



(11) **EP 2 206 952 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
14.07.2010 Bulletin 2010/28

(51) Int Cl.:
F22G 1/16 (2006.01) **F22G 5/04** (2006.01)
F22G 7/12 (2006.01) **F23L 9/02** (2006.01)

(21) Application number: **08765283.0**

(86) International application number:
PCT/JP2008/060470

(22) Date of filing: **06.06.2008**

(87) International publication number:
WO 2009/050917 (23.04.2009 Gazette 2009/17)

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HR HU IE IS IT LI LT LU LV MC MT NL NO PL PT
RO SE SI SK TR**
Designated Extension States:
AL BA MK RS

(71) Applicant: **Mitsubishi Heavy Industries, Ltd.**
Tokyo 108-8215 (JP)

(72) Inventor: **The designation of the inventor has not
yet been filed**

(30) Priority: **17.10.2007 JP 2007270225**

(74) Representative: **Henkel, Feiler & Hänzel**
Patentanwälte
Maximiliansplatz 21
80333 München (DE)

(54) **REHEAT BOILER AND GAS TEMPERATURE CONTROL METHOD OF REHEAT BOILER**

(57) A reheat boiler according to the present invention includes a main boiler configured to make combustion gas originating from combustion in a burner flow from a furnace (102) and pass through a super heater and an evaporation tube bank, a reheat furnace (108) including a reheat burner (107) provided downstream of the evaporation tube bank, and a reheater (109) provided on the upper side of the reheat furnace (108), and also includes a combustion air supply portion (12) that is provided at a position opposite to the reheat burner (107) in the reheat furnace (108) to supply a part of the combustion air as combustion air (11b). By making combustion gas (107a) and the combustion air (11b) collide head-on to facilitate mixing of the combustion gas (107a) with the combustion air (11b), the flow patterns of the combustion gas are changed, whereby temperature unevenness of the combustion gas (107a) at the outlet of the reheat furnace (108) is reduced.

EP 2 206 952 A1

FIG.1A

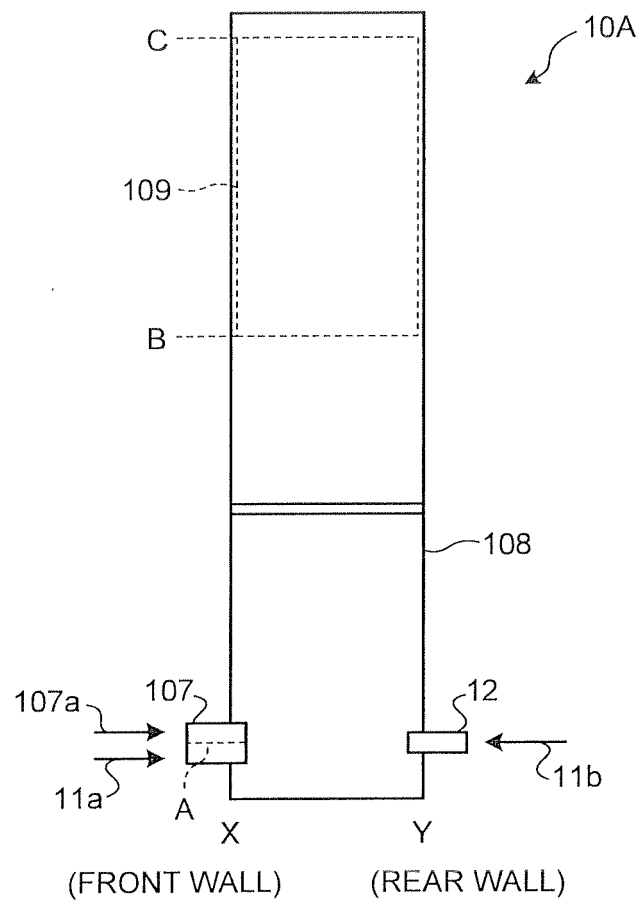
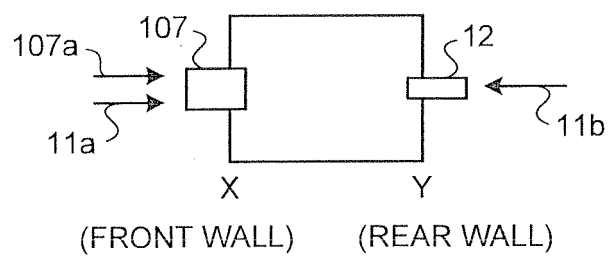


FIG.1B



Description

TECHNICAL FIELD

[0001] The present invention relates to a reheat boiler including a reheat furnace and a reheater provided downstream of an evaporation tube bank and reducing temperature unevenness of combustion gas near an outlet of the reheat furnace and to a gas temperature controlling method of such a reheat boiler.

