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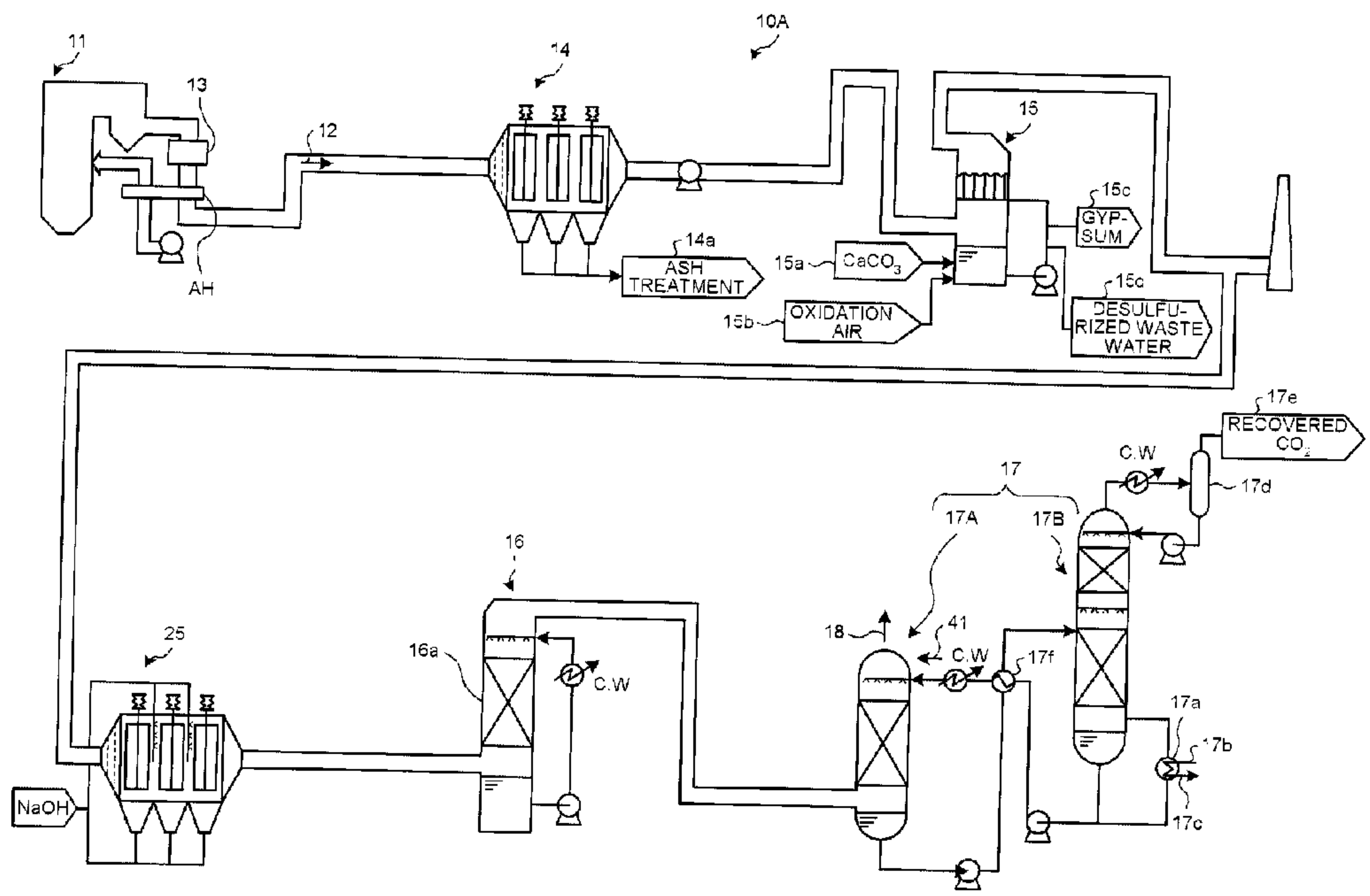

(57) Abrégé/Abstract:
An air pollution control system includes SO_x removal equipment for reducing sulfur oxides from flue gas from a boiler, a cooler which is provided on the downstream side of the sox removal equipment for reducing the sulfur oxides from the flue gas and for decreasing a gas temperature, CO_2 recovery equipment which includes an absorber for bringing CO_2 in the flue gas into contact with a CO_2 absorption liquid so as to be reduced and a regenerator for causing the CO_2 absorption liquid to emit CO_2 so as to recover CO_2 and regenerate the CO_2 absorption liquid. A wet type electric dust collector is provided for reducing a mist generation material which is a generation source of mist that is generated in the absorber of the CO_2 recovery equipment before introducing the flue gas to the CO_2 recovery equipment.

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ABSTRACT

An air pollution control system includes SO_x removal equipment for reducing sulfur oxides from flue gas from a boiler, a cooler which is provided on the downstream side of the SO_x removal equipment for reducing the sulfur oxides from the flue gas and for decreasing a gas temperature, CO_2 recovery equipment which includes an absorber for bringing CO_2 in the flue gas into contact with a CO_2 absorption liquid so as to be reduced and a regenerator for causing the CO_2 absorption liquid to emit CO_2 so as to recover CO_2 and regenerate the CO_2 absorption liquid. A wet type electric dust collector is provided for reducing a mist generation material which is a generation source of mist that is generated in the absorber of the CO_2 recovery equipment before introducing the flue gas to the CO_2 recovery equipment.

DESCRIPTION

AIR POLLUTION CONTROL SYSTEM AND METHOD

Field

[0001] The present invention relates to an air pollution control system and method that reduce CO_2 from flue gas.

Background

[0002] In recent years, the greenhouse effect due to CO_2 is indicated as one of causes of the global warming phenomenon, and the countermeasures thereof become an internationally urgent matter to protect the global environment. CO_2 generation sources reach all human activity fields in which fossil fuels are burned, and there is a tendency to further strengthen the demand for suppression of the discharge thereof. For this, for a power generation facility such as a thermal power plant that uses a large amount of fossil fuels, a method of bringing combustion flue gas of an industrial facility such as a boiler or a gas turbine into contact with an amine-based CO_2 absorption liquid to reduce and recover CO_2 from the combustion flue gas and an air pollution control system which stores the recovered CO_2 without emission to air has been energetically researched.

[0003] CO_2 recovery equipment which has, as the process of reducing and recovering CO_2 from the combustion flue gas using a CO_2 absorption liquid as described above, a process of bringing the combustion flue gas into contact with the CO_2 absorption liquid in a CO_2 absorber (hereinafter, also simply referred to as "absorber"), and a process of heating the CO_2 absorption liquid that absorbs CO_2 in an absorption liquid regenerator (hereinafter, also simply referred to as "regenerator") to emit CO_2 and regenerate the CO_2 absorption liquid so as to be circulated through the CO_2 absorber to be reused, is proposed (for example, Patent

Literature 1).

[0004] In the CO_2 absorber, through countercurrent contact using an amine-based CO_2 absorption liquid such as alkanolamine, CO_2 in the flue gas is absorbed by the CO_2 absorption liquid in a chemical reaction (exothermic reaction), and the flue gas from which CO_2 is reduced is emitted to the outside of the system. The CO_2 absorption liquid that absorbs CO_2 is also called a "rich solution". The rich solution is pressurized by a pump, is heated in a heat exchanger by a high-temperature CO_2 absorption liquid (lean solution) regenerated as CO_2 is emitted in the regenerator, and is supplied to the regenerator.

Citation List

Patent Literature

[0005] Patent Literature 1: Japanese Laid-open Patent Publication No. 3-193116

Summary

[0006] However, in the air pollution control system, in a case where a mist generation material that is a generation source of mist generated in the absorber of the CO_2 recovery equipment is included in the flue gas introduced to the CO_2 absorber that absorbs CO_2 in the CO_2 recovery equipment, there is a problem in that the CO_2 absorption liquid is entrained by the mist generation material and thus the amount of CO_2 absorption liquid that scatters to the outside of the system is increased.

