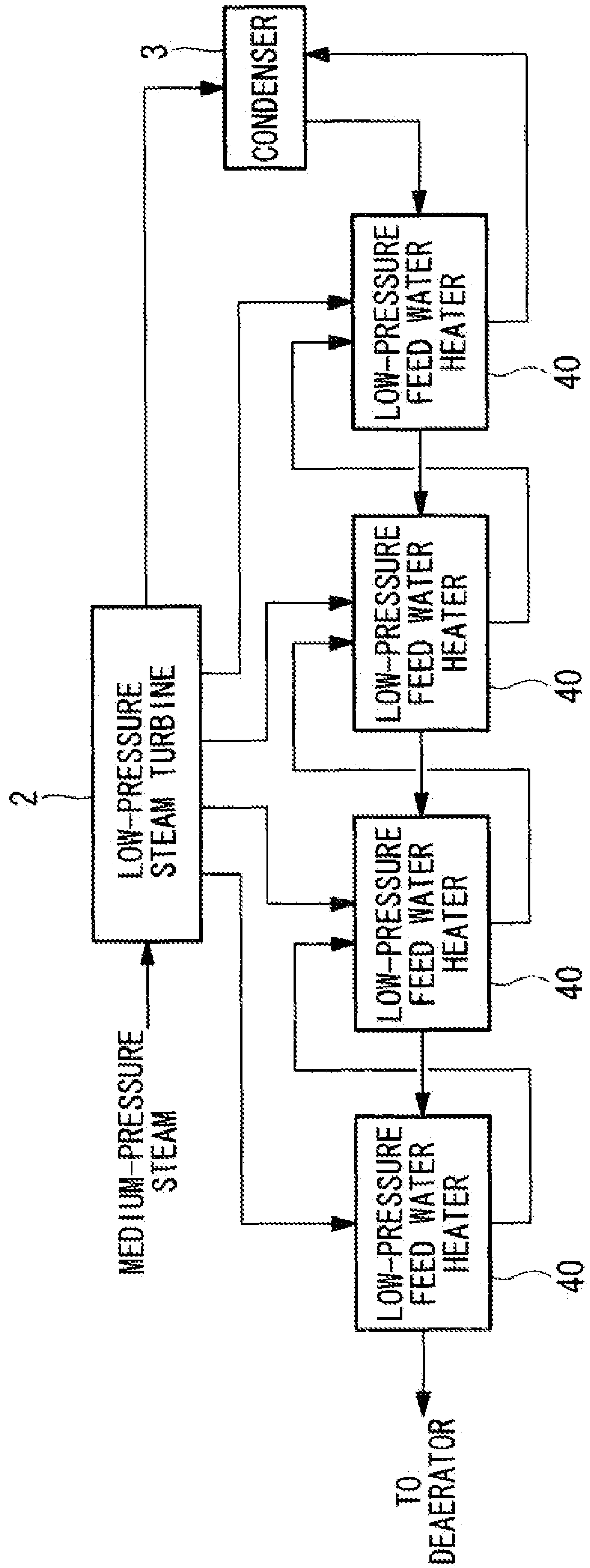

CONDENSER
3
LOW-PRESSURE STEAM TURBINE
2
MEDIUM-PRESSURE STEAM
LOW-PRESSURE FEED WATER HEATER
40
LOW-PRESSURE FEED WATER HEATER
40
LOW-PRESSURE FEED WATER HEATER
40
LOW-PRESSURE FEED WATER HEATER
40
PREHEATER
4
GAS HEATER
5
TO DEAERATOR
1

FIG. 5


CONDENSER
3
LOW-PRESSURE FEED WATER HEATER
40
LOW-PRESSURE FEED WATER HEATER
40
LOW-PRESSURE FEED WATER HEATER
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LOW-PRESSURE FEED WATER HEATER
40
LOW-PRESSURE STEAM TURBINE
2
MEDIUM-PRESSURE STEAM
TO DEAERATOR

HEAT RECOVERY SYSTEM AND HEAT RECOVERY METHOD

TECHNICAL FIELD

[0001] The present invention relates to a heat recovery system and a heat recovery method.

BACKGROUND ART

[0002] A CO_2 recovery apparatus recovers carbon dioxide (CO_2) which is generated when fossil fuel is burned in a thermal power plant etc. The CO_2 recovery apparatus contacts water solution of amine compound (hereinafter, referred to as "absorbing liquid") with combustion exhaust gas discharged from a boiler and eliminates CO_2 included in the combustion exhaust gas to store it without discharging to ambient air.