BACKGROUND ART

[0002] Marine boilers including a super heater have been widely used (Patent Document 1). Furthermore, reheat boilers including a reheat furnace and a reheater provided downstream of combustion gas in conventional marine boilers have been used.

[0003] An exemplary configuration of the conventional marine reheat boiler is illustrated in Fig. 6. Fig. 6 is a schematic of a configuration of the conventional reheat boiler. As illustrated in Fig. 6, this conventional reheat boiler 100 includes: a main boiler 106 including a burner 101, a furnace 102, a front tube bank 103, a super heater (SH) 104, and an evaporation tube bank (rear tube bank) 105; a reheat furnace 108 including a reheat burner 107 provided downstream of the evaporation tube bank 105; and a reheater 109 provided at a combustion gas outlet side. The combustion gas originating from combustion in the burner 101 flows from the furnace 102, passes through the front tube bank 103, the SH 104, and the evaporation tube bank 105, and is mixed with the combustion gas originating from combustion in the reheat burner 107 in the reheat furnace 108. With its heat exchanged with the reheater 109, the gas further flows, and is output from a gas outlet 110. The reheat boiler is thus operated efficiently.

In Fig. 6, the numeral 111 indicates a water drum, the numeral 112 indicates a steam drum, the numerals 113, 114 indicate headers, and the numeral 115 indicates a wall tube.

[0004] [Patent Document 1] Japanese Patent Application Laid-open No. 2002-243106.

DISCLOSURE OF INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0005] The conventional marine reheat boiler 100 includes the reheat burner 107 on a front wall side of the reheat furnace 108, but not on a rear wall side of the reheat furnace 108. Because of this configuration, as illustrated in Fig. 7, large temperature unevenness of the combustion gas arises between the front wall side (indicated by the letter X in Fig. 7) and the rear wall side (indicated by the letter Y in Fig. 7) of the reheat furnace 108 on the outlet side thereof (indicated by the letter B in Fig. 6).

[0006] Temperature unevenness of the combustion gas on the outlet side of the reheat furnace 108 (that is, on the inlet side of the reheater 109) deteriorates heat conductivity of the reheat furnace 108 and the reheater 109, and may also cause high-temperature corrosion of reheater tubes and strength drops of support members in the reheater 109. The letter A in Fig. 7 indicates where the reheat burner is provided, and the letter C indicates the outlet portion of the reheater 109.

[0007] In view of the above problems, an object of the present invention is to provide a reheat boiler and a gas temperature controlling method of a reheat boiler that change gas flow patterns of a reheat burner to reduce temperature unevenness of combustion gas on the outlet side of a reheat furnace.

MEANS FOR SOLVING PROBLEM

[0008] [0008] According to an aspect of the present invention, a reheat boiler that includes a main boiler in which combustion gas produced by combustion in a burner flows through a super heater and an evaporation tube bank from a furnace, a reheat furnace with a reheat burner provided downstream of the evaporation tube bank, and a reheater provided on an upper side of the reheat furnace, includes a combustion air supply portion that is provided at a position opposite to the reheat burner in the reheat furnace to supply a part of combustion air.

[0009] Advantageously, in the reheat boiler, at least two stages of such combustion air supply portions are provided in a height direction of the reheat furnace.

[0010] Advantageously, in the reheat boiler, a part of the combustion air is supplied to the combustion air supply portion by a rate of 50% or less.

[0011] Advantageously, in the reheat boiler, at least two stages of such combustion air supply portions are provided in a height direction of the reheat furnace, and each stage of the combustion air supply portions supplies a different volume of the combustion air.

[0012] According to another aspect of the present invention, a gas temperature controlling method of the above mentioned reheat boiler includes: supplying a part of the combustion air into the reheat furnace from a position opposite to the reheat burner to reduce temperature unevenness of the combustion gas on an outlet side of the reheat furnace.