Such a case, where the scattering of the CO_2 absorption liquid to the outside of the system occurs, is connected to a significant loss of the CO_2 absorption liquid, and an unnecessary amount of the CO_2 absorption liquid has to be replenished. Therefore, the scattering of the CO_2 absorption liquid to the outside of the system needs to be suppressed.

[0007] Here, the establishment of an air pollution control system which suppresses the scattering of a CO_2 absorption liquid from a CO_2 absorber is desired.

[0008] Some embodiments of the present invention may provide an air pollution control system and method capable of significantly reducing entraining of a CO_2 absorption liquid when flue gas from which CO_2 is reduced is discharged to the outside of a system, and performing an appropriate air pollution control.

[0009] According to a first aspect of invention, there is provided an air pollution control system comprising: SO_x removal equipment for reducing sulfur oxides from flue gas from a boiler; a cooler which is provided downstream of the SO_x removal equipment, for reducing the sulfur oxides that remain in the flue gas and for decreasing a gas temperature; CO_2 recovery equipment including: an absorber for bringing CO_2 in the flue gas into contact with a CO_2 absorption liquid so as to be reduced; and a regenerator for causing the CO_2 absorption liquid to emit CO_2 so as to recover CO_2 and regenerate the CO_2 absorption liquid; and a wet type electric dust collector for reducing a particulates and mist generation material before introducing the flue gas to the CO_2 recovery equipment, the mist generation material containing SO_3 and being a generation source of mist that is generated in the absorber of the CO_2 recovery equipment.

[0010] According to some embodiments, the air pollution control system further includes NO_x removal equipment for reducing nitrogen oxides from the flue gas; and a dry type electric dust collector for reducing particulates.

[0011] According to some embodiments, an SO_x removal unit is provided to be integrated into the cooler, and a wet type electric dust collection unit is provided on a downstream side of the SO_x removal unit.

[0012] According to a second aspect of invention, there is provided an air pollution control method comprising: upstream of CO_2 recovery equipment, bringing CO_2 in flue gas into contact with a CO_2 absorption liquid so as to be absorbed and reduced, downstream of SO_x removal equipment, reducing particulates and mist from the flue gas by a wet type electric dust collector to decrease an amount of SO_3 mist in the flue gas to be introduced to the CO_2 recovery equipment to 3ppm or less, the mist generation material containing SO_3.

[0013] According to some embodiments, a SO_x removal unit and a wet type electric dust collection unit are included in a cooler to perform SO_x removal and reduce particulates and mist.

[0014] According to the air pollution control system of some embodiments, since the wet type electric dust collection unit is provided as the mist generation material reduction equipment before the introduction to the CO_2 recovery equipment, the amount of mist generation material in the flue gas when being introduced to the CO_2 absorber is significantly decreased. As a result, the amount of CO_2 absorption liquid that is entrained by mist and scatters to the outside of the system is decreased. Therefore, the loss of the CO_2 absorption liquid that scatters to the outside of the system may be significantly decreased, and an increase in running cost during the air pollution control may be suppressed.

Brief Description of Drawings

[0015] FIG. 1 is a schematic diagram of an air pollution control system of an embodiment according to the present invention.

FIG. 2 is a conceptual diagram of a mechanism of mist generation.

FIG. 3-1 is a photograph illustrating a state where white smoke is decreased in a CO_2 absorber.

FIG. 3-2 is a photograph illustrating a state where white smoke is generated in the CO_2 absorber.

FIG. 4 is a schematic diagram of the air pollution control system according to a first embodiment.

FIG. 5 is a schematic diagram of another air pollution control system according to the first embodiment.

FIG. 6 is a schematic diagram of an air pollution control system according to Embodiment 2.

Description of Embodiments

[0016] Hereinafter, examples of embodiments of the present invention will be described in detail with reference to the drawings. Note that, the present invention is not limited by embodiments and examples. In addition, components in the embodiments and the examples include those that may be easily assumed by those skilled in the art or are practically the same.

[0017] FIG. 1 is a schematic diagram of an air pollution control system of an embodiment according to the present invention.

As illustrated in FIG. 1, in an air pollution control system 10 of the embodiment according to the present invention, flue gas 12 from a boiler 11 is subjected to a reduction in nitrogen oxides (NO_x) from the flue gas 12 by NO_x removal equipment 13, and thereafter is first guided to an air heater AH to heat air supplied to the boiler 11. Thereafter, the flue gas 12 is introduced to a dry type electric dust collector 14 which is dust reduction equipment so as to reduce particulates. Next, the flue gas 12 is introduced to SO_x removal equipment 15 to reduce sulfur oxides (SO_x). Then, the flue gas 12 is cooled by a cooler 16, is thereafter introduced to CO_2 recovery equipment 17 to reduce carbon dioxide, and purified gas 18 is emitted from the top portion of a CO_2 absorber to the air which is outside the system. Note that, the particulates reduced by the electric dust collector 14 are subjected to an additional ash treatment 14a.

[0018] In the present embodiment, before introducing the flue gas 12 to the CO_2 recovery equipment 17, mist generation material reduction equipment 20 which reduces a mist generation material that is a generation source of mist generated in the CO_2 absorber of the CO_2 recovery equipment 17 is provided.

[0019] According to the air pollution control system according to the present embodiment, since the mist generation material reduction equipment 20 is provided before the introduction to the CO_2 recovery equipment 17, the amount of mist generation material in the flue gas 12 when being introduced to the CO_2 absorber of the CO_2 recovery equipment 17 is significantly decreased. As a result, the amount of CO_2 absorption liquid (hereinafter, also referred to as "absorption liquid") entrained by mist and discharged to the outside may be significantly decreased. As a result, the loss of the absorption liquid that scatters to the outside of the system is significantly decreased, and thus an unnecessary replenishment is eliminated, thereby suppressing an increase in running cost during the air pollution control.

[0020] The mist generation material reduced by the mist generation material reduction equipment 20 according to the present embodiment is SO_3 mist, nitric acid mist, hydrochloric acid mist, water vapor mist, or the like and is referred to as a material that becomes a mist generation factor in the CO_2 absorber. Note that, equipment that performs a reduction in a gas state before becoming mist is also included in the mist generation material reduction equipment 20 according to the present embodiment.

[0021] Since the flue gas 12 from the boiler 11 is in a high-temperature state, the mist generation material is present in a gas state at first. Thereafter, in a process of passing through the electric dust collector and the SO_x removal equipment, the flue gas is cooled, and thus the mist generation material changes from the gas state to a mist state.

The particle size of the mist of the mist generation material in the present embodiment is referred to as a size of equal to or smaller than 3.0 μm.

[0022] The form of mist generation and entraining of the absorption liquid in the CO_2 absorber of the CO_2 recovery equipment 17 will be described using FIGS. 2, 3-1, and 3-2.

FIG. 2 is a conceptual diagram of a mechanism of entraining of the absorption liquid by mist generation. FIG. 3-1 is a photograph illustrating a state where white smoke is decreased in the CO_2 absorber, and FIG. 3-2 is a photograph illustrating a state where white smoke is generated in the CO_2 absorber. Although, SO_3 mist is exemplified as the mist generation material in the description, descriptions with other kinds of mist will be the same. The flue gas 12 from the boiler 11 is subjected to a gas purifying treatment such as NO_x removal, a reduction in particulates, and SO_x removal, and the flue gas 12 is cooled by the cooler 16, resulting in a gas temperature of about 50°C. Since this temperature state is equal to or less than the acid dew point, there is SO_3 mist (for example, 0.1 to 1.0 μm).

The SO_3 mist 50 has SO_3 as a nucleus 51 and water vapor 52 that is incorporated into the periphery thereof.

[0023] In the CO_2 absorber, the absorption liquid is sprayed from nozzles and falls, and the falling absorption liquid and the flue gas are subjected to countercurrent contact such that CO_2 is absorbed by the absorption liquid. On the other hand, the flue gas 12 is introduced from the lower side of the CO_2 absorber and is discharged to the upper side. Here, the SO_3 mist 50 is not absorbed by the absorption liquid and ascends along with the gas stream of the flue gas 12.