[0003] The CO_2 recovery apparatus includes an absorbing tower that contacts the combustion exhaust gas with the absorbing liquid and a regeneration tower that heats the absorbing liquid which absorbs CO_2 to discharge CO_2 while regenerating the absorbing liquid. The regenerated absorbing liquid is delivered to the absorbing tower and reused.

[0004] Consequently, the CO_2 recovery apparatus is placed in parallel with an electric power generation plant that generates CO_2, and it is desirable to establish a highly-efficient plant as a whole by integration of the CO_2 recovery apparatus and the electric power generation plant.

[0005] Patent Literatures 1 and 2 disclose the technology that uses waste heat of a CO_2 recovery apparatus to heat boiler supply water to be supplied to a boiler. Moreover, Patent Literature 3 discloses the technology that uses waste heat of exhaust gas discharged from a boiler to heat boiler supply water to be supplied to a boiler.

CITATION LIST

Patent Literature

[0006] {PTL 1} Japanese Unexamined Patent Application, Publication No. 2012-37180

[0007] {PTL 2} Japanese Unexamined Patent Application, Publication No. 2006-213580

[0008] {PTL 3} Japanese Unexamined Patent Application, Publication No. 2006-308269

SUMMARY OF INVENTION

Technical Problem

[0009] The CO_2 recovery apparatus has to be heated using low-pressure steam when CO_2 is discharged from the absorbing liquid which absorbs CO_2. Accordingly, an output of a low-pressure steam turbine is lowered and power generation efficiency is lowered. Consequently, it is desirable to an amount of steam extracted from the low-pressure steam turbine is reduced as much as possible to suppress output lowering of the low-pressure steam turbine.

[0010] The present invention is made under such circumstances, and an object of the present invention is to provide a heat recovery system that can reduce an amount of steam extracted from a low-pressure steam turbine and a heat recovery method.

Solution to Problem

[0011] A heat recovery system according to the present invention includes: a CO_2 recovery apparatus which includes an absorbing tower that absorbs CO_2 in exhaust gas into absorbing liquid and a regeneration tower that discharges CO_2 from the absorbing liquid that absorbed CO_2 in the absorbing tower to reuse the absorbing liquid that discharged CO_2 in the regeneration tower in the absorbing tower; a steam turbine; a condenser which condenses steam discharged from the steam turbine; a first heat exchange portion in which heat exchange is performed between condensed water generated in the condenser and CO_2 recovered in the regeneration tower of the CO_2 recovery apparatus or semi-lean solution in the CO_2 recovery apparatus; a second heat exchange portion in which heat exchange is performed between the condensed water heated in the first heat exchange portion and exhaust gas discharged from a boiler; and the boiler to which the condensed water heated in the second heat exchange portion is supplied as boiler supply water.

[0012] According to this configuration, the condensed water generated in the condenser is subjected to heat exchange with CO_2 recovered in the regeneration tower of the CO_2 recovery apparatus or semi-lean solution in the CO_2 recovery apparatus in the first heat exchange portion, and subjected to heat exchange with exhaust gas discharged from the boiler in the second heat exchange portion. Consequently, waste heat of the CO_2 recovery apparatus and waste heat of a boiler exhaust system can be recovered.

[0013] In the above invention, an entire amount of condensed water generated in the condenser is used as the condensed water subjected to heat exchange in the first heat exchange portion and the second heat exchange portion.

[0014] According to this configuration, the entire amount of the condensed water generated in the condenser is subjected to heat exchange in the first heat exchange portion and the second heat exchange portion and supplied to the boiler as boiler supply water. At this time, a water supply heater that heats the condensed water and supplies it to the boiler is omitted. As a result, steam extraction from the steam turbine for the water supply heater can be eliminated, and an amount of consumption of steam is reduced, which improves turbine efficiency.

[0015] In the above invention, a water supply heater which heats the condensed water generated in the condenser by steam extracted from the steam turbine and supplies the heated condensed water to the boiler may not be included.