[0024] Here, in the CO_2 absorber, when the absorption liquid is supplied from the nozzles, the absorption liquid falls and a part of the absorption liquid and moisture evaporates, and thus a gaseous absorption liquid 41G and water vapor 42 are generated.

In addition, the amount of gaseous absorption liquid 41G and the water vapor 42 further increases as the temperature of the absorption liquid is increased due to, for example, the exothermic reaction of the absorption liquid when CO_2 is absorbed.

[0025] Then, the gaseous absorption liquid 41G and the water vapor 42 are incorporated into the SO_3 mist 50, resulting in a SO_3 mist (bloated mist) 53 including a bloated (for example, about 0.5 to 2.0 μm) absorption liquid.

[0026] As described above, the SO_3 mist 50 in the flue gas 12, before being introduced to the CO_2 recovery equipment 17, incorporates the gaseous absorption liquid 41G and the water vapor 42 in the CO_2 absorber, becomes the SO_3 mist 53 including the absorption liquid, and scatters from the top portion of the CO_2 absorber while being entrained by the flue gas 12. Therefore, the loss of the absorption liquid occurs.

[0027] The form of white smoke generation in the CO_2 absorber is illustrated in FIGS. 3-1 and 3-2.

FIG. 3-1 illustrates a case where the amount of mist generation material is decreased to a predetermined amount or less by providing the mist generation material reduction equipment 20 for the flue gas 12 introduced to the CO_2 absorber and a state where the scatting of the SO_3 mist (bloated mist) 53 including the absorption liquid in the CO_2 absorber is significantly reduced and thus generation of white smoke is suppressed. FIG. 3-2 illustrates a case where the flue gas 12 is introduced as it is without providing the mist generation material reduction equipment 20 for the flue gas 12 introduced to the CO_2 absorber and a state where the scatting of the SO_3 mist (bloated mist) 53 including the absorption liquid in the CO_2 absorber occurs and thus white smoke is generated.

[0028] That is, in the present embodiment, the mist generated in the CO_2 absorber is referred to as the SO_3 mist (bloated mist) 53 including the absorption liquid. Confirming the presence or absence of the generation of bloated mist is referred to as the presence or absence of generation of white smoke, and by suppressing the bloated mist in the CO_2 absorber, generation of white smoke is eliminated. Furthermore, the scattering of the absorption liquid is prevented.

[0029] In addition, regarding the bloated mist, as illustrated in FIG. 2, there may be cases where the gaseous absorption liquid 41G and the gaseous water vapor 42 are separately incorporated into the SO_3 mist 50 in the flue gas 12 in the CO_2 absorber to respectively form a SO_3 mist (bloated mist) 53A including the absorption liquid and a SO_3 mist (bloated mist) 53B including the water vapor.

Here, in the case of the mist (bloated mist) 53B including the water vapor, there is no loss of the absorption liquid. However, since generation of white smoke of the purified gas 18 to be discharged to the outside of a system occurs, a reduction in the mist generation material is also needed.

Therefore, according to the present embodiment, by providing the mist generation material reduction equipment 20 before introduction to the CO_2 recovery equipment 17, entraining of the CO_2 absorption liquid may be significantly reduced when the flue gas 12 from which CO_2 is reduced is discharged to the outside of the system, and an appropriate air pollution control may be performed.

[0030] Therefore, in the present embodiment, by providing the mist generation material reduction equipment 20 that reduces the mist generation material which is the generation source of the mist (the SO_3 mist including the absorption liquid which is the bloated mist) generated in the CO_2 absorber of the CO_2 recovery equipment 17 before introducing the flue gas 12 to the CO_2 recovery equipment 17, the loss of the absorption liquid that scatters to the outside of the system from the CO_2 absorber may be significantly decreased.

[0031] The mist generation material reduction equipment 20 may be provided on the upstream side of the dry type electric dust collector 14, between the dry type electric dust collector 14 and the SO_x removal equipment 15, or in either of the front and the rear of the cooler 16, or to be integrated into the cooler 16.

Here, before introducing the flue gas 12 to the CO_2 recovery equipment 17, it is preferable that the amount of SO_3 mist 50 be decreased to 3 ppm or less for prevention of white smoke and prevention of scattering of the absorption liquid in the CO_2 absorber. This is because when the amount of SO_3 mist 50 is decreased to 3 ppm or less, scattering is suppressed, and deterioration of, for example, an amine-based absorption liquid due to SO_3 is prevented.

[0032] According to the present embodiment, since the scattering of the absorption liquid is prevented and the deterioration of the absorption liquid is prevented, a decrease in the number of regeneration treatments performed in the regeneration equipment (reclaiming equipment) for the absorption liquid may be achieved, and the loss of the absorption liquid is further significantly decreased, so that a decrease in the amount of the replenished absorption liquid may be achieved. Therefore, the system efficiency of the air pollution control system may be significantly enhanced.

[0033] Note that, in this embodiment, the electric dust collector is exemplified as the dust reduction equipment in the description. However, the present invention is not limited to this as long as particulates are reduced from the flue gas 12, and besides the electric dust collector, for example, a bag filter or a venturi scrubber may be exemplified.

[0034] In the following embodiment, a specific form of the mist generation material reduction equipment that reduces the mist generation material will be described.

First Embodiment

[0035] The air pollution control system including the

CO_2 recovery equipment according to an embodiment of the present invention will be described with reference to the drawings. FIG. 4 is a schematic diagram of the air pollution control system according to the first embodiment. FIG. 5 is a schematic diagram of another air pollution control system according to the first embodiment. Note that, in the following embodiment, SO_3 is exemplified as the mist generation material in the description, but the present invention is not limited thereto.

As illustrated in FIG. 4, an air pollution control system 10A according to the first embodiment includes the NO_x removal equipment 13 which reduces nitrogen oxides from the flue gas 12 from the boiler (for example, coal-fired boiler) 11, the dry type electric dust collector 14 which is provided on the downstream side of the NO_x removal equipment 13 and reduces particulates from the flue gas 12, the SO_x removal equipment 15 which is provided on the downstream side of the electric dust collector 14 and reduces sulfur oxides from the flue gas 12, the cooler 16 which is provided on the downstream side of the SO_x removal equipment 15 and has a cooling unit 16a that decreases the gas temperature, and the CO_2 recovery equipment 17 which includes an absorber 17A that brings CO_2 in the flue gas 12 into contact with the absorption liquid so as to be reduced and a regenerator 17B that causes the absorption liquid to emit CO_2 to recover the CO_2 and regenerate the absorption liquid.

[0036] In this embodiment, before introducing the SO_3 mist to the CO_2 recovery equipment 17, as a countermeasure to reduce the mist generation material, a wet type electric dust collector 25 is provided between the SO_x removal equipment 15 and the cooler 16. The wet type electric dust collector 25 according to this embodiment functions as the mist generation material reduction equipment 20 illustrated in FIG. 1.

By providing the wet type electric dust collector 25 according to this embodiment, particulates that remain in the flue gas may be reduced, and the mist generation material in the mist state may be reduced from the flue gas.

[0037] The wet type electric dust collector 25 may be provided on the downstream side of the SO_x removal equipment 15 to charge and reduce the SO_3 mist 50 from the flue gas 12. In this embodiment, the wet type electric dust collector 25 is provided on the upstream side of the cooler 16 (between the SO_x removal equipment 15 and the cooler 16). However, the present invention is not limited thereto, and the wet type electric dust collector 25 may also be provided on the downstream side of the cooler 16 (between the cooler 16 and the CO_2 recovery equipment 17).

[0038] In this embodiment, as a result of reducing SO_3 in the mist state which is the mist generation material from the flue gas 12, a decrease in the amount of the SO_3 mist 50 introduced to the CO_2 recovery equipment 17 is achieved. Therefore, the generation of white smoke of the purified gas 18 discharged from the CO_2 absorber 17A, which is caused by the mist, is suppressed, and the entraining of the absorption liquid 41 is suppressed. As a result, an air pollution control system in which the loss of the absorption liquid 41 is significantly decreased may be provided.