[0016] According to this configuration, the water supply heater that heats the condensed water and supplies it to the boiler is omitted, and the condensed water generated in the condenser is not heated by the water supply heater but subjected to heat exchange in the first heat exchange portion and the second heat exchange portion, and supplied to the boiler as boiler supply water. As a result, steam extraction from the steam turbine by the water supply heater is eliminated, and an amount of consumption of steam is reduced, which improves turbine efficiency.

[0017] In the above invention, a third heat exchange portion which heats the condensed water heated in the second heat exchange portion and returns the heated condensed water to the second heat exchange portion, and a control portion which switches between the boiler and the third heat exchange portion as a supply destination of the condensed water heated in the second heat exchange portion may be further included.

[0018] According to this configuration, by switching the supply destination, the condensed water heated in the second heat exchange portion is heated in the third heat exchange portion and again heated in the second heat exchange portion. For example, when the temperature of the condensed water supplied from the condenser is low or an amount of heat capable of heat exchange in the first heat exchange portion is small at the time of activation of the CO_2 recovery apparatus, by forming a circulation route between the second heat exchange portion and the third heat exchange portion, temperature lowering of the second heat exchange portion can be prevented.

[0019] In a heat recovery method according to the present invention which uses a CO_2 recovery apparatus including an absorbing tower that absorbs CO_2 in exhaust gas into absorbing liquid and a regeneration tower that discharges CO_2 from the absorbing liquid that absorbs CO_2 in the absorbing tower and reuses the absorbing liquid that discharged CO_2 in the regeneration tower in the absorbing tower, the method including: a first step of condensing steam discharged from a steam turbine; a second step of performing heat exchange between generated condensed water and CO_2 recovered in the regeneration tower of the CO_2 recovery apparatus or semi-lean solution in the CO_2 recovery apparatus in a first heat exchange portion; a third step of performing heat exchange between the condensed water heated in the first heat exchange portion and exhaust gas discharged from a boiler in a second heat exchange portion; and a fourth step of supplying the condensed water heated in the second heat exchange portion to the boiler as boiler supply water.

[0020] In the above invention, a fifth step of heating the condensed water heated in the second heat exchange portion in a third heat exchange portion which is different from the boiler and heating the condensed water heated in the third heat exchange portion in the second heat exchange portion may be further included.

Advantageous Effects of Invention

[0021] According to the present invention, when boiler supply water is heated, waste heat recovered from the CO_2 recovery apparatus and waste heat recovered from the boiler exhaust system are used, so that an amount of steam extracted from the low-pressure steam turbine can be reduced.

BRIEF DESCRIPTION OF DRAWINGS

[0022] FIG. **1** is a schematic view showing a boiler water supply system according to one embodiment of the present invention.

[0023] FIG. **2** is a schematic view showing a boiler exhaust system according to one embodiment of the present invention.

[0024] FIG. **3** is a schematic view showing a CO_2 recovery apparatus according to one embodiment of the present invention.

[0025] FIG. **4** is a schematic view showing a modification of the boiler water supply system according to one embodiment of the present invention.

[0026] FIG. **5** is a schematic view showing the conventional boiler water supply system.

DESCRIPTION OF EMBODIMENTS

[0027] Hereinafter, a boiler water supply system **1** according to one embodiment of the present invention will be explained with reference to FIG. **1**.

[0028] As shown in FIG. **1**, a boiler water supply system **1** is constituted by a condenser **3**, a preheater **4**, a gas heater **5** and the like. The boiler water supply system **1** condenses steam discharged from a low-pressure steam turbine **2** in the condenser **3**, and condensed water condensed and generated by the condenser **3** is heated to be supplied to a boiler **7**. The boiler water supply system is an example of a heat recovery system, which recovers waste heat of a CO_2 recovery apparatus **11** and waste heat of exhaust gas etc. when condensed water is heated.

[0029] The low-pressure steam turbine **2** is driven to rotate when medium-pressure steam is supplied from a medium pressure turbine (not shown) for example. The low-pressure steam turbine **2** is connected to a generator (not shown) via a rotation shaft, and a rotary drive force is used for power generation in the generator. The low-pressure steam turbine **2** discharges the generated low-pressure steam to the condenser **3**.

[0030] The condenser **3** condenses low-pressure steam supplied from the low-pressure steam turbine **2**. The generated condensed water due to condensation of low-pressure steam in the condenser **3** is supplied to the preheater **4**. The temperature of the condensed water supplied from the condenser **3** to the preheater **4** is, for example, about 38° C.

[0031] To the preheater **4**, the condensed water generated in the condenser **3** is supplied from the condenser **3**. Moreover, to the preheater **4**, CO_2 recovered in a regeneration tower **27** of the CO_2 recovery apparatus **11** shown in FIG. **3** or semi-lean solution in the CO_2 recovery apparatus **11** is supplied. In the preheater **4**, heat exchange is performed between the condensed water generated in the condenser **3** and CO_2 recovered in the regeneration tower **27** of the CO_2 recovery apparatus **11** or the semi-lean solution in the CO_2 recovery apparatus **11**. The condensed water is heated by passing through the preheater **4**, and the heated condensed water is supplied to the gas heater **5**. By doing this, the preheater **4** can recover waste heat of the CO_2 recovery apparatus **11**. The temperature of the condensed water supplied from the preheater **4** to the gas heater **5** is, for example, about 75° C.

[0032] To the gas heater **5**, condensed water heated by the preheater **4** is supplied from the preheater **4**. Moreover, to the gas heater **5**, exhaust gas discharged from the boiler **7** is supplied. In the gas heater **5**, heat exchange is performed between the condensed water heated in the preheater **4** and the exhaust gas discharged from the boiler **7**. The condensed water is heated by passing through the gas heater **5**, and the heated condensed water is supplied to a deaerator **6** connected to the boiler **7**. By doing this, the gas heater **5** can recover waste heat of a boiler exhaust system. The temperature of the condensed water supplied from the gas heater **5** to the deaerator **6** is, for example, about 137° C.

[0033] Moreover, the condensed water generated in the condenser **3** is heated by the preheater **4** and the gas heater **5**, deaerated in the deaerator **6**, and introduced into the boiler **7** as boiler supply water.

[0034] As described above, according to the boiler water supply system **1** according to this embodiment, condensed water generated in the condenser **3** is subjected to heat exchange with CO_2 recovered in the regeneration tower **27** of the CO_2 recovery apparatus **11** or semi-lean solution in the

CO_2 recovery apparatus **11** in the preheater **4**, and subjected to heat exchange with exhaust gas discharged from the boiler **7** in the gas heater **5**. As a result, the boiler water supply system **1** can recover waste heat in the CO_2 recovery apparatus **11** and waste heat in the boiler exhaust system.

[0035] Moreover, in the above-described boiler water supply system **1**, the entire amount of the condensed water generated in the condenser **3** is subjected to heat exchange in the preheater **4** and the gas heater **5**, not branched in a path from the condenser **3** to the boiler **7**, and the condensed water is supplied to the boiler **7** as boiler supply water.

[0036] Conventionally, when condensed water generated in the condenser **3** is supplied as boiler supply water to the boiler **7**, as shown in FIG. **5**, the condensed water has been heated by extracting low-pressure steam from the low-pressure steam turbine **2** and performing heat exchange between the condensed water and the low-pressure steam in a low-pressure water supply heater **40**. In this embodiment, the low-pressure water supply heater **40** may be omitted by adjusting the temperature condition such that the entire amount of the condensed water generated in the condenser **3** is supplied to the boiler **7** as boiler supply water. As a result, steam extraction from the low-pressure steam turbine **2** for the low-pressure water supply heater **40** can be eliminated, and an amount of steam consumption is reduced to improve turbine efficiency.

[0037] Next, with reference to FIG. **2**, the boiler exhaust system according to this embodiment and an installation example of the gas heater **5** in the boiler exhaust system will be explained.

[0038] The boiler exhaust system eliminates dust from exhaust gas discharged from the boiler **7** as well as executes desulfurization, and discharges exhaust gas to ambient air. The boiler exhaust system is constituted by, for example, an air preheater **8**, the gas heater **5**, a dry electric dust collector **9**, a desulfurization equipment **10**, a CO_2 recovery apparatus **11** and a stack **12**.

[0039] To the air preheater **8**, ambient air is supplied from the outside. Moreover, to the air preheater **8**, exhaust gas discharged from the boiler **7** is supplied. In the air preheater **8**, heat exchange is performed between the ambient air to be introduced into the boiler **7** and the exhaust gas discharged from the boiler **7**. The exhaust gas passing through the air preheater **8** is cooled and supplied to the gas heater **5**. In addition, the ambient air passing through the air preheater **8** is heated and introduced into the boiler **7**.