[0039] In addition, the flue gas 12 from which particulates are reduced in the electric dust collector 14 is subjected to a reduction in sulfur oxides from the flue gas 12 in the SO_x removal equipment 15, the reduced sulfur oxides are supplied with limestone ($CaCO_3$) 15a and oxidation air 15b to become gypsum 15c through a limestone-gypsum method, and desulfurized waste water 15d is separately treated. Note that, in the figures, reference numerals 17a, 17b, 17c, 17d, 17e, and 17f denote a reboiler, saturated water vapor, condensed water, a separation drum, recovered CO_2, and a heat exchanger, respectively.

[0040] The flue gas 12 desulfurized by the SO_x removal equipment 15 is cooled by the cooler 16 to cause the flue gas temperature to be 50°C or less, and is introduced to the CO_2 recovery equipment 17 including the absorber 17A and the regenerator 17B. Here, CO_2 in the flue gas 12 is reduced by, for example, the amine-based absorption liquid 41. At this time, in this embodiment, as a result of reducing SO_3 in the gas state which is the mist generation material from the flue gas 12, a decrease in the amount of the SO_3 mist introduced to the CO_2 recovery equipment 17 is achieved. Therefore, the generation of white smoke of the purified gas 18 discharged from the absorber 17A, which is caused by the mist, is suppressed, and the entraining of the absorption liquid 41 is suppressed.

As a result, an air pollution control system in which there is no loss of the absorption liquid may be provided.

[0041] Here, in this embodiment, the amine-based absorption liquid is exemplified as the absorption liquid. However, the absorption liquid of the present invention is not limited to the amine-based absorption liquid. As the absorption liquid, besides the amine-based absorption liquid, for example, an amino acid-based absorption liquid, an ionic liquid absorption liquid, a hot potassium carbonate absorption liquid made of potassium carbonate and amines, and the like may be exemplified.

[0042] FIG. 5 is a schematic diagram of an air pollution control system of a modified example of Embodiment 1. In the cooler 16 illustrated in FIG. 4, the flue gas 12 is cooled. However, as illustrated in FIG. 5, the air pollution control system 10B is provided with a finishing SO_x removal unit 16b at the lower portion of the cooler 16 and supplies the limestone ($CaCO_3$) 15a and the oxidation air 15b to form the gypsum 15c through the limestone-gypsum method. Accordingly, sulfur oxides that remain in the flue gas 12 from the SO_x removal equipment 15 is reduced, and thus the SO_x removal efficiency is further enhanced. In addition, a strong alkaline agent such as sodium hydroxide (NaOH) may be added along with the limestone.

In this embodiment, in the finishing SO_x removal unit 16b, a liquid column type is used as a method of supplying a SO_x removal absorption liquid. However, the present invention is not limited thereto, and any of sprinkling type, jet type, and filling type may also be used.

[0043] Here, as the SO_x removal absorption liquid used in the finishing SO_x removal unit 16b, besides the limestone ($CaCO_3$), a strong alkaline agent such as NaOH, Na_2CO_3, $NaHCO_3$, $Ca(OH)_2$, or $Mg(OH)_2$ may be exemplified. By using the strong alkaline agent, further enhancement of the SO_x removal performance may be achieved, and this is particularly effective in a case where the flue gas 12 having a high sulfur oxide concentration is introduced, thereby decreasing the concentration of sulfur oxides in the flue gas 12 introduced to the CO_2 recovery equipment 17 to an extremely low concentration. The SO_x removal performance is increased compared to the limestone-gypsum method. Therefore, even in a case where the concentration of sulfur oxides in the introduced flue gas 12 is high, favorable SO_x removal performance is exhibited, which is preferable.

[0044] Note that, in this embodiment, the wet type electric dust collector 25 is installed on the upstream side of the cooler 16. However, the present invention is not limited thereto, and the wet type electric dust collector 25 may also be installed on the downstream side of the cooler 16.

[0045] In addition, as illustrated in Embodiment 2 as follows, a wet type electric dust collection unit may be provided to be integrated into the cooler.

Embodiment 2

[0046] An air pollution control system including the CO_2 recovery equipment according to an embodiment of the present invention will be described with reference to the drawings.

FIG. 6 is a schematic diagram of the air pollution control system according to Embodiment 2. As illustrated in FIG. 6, the air pollution control system 10C according to Embodiment 2 has the wet type electric dust collection function of Embodiment 1 in the cooler. Accordingly, a wet type electric dust collector-integrated cooler 27 including the finishing SO_x removal unit 16b that performs a finish of SO_x removal and a wet type electric dust collection unit 25a is constructed. The wet type electric dust collection unit 25a according to the present embodiment functions as the mist generation material reduction equipment 20. Compared to the system of Embodiment 1, it is unnecessary to separately install the wet type electric dust collector 25, and thus there is no need to secure the installation space thereof.

[0047] In this embodiment, as a result of reducing SO_3 in the mist state which is the mist generation material from the flue gas 12, a decrease in the amount of the SO_3 mist introduced to the CO_2 recovery equipment 17 is achieved. Therefore, the generation of white smoke of the purified gas 18 discharged from the absorber 17A, which is caused by the mist, is suppressed, and the entraining of the absorption liquid 41 is suppressed. As a result, an air pollution control system in which there is no loss of the absorption liquid 41 may be provided.

[0048] As described above with the embodiment, according to the present invention, the wet type electric dust collector 23 is provided as the mist generation material reduction equipment 20. Therefore, an air pollution control system in which the absorption liquid 41 is not entrained when the flue gas 12 from which CO_2 is reduced is discharged to the outside may be provided.

Reference Signs List

[0049] 10, 10A-10C AIR POLLUTION CONTROL SYSTEM

11 BOILER

12 FLUE GAS

13 NO_x REMOVAL EQUIPMENT

14 ELECTRIC DUST COLLECTOR

15 SO_x REMOVAL EQUIPMENT

16 COOLER

16a COOLING UNIT

16b FINISHING SO_x REMOVAL UNIT

17 CO_2 RECOVERY EQUIPMENT

17A ABSORBER

17B REGENERATOR

18 PURIFIED GAS

20 MIST GENERATION MATERIAL REDUCTION EQUIPMENT

25 Wet type electric dust collector

25a Wet type electric dust collection unit

27 Wet type electric dust collector-integrated cooler

CLAIMS:

1. An air pollution control system comprising:

SO_x removal equipment for reducing sulfur oxides from flue gas from a boiler;

a cooler which is provided downstream of the SO_x removal equipment, for reducing the sulfur oxides that remain in the flue gas and for decreasing a gas temperature;

CO_2 recovery equipment including:

an absorber for bringing CO_2 in the flue gas into contact with a CO_2 absorption liquid so as to be reduced; and

a regenerator for causing the CO_2 absorption liquid to emit CO_2 so as to recover CO_2 and regenerate the CO_2 absorption liquid; and

a wet type electric dust collector for reducing a particulates and mist generation material before introducing the flue gas to the CO_2 recovery equipment, the mist generation material containing SO_3 and being a generation source of mist that is generated in the absorber of the CO_2 recovery equipment.

2. The air pollution control system according to claim 1, further comprising:

NO_x removal equipment for reducing nitrogen oxides from the flue gas; and

a dry type electric dust collector for reducing particulates.

3. The air pollution control system according to claim 1 or 2,

wherein a SO_x removal unit is provided to be integrated into the cooler, and the wet type electric dust collection unit is provided downstream of the SO_x removal unit.

4. An air pollution control method comprising:

upstream of CO_2 recovery equipment, bringing CO_2 in flue gas into contact with a CO_2 absorption liquid so as to be absorbed and reduced,

downstream of SO_x removal equipment, reducing particulates and mist from the flue gas by a wet type electric dust collector to

decrease an amount of SO_3 mist in the flue gas to be introduced to the CO_2 recovery equipment to 3ppm or less, the mist generation material containing SO_3.

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

wherein a SO_x removal unit and the wet type electric dust collection unit are included in a cooler to perform SO_x removal and reduce particulates and mist.

6. The air pollution control method according to claim 4,

wherein the CO_2 absorption liquid is an amine-based CO_2 absorption liquid.

FIG.1

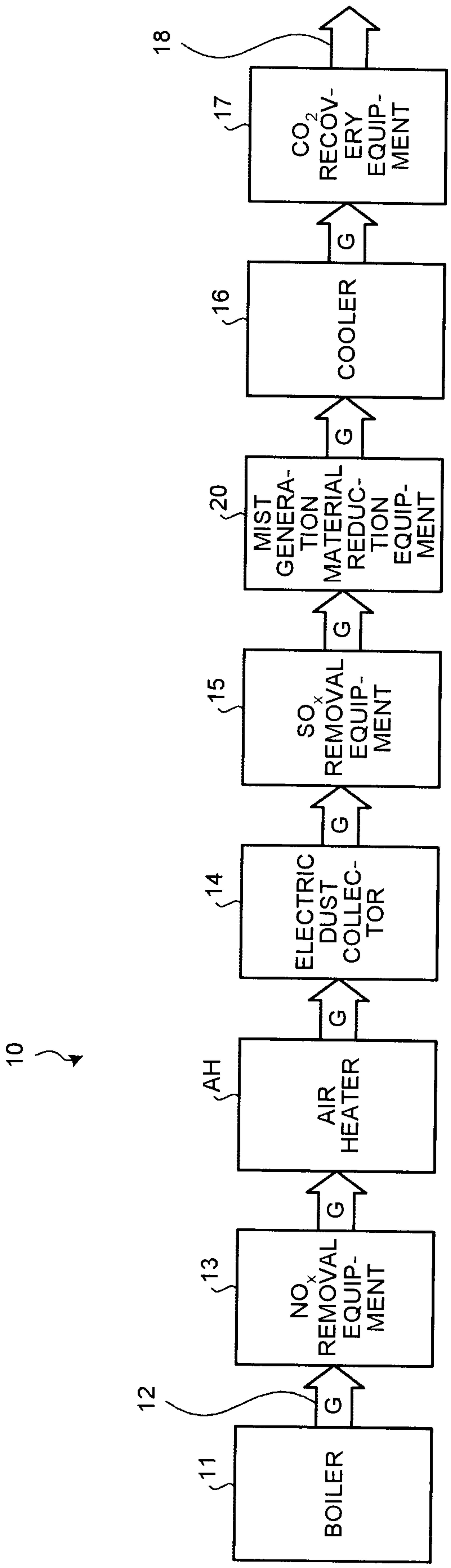

10
11
BOILER
12
G
13
NO$_x$ REMOVAL EQUIP-MENT
G
AH
AIR HEATER
G
14
ELECTRIC DUST COLLEC-TOR
G
15
SO$_x$ REMOVAL EQUIP-MENT
G
20
MIST GENERA-TION MATERIAL REDUC-TION EQUIP-MENT
G
16
COOLER
G
17
CO$_2$ RECOV-ERY EQUIP-MENT
18

FIG.2

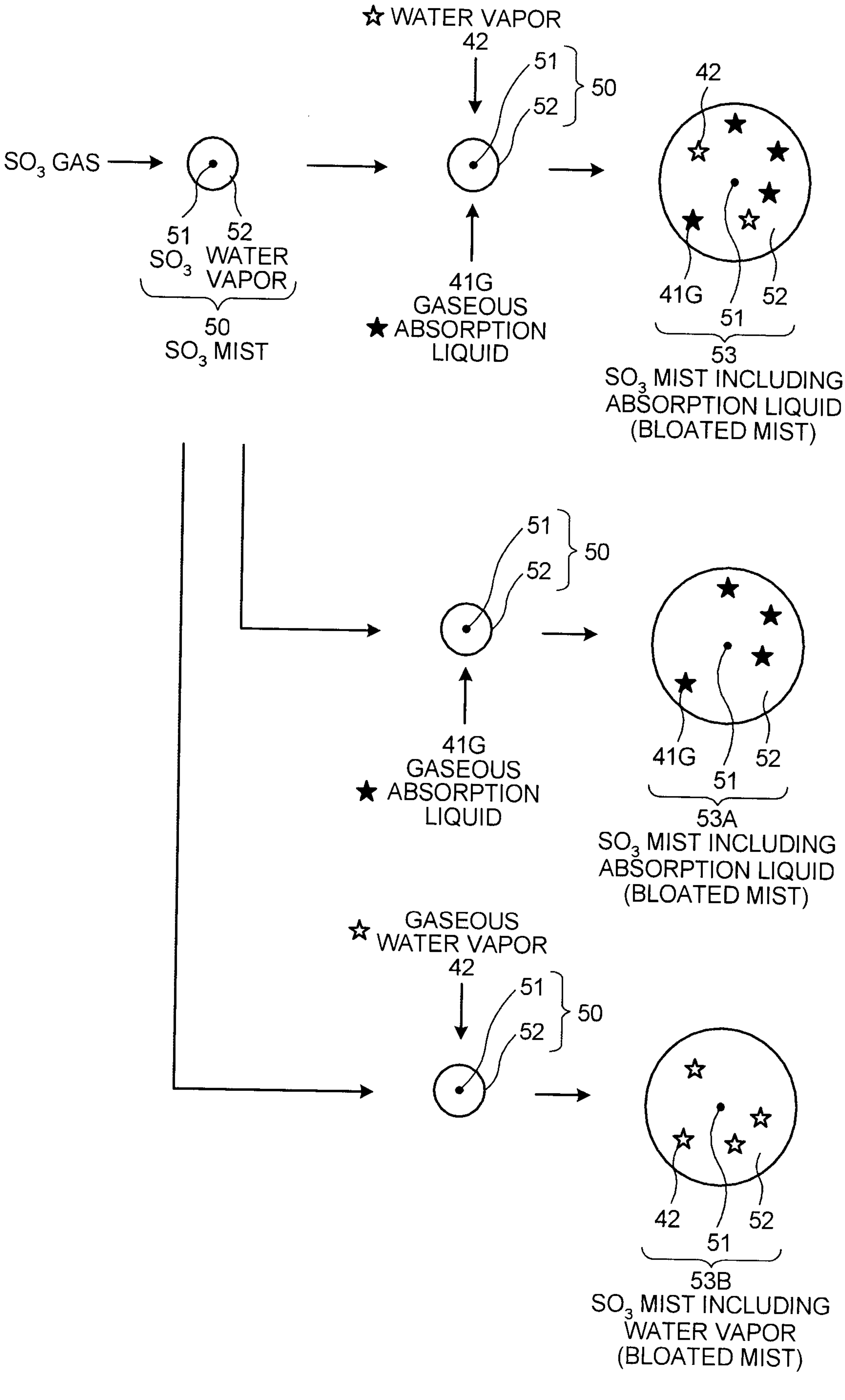

WATER VAPOR
42
51
52
50
42
SO3 GAS
51
SO3
52
WATER
VAPOR
50
SO3 MIST
41G
GASEOUS
ABSORPTION
LIQUID
41G
51
52
53
SO3 MIST INCLUDING
ABSORPTION LIQUID
(BLOATED MIST)
51
52
50
41G
GASEOUS
ABSORPTION
LIQUID
41G
51
52
53A
SO3 MIST INCLUDING
ABSORPTION LIQUID
(BLOATED MIST)
GASEOUS
WATER VAPOR
42
51
52
50
42
51
52
53B
SO3 MIST INCLUDING
WATER VAPOR
(BLOATED MIST)