[0040] As described before, in the gas heater **5**, heat exchange is performed between the condensed water heated by the preheater **4** and the exhaust gas discharged from the boiler **7**. The exhaust gas passing through the gas heater **5** is cooled and supplied to the dry electric dust collector **9**. Since the exhaust gas passes through the air preheater **8** and the gas heater **5**, its temperature is lowered before it is introduced into the dry electric dust collector **9**, which improves removing property of dust and SO_3 in the dry electric dust collector **9**.

[0041] The dry electric dust collector **9** removes dust from the cooled exhaust gas. The exhaust gas in which the dust is removed is supplied to the desulfurization equipment **10**. The desulfurization equipment **10** mainly absorbs and removes sulfurous acid gas from the exhaust gas and removes dust. The exhaust gas passing through the desulfurization equipment **10** is introduced into the CO_2 recovery apparatus **11**.

[0042] Moreover, the CO_2 recovery apparatus **11** removes CO_2 from the exhaust gas. The exhaust gas in which CO_2 is removed passes through the stack **12** to be discharged to ambient air. In addition, CO_2 removed from the exhaust gas is compressed to be transmitted to a storage step.

[0043] As explained above, the condensed water generated in the condenser **3** is subjected to heat exchange with the exhaust gas discharged from the boiler **7** in the gas heater **5** of the boiler exhaust system. Additionally, while an arrangement is made in the order of the gas heater **5** and the dry electric dust collector **9** from the upstream side of the exhaust gas flow in the above-described boiler exhaust system, the present invention is not limited to this example, and for example, an arrangement may be made in the order of the dry electric dust collector **9** and the gas heater **5** from the upstream side of the exhaust gas flow.

[0044] Next, the CO_2 recovery apparatus **11** according to this embodiment and an installation example of the preheater **4** in the CO_2 recovery apparatus **11** will be explained with reference to FIG. **3**.

[0045] In the CO_2 recovery apparatus **11**, exhaust gas **20** including CO_2 discharged from facilities such as the boiler **7** and a gas turbine (not shown) is supplied to cooling tower **22** by a not shown blower. The exhaust gas **20** supplied to the cooling tower **22** is cooled by cooling water **21** in the cooling tower **22**.

[0046] The cooled exhaust gas **20** including CO_2 is supplied from a lower portion of an absorbing tower **24** via an exhaust gas line **23**. In the absorbing tower **24**, for example, alkanolamine-based CO_2 absorbing liquid **25** (amine solution) is countercurrently contacted to the exhaust gas **20**. By doing this, CO_2 in the exhaust gas **20** is absorbed in the CO_2 absorbing liquid **25**, and CO_2 is removed from the exhaust gas **20** discharged from an industrial installation. Purged gas **26** in which CO_2 is removed is discharged from a tower top portion **24*a*** of the absorbing tower **24**. The purged gas **26** is transmitted to ambient air from the above-described stack **12**.

[0047] The CO_2 absorbing liquid **25** that absorbs CO_2 in the absorbing tower **24** is stored in a tower bottom portion **24*b***, and transmitted to the regeneration tower **27** by a pump **35**.

[0048] The CO_2 absorbing liquid **25** (rich solution) discharges CO_2 by being heated by steam generated in a reboiler **28** in the regeneration tower **27** to be regenerated as CO_2 absorbing liquid **25** (lean solution) that can absorb CO_2. The regenerated CO_2 absorbing liquid **25** is, after it is cooled via a heat exchanger **30** and a lean solution cooling apparatus **31** by a pump **29**, supplied to the absorbing tower **24** again and reused.

[0049] The CO_2 discharged from the CO_2 absorbing liquid **25** in the regeneration tower **27** sequentially passes through the preheater **4**, a cooler **32** and a gas-liquid separator **33**, is delivered to a CO_2 compression apparatus **34** to be compressed, and transmitted to the storage step.

[0050] In the regeneration tower **27** of the CO_2 recovery apparatus **11**, a multiple stages of (for example, two or three stages) regeneration portions are placed. Each regeneration portion includes a nozzle **36** that lowers the CO_2 absorbing liquid **25** (rich solution or semi-lean solution), a packed layer **37** that countercurrently contacts the CO_2 absorbing liquid which is lowered from the nozzle **36** with steam for heating and a tray portion **38** that stores the CO_2 absorbing liquid **25** (semi-lean solution) in which CO_2 is partially removed.

[0051] Additionally, the preheater **4** may be provided to a supply tube L_1 placed on the regeneration tower **27**. The supply tube L_1 supplies the CO_2 absorbing liquid **25** (semi-lean solution) stored in the tray portion **38** of the regeneration portion on the upper side of the preheater **4** to the packed layer

37 of the regeneration portion on the lower side of the preheater **4** via the nozzle **36**. The CO_2 absorbing liquid **25** (semi-lean solution) passes through the preheater **4** provided to the supply tube L_1 to be cooled. At this time, in the preheater **4**, heat exchange is performed between the semi-lean solution flowing in the supply tube L_1 and the condensed water flowing in the boiler water supply system **1**. The condensed water passing through the preheater **4** is heated.

[0052] The CO_2 compression apparatus **34** includes a compressor (not shown) that compresses CO_2, a cooler (not shown) that cools the compressed CO_2 whose temperature is raised and a gas-liquid separator (not shown). In this embodiment, in the CO_2 compression apparatus **34**, the preheater **4** according to this embodiment may be placed in parallel with or instead of the cooler. At this time, in the preheater **4**, heat exchange is performed between the compressed and high-temperature CO_2 and the condensed water flowing in the boiler water supply system **1**. The CO_2 passing through the preheater **4** is cooled. On the other hand, the condensed water passing through the preheater **4** is heated.

[0053] As explained above, the condensed water generated in the condenser **3** is subjected to heat exchange with CO_2 discharged from the CO_2 absorbing liquid **25** in the regeneration tower **27** or CO_2 compressed in the CO_2 compression apparatus **34** and moreover, subjected to heat exchange with the semi-lean solution in the regeneration tower **27** of the CO_2 recovery apparatus **11**.

[0054] Next, a start-up method of the boiler water supply system **1** according to this embodiment will be explained.

[0055] In addition to the above configuration, as shown in FIG. **3**, a return tube L_2 connected to the outlet side and the inlet side of the gas heater **5** is provided to the boiler water supply system **1**, and an auxiliary heater **14** is placed to the return tube L_2. Moreover, control valves **15** and **16** are placed to the piping of the boiler water supply system **1**. The control valve **15** is placed on the upstream side from a meeting with the return tube L_2 on the inlet side of the gas heater **5**, and the control valve **16** is placed on the downstream side from a meeting with the return tube L_2 on the outlet side of the gas heater **5**.

[0056] When the temperature of the condensed water supplied from the condenser **3** is low or an amount of heat capable of heat exchange in the preheater **4** is small at the time of start-up of the CO_2 recovery apparatus **11**, the temperature of the gas heater could be excessively lowered.

[0057] Accordingly, the temperature of the condensed water at the outlet of the preheater **4** is detected, and if the detected temperature is lower than a predetermined temperature, the degree of opening of the control valves **15** and **16** is adjusted to be throttled to supply the condensed water from the gas heater **5** to the auxiliary heater **14**. Steam is supplied to the auxiliary heater **14**, and heat exchange is performed between the supplied steam and the condensed water heated in the gas heater **5**. By passing through the auxiliary heater **14**, the condensed water is further heated, and thereafter, heated again by the gas heater **5**.

[0058] Since the condensed water circulates between the gas heater **5** and the auxiliary heater **14**, the temperature of the condensed water to be supplied to the gas heater **5** is raised in a short time. This prevents temperature lowering in a heat exchanger, for example, a fin tube, and corrosion due to sulfuric acid condensation on the surface of fin tube can be prevented.

[0059] After that, if the temperature of the condensed water at the outlet of the preheater **4** is higher than a predetermined temperature, the degree of opening of the control valves **15** and **16** is adjusted to be opened to reduce an amount of supply of the condensed water to the auxiliary heater **14**. This moves into a normal operation, and the entire amount of the condensed water generated in the condenser **3** is, after it is subjected to heat exchange in the preheater **4** and the gas heater **5**, supplied to the boiler **7** as boiler supply water.

[0060] As described above, in this embodiment, an explanation is made on the configuration that the entire amount of the condensed water generated in the condenser **3** is subjected to heat exchange in the preheater **4** and the gas heater **5** and supplied to the boiler **7** as boiler supply water. According to this configuration, as explained above, the preheater **4** and the gas heater **5** can heat the condensed water instead of the conventional low-pressure water supply heater **40** (see FIG. **5**).