FIG.3-1

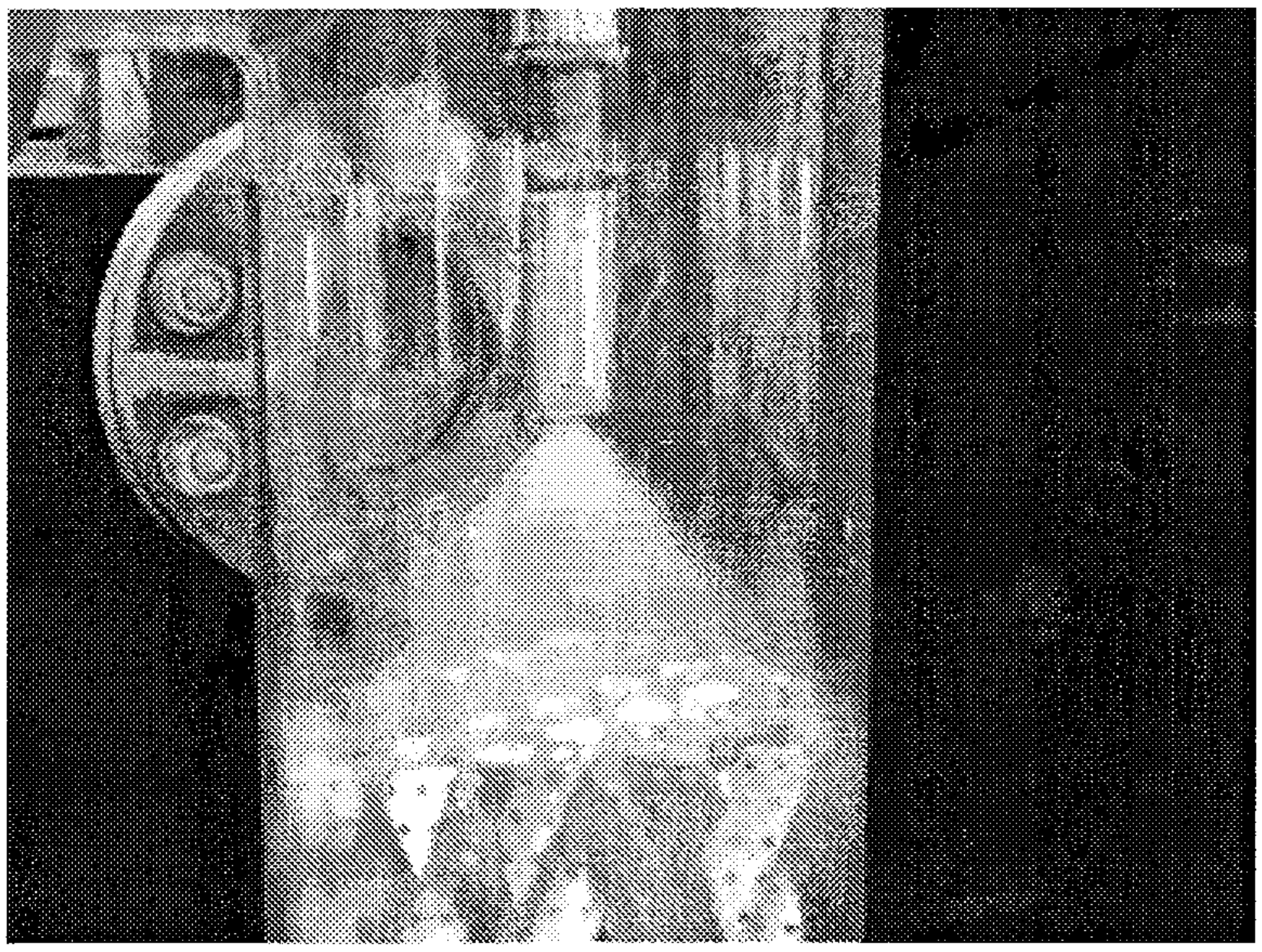
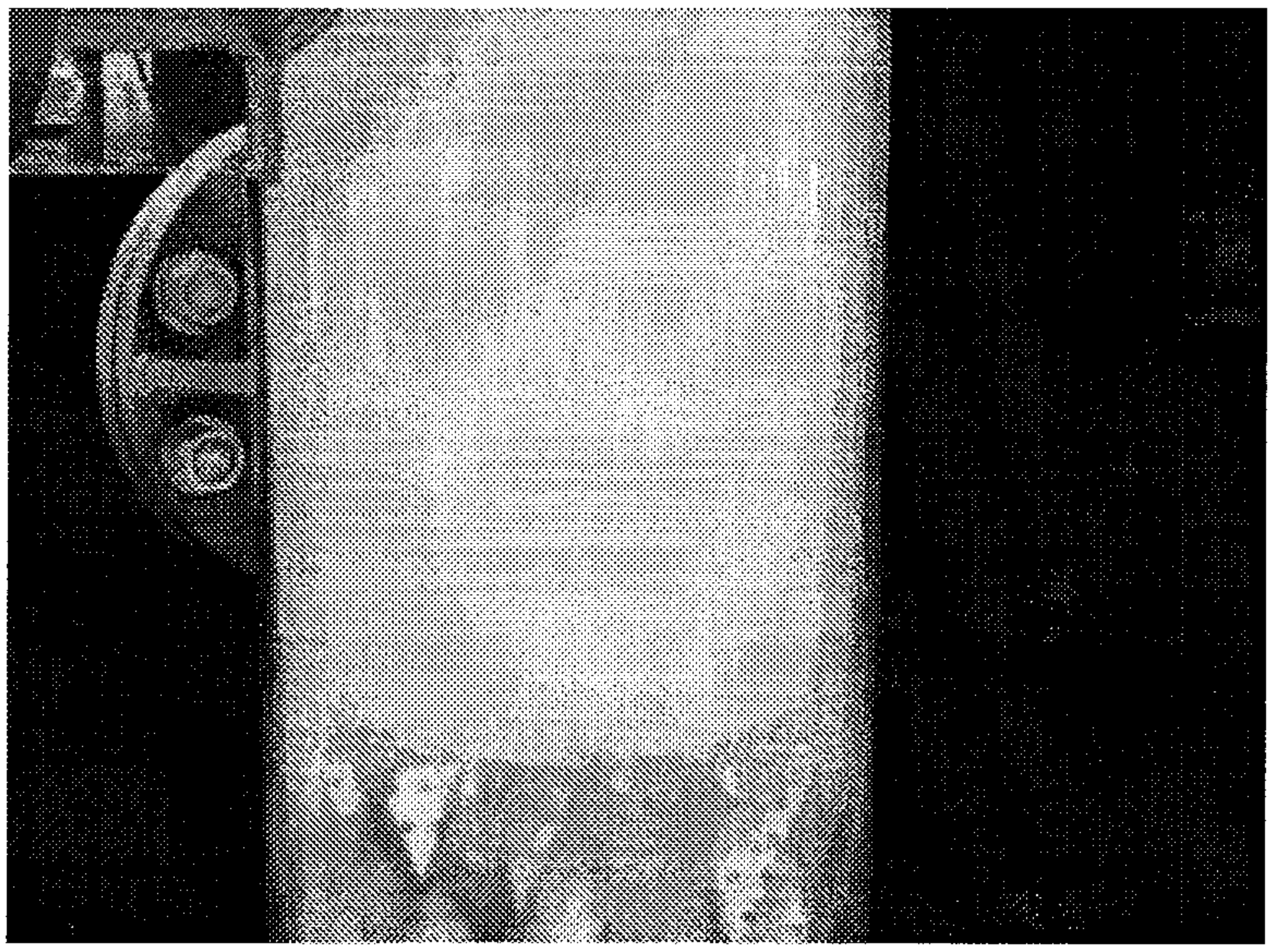