[0061] Especially, in a case where a plant in which the CO_2 recovery apparatus **11** and an electric power generation plant including a boiler are placed in parallel is newly installed, since a plant required for steam extraction the low-pressure steam turbine **2** for the low-pressure water supply heater **40** is unnecessary, a facility configuration of the plant can be simplified and initial cost can be reduced.

[0062] Additionally, the present invention is not limited to a case where the low-pressure water supply heater **40** is not placed. For example, as shown in FIG. **4**, to the boiler water supply system having the low-pressure water supply heater **40** in the existing electric power facility, the boiler water supply system **1** according to the this embodiment described above may be placed in parallel. Even in such a case, compared to the conventional boiler water supply system shown in FIG. **5**, extracted steam to be supplied from the low-pressure steam turbine **2** to the low-pressure water supply heater **40** can be reduced, and turbine efficiency can be improved.

REFERENCE SIGNS LIST

[0063] **1** boiler water supply system
[0064] **2** low-pressure steam turbine
[0065] **3** condenser
[0066] **4** preheater
[0067] **5** gas heater
[0068] **6** deaerator
[0069] **7** boiler
[0070] **8** air preheater
[0071] **9** dry electric dust collector
[0072] **10** desulfurization equipment
[0073] **11** CO_2 recovery apparatus
[0074] **12** stack
[0075] **14** auxiliary heater
[0076] **15**, **16** control valve
[0077] **20** exhaust gas
[0078] **24** absorbing tower
[0079] **27** regeneration tower
[0080] **28** reboiler
[0081] **34** CO_2 compression apparatus
[0082] **35** pump
[0083] **40** low-pressure water supply heater

1. A heat recovery system comprising:

a CO_2 recovery apparatus which includes an absorbing tower that absorbs CO_2 in exhaust gas into absorbing liquid and a regeneration tower that discharges CO_2 from the absorbing liquid that absorbed CO_2 in the absorbing tower to reuse the absorbing liquid that discharged CO_2 in the regeneration tower in the absorbing tower;

a steam turbine;

a condenser which condenses steam discharged from the steam turbine;

a first heat exchange portion in which heat exchange is performed between condensed water generated in the condenser and CO_2 recovered in the regeneration tower of the CO_2 recovery apparatus;

a second heat exchange portion in which heat exchange is performed between the condensed water heated in the first heat exchange portion and exhaust gas discharged from a boiler; and

the boiler to which the condensed water heated in the second heat exchange portion is supplied as boiler supply water.

2. The heat recovery system according to claim **1**, wherein an entire amount of condensed water generated in the condenser is used as the condensed water subjected to heat exchange in the first heat exchange portion and the second heat exchange portion.

3. The heat recovery system according to claim **1**, wherein a water supply heater which heats the condensed water generated in the condenser by steam extracted from the steam turbine and supplies the heated condensed water to the boiler is not included.

4. The heat recovery system according to claim **1**, further comprising a third heat exchange portion which heats the condensed water heated in the second heat exchange portion and returns the heated condensed water to the second heat exchange portion, and

a control portion which switches between the boiler or the third heat exchange portion as a supply destination of the condensed water heated in the second heat exchange portion.

5. A heat recovery method which uses a CO_2 recovery apparatus including an absorbing tower that absorbs CO_2 in exhaust gas into absorbing liquid and a regeneration tower that discharges CO_2 from the absorbing liquid that absorbs CO_2 in the absorbing tower and reuses the absorbing liquid that discharged CO_2 in the regeneration tower in the absorbing tower, the method comprising:

a first step of condensing steam discharged from a steam turbine;

a second step of performing heat exchange between generated condensed water and CO_2 recovered in the regeneration tower of the CO_2 recovery apparatus in a first heat exchange portion;

a third step of performing heat exchange between the condensed water heated in the first heat exchange portion and exhaust gas discharged from a boiler in a second heat exchange portion; and

a fourth step of supplying the condensed water heated in the second heat exchange portion to the boiler as boiler supply water.

6. The heat recovery method according to claim **5**, further comprising a fifth step of heating the condensed water heated in the second heat exchange portion in a third heat exchange portion which is different from the boiler and heating the condensed water heated in the third heat exchange portion in the second heat exchange portion.

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