FIG.3-2



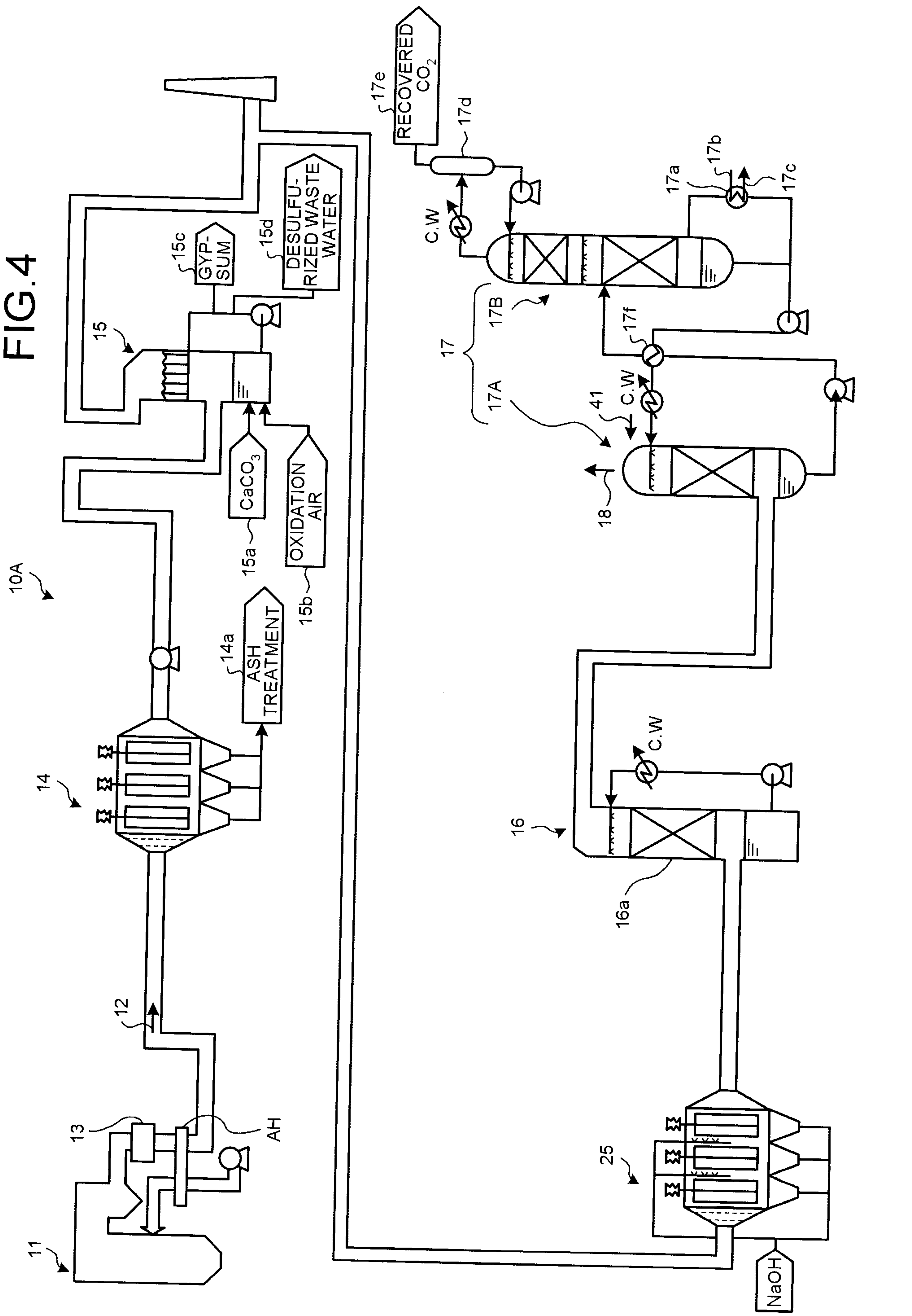

10A
11
13
AH
12
14
14a
ASH TREATMENT
15
15a
CaCO3
15b
OXIDATION AIR
15c
GYP-SUM
15d
DESULFU-RIZED WASTE WATER
16
16a
C.W
17
17A
17B
17a
17b
17c
17d
17e
RECOVERED CO2
17f
18
41
25
NaOH

FIG.4

FIG.5

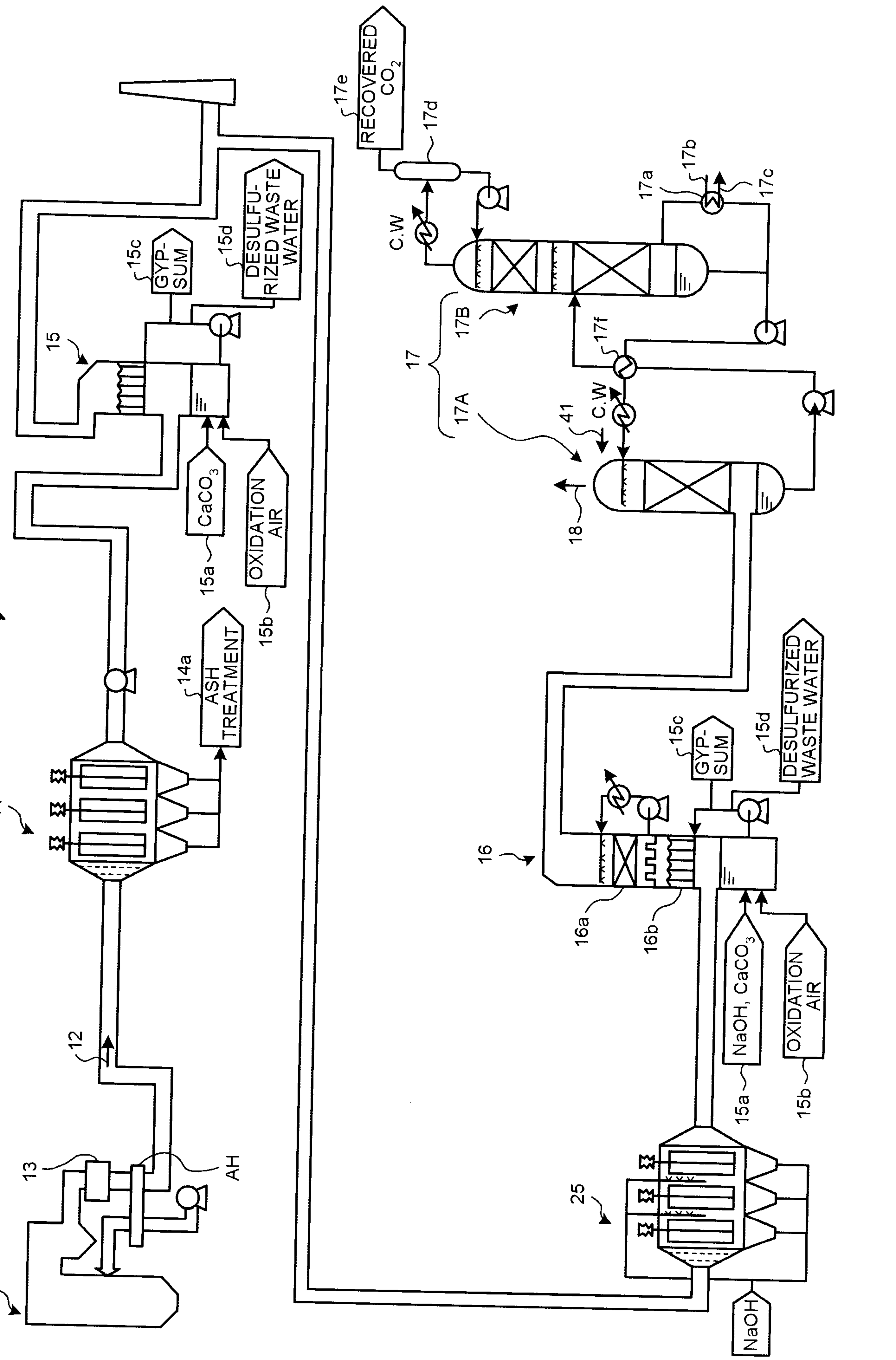
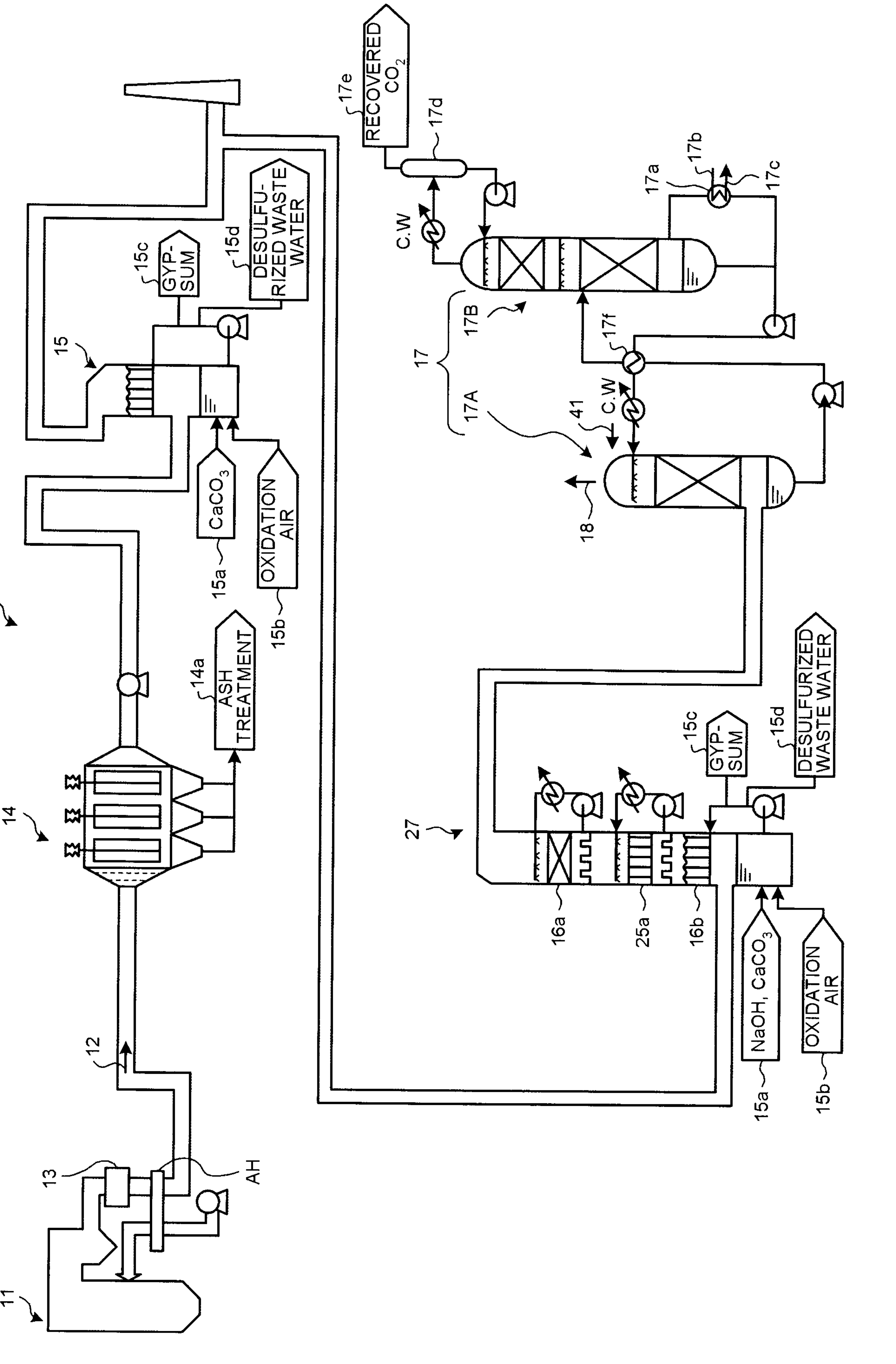
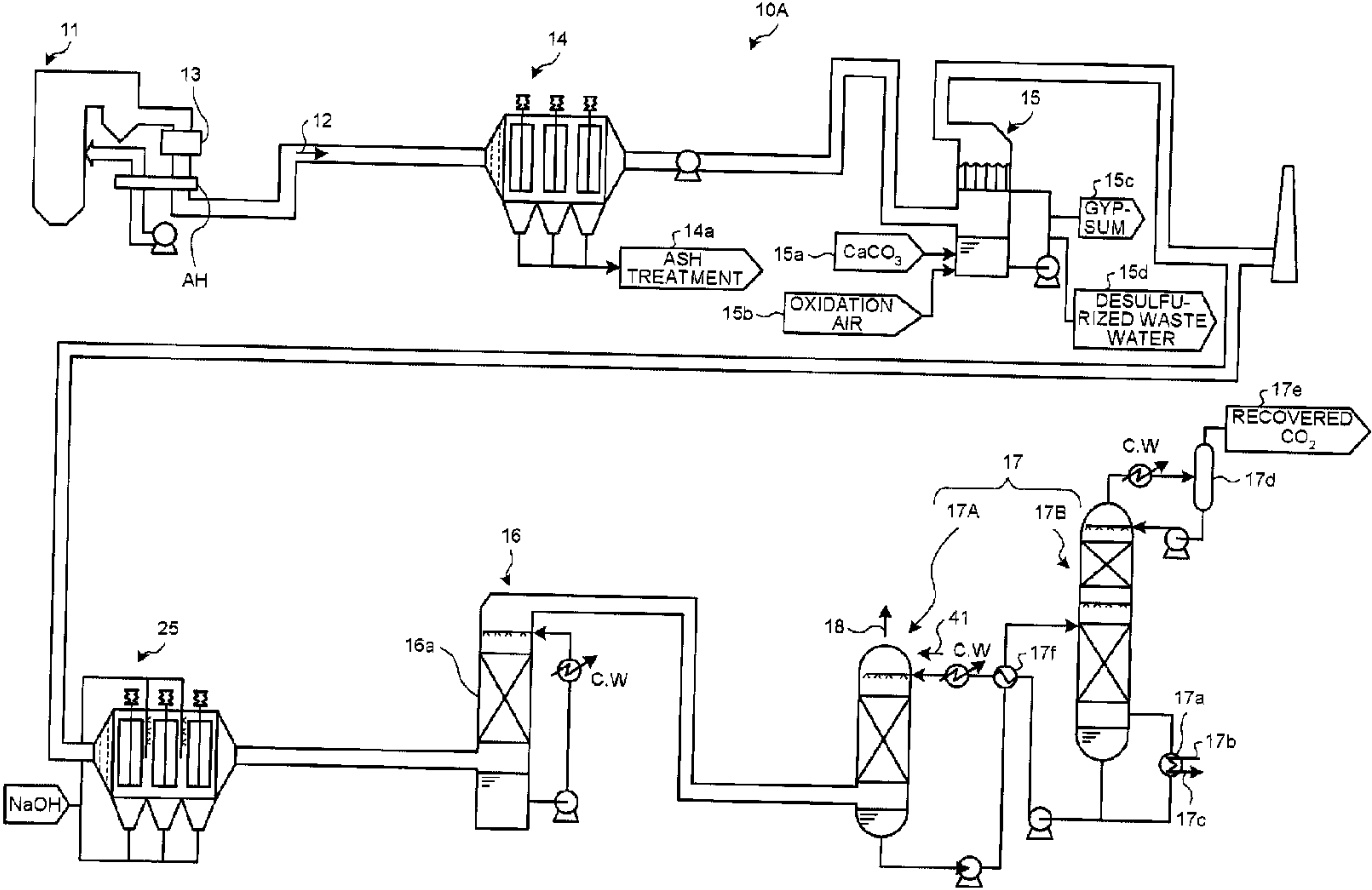

10B
11
13
AH
12
14
14a
ASH TREATMENT
15
15a
CaCO$_3$
15b
OXIDATION AIR
15c
GYP-SUM
15d
DESULFU-RIZED WASTE WATER
25
NaOH
16
16a
16b
15a
NaOH, CaCO$_3$
15b
OXIDATION AIR
15c
GYP-SUM
15d
DESULFURIZED WASTE WATER
18
41
C.W
17
17A
17B
17f
C.W
17a
17b
17c
17d
17e
RECOVERED CO$_2$

FIG.6


10C
11
13
AH
12
14
14a
ASH TREATMENT
15
15a
$CaCO_3$
15b
OXIDATION AIR
15c
GYP-SUM
15d
DESULFU-RIZED WASTE WATER
RECOVERED CO_2
17e
17d
17a
17b
17c
C.W
17B
17f
17
17A
41
C.W
18
27
16a
25a
16b
15c
GYP-SUM
15d
DESULFURIZED WASTE WATER
15a
NaOH, $CaCO_3$
15b
OXIDATION AIR



10A
11
13
14
12
AH
15
14a
ASH TREATMENT
15a
$CaCO_3$
15b
OXIDATION AIR
15c
GYP-SUM
15d
DESULFU-RIZED WASTE WATER
17e
RECOVERED CO_2
C.W
17d
17
17A
17B
16
25
16a
C.W
18
41
C.W
17f
17a
17b
17c
NaOH