EFFECT OF THE INVENTION

[0013] According to the present invention, by providing the combustion air supply portion at a position opposite to the reheat burner in the reheat furnace to supply a part of the combustion air to the reheat furnace, flow patterns of gas discharged from the reheat burner can be changed. Therefore, temperature unevenness of the combustion gas on the outlet side of the reheat furnace is reduced.

BRIEF DESCRIPTION OF DRAWINGS

[0014]

[Fig. 1A] Fig. 1A is a schematic of the configuration of a reheat furnace and a reheater included in a reheat boiler according to a first embodiment of the present invention.

[Fig. 1B] Fig. 1B is a sectional view seen in a direction perpendicular to the vertical direction of the reheat furnace illustrated in Fig. 1A.

[Fig. 2] Fig. 2 is a schematic of the configuration of the reheat boiler according to the first embodiment of the present invention.

[Fig. 3] Fig. 3 is an illustrative view of the temperature distribution of combustion gas at the outlet of the reheat furnace.

[Fig. 4] Fig. 4 is a schematic of the configuration of a reheat boiler according to a second embodiment of the present invention, extracting its reheat furnace and reheater alone.

[Fig. 5] Fig. 5 is an illustrative view of the temperature distribution of combustion gas near the outlet of the reheat furnace.

[Fig. 6] Fig. 6 is a schematic of an exemplary configuration of a conventional reheat boiler.

[Fig. 7] Fig. 7 is an illustrative view of the temperature distribution near the outlet of a conventional reheat furnace.

EXPLANATIONS OF LETTERS OR NUMERALS

[0015]

| | |
|--------------------|--|
| 10A, 10B | reheat boiler |
| 11, 11b-1 to 11b-3 | combustion air |
| 12, 12-1 to 12-3 | combustion air supply portion |
| 101 | burner |
| 102 | furnace |
| 103 | front tube bank |
| 104 | super heater (SH) |
| 105 | evaporation tube bank (rear tube bank) |
| 106 | main boiler |
| 107 | reheat burner |
| 108 | reheat furnace |
| 109 | reheater |
| 110 | gas outlet |
| 111 | water drum |
| 112 | steam drum |
| 113, 114 | header |
| 115 | wall tube |

BEST MODE (S) FOR CARRYING OUT THE INVENTION

[0016] The present invention will be described in detail with reference to the accompanying drawings. The embodiments below are not intended to limit the scope of the present invention. Elements described in the embodiments include their variations readily thought of by those skilled in the art and substantially equivalent elements.

First Embodiment

[0017] A reheat boiler according to an embodiment of the present invention will now be described with reference to some drawings.

The reheat boiler according to the present embodiment has a similar configuration to that of a conventional reheat boiler as illustrated in Fig. 6 and has an air supply portion provided to a reheat furnace; therefore, like elements have like reference numerals, and repeated descriptions will be omitted.

Fig. 1A is a schematic of the configuration of the reheat furnace and a reheater included in the reheat boiler according to the first embodiment of the present invention, and is a sectional view along the line I-I in Fig. 2. Fig. 1B is a sectional view seen in a direction perpendicular to the vertical direction of the reheat furnace illustrated in Fig. 1A. Fig. 2 is a schematic of the configuration of the reheat boiler according to the first embodiment of the present invention.

In Figs. 1A and 1B, the letter X represents a front wall side of the reheat furnace, and the letter Y represents a rear wall side of the reheat furnace.

[0018] Referring to Figs. 1A, 1B, and 2, this reheat boiler 10A according to the present embodiment includes, like the configurations of conventional reheat boilers as illustrated in Fig. 6, the main boiler 106 configured to make combustion gas originating from combustion in the burner 101 flow from the furnace 102 and pass through the SH 104 and the evaporation tube bank 105, the reheat furnace 108 in which the combustion gas is reburned with the reheat burner 107, and the reheater 109 through which the reburned combustion gas passes. Referring to Figs. 1A and 1B, the reheat boiler 10A also includes a combustion air supply portion 12 provided at a position opposite to the reheat burner 107 in the reheat furnace 108 to supply a part of combustion air 11a to be supplied to the reheat burner 107 as combustion air 11b. According to the present invention, the combustion air 11a refers to combustion air that is a part of the combustion air 11 and is supplied to the reheat burner 107, while the combustion air 11b refers to combustion air that is another part of the combustion air 11 remaining after being allocated to the reheat burner 107 and is supplied to the combustion air supply portion 12.

[0019] By providing the combustion air supply portion 12 at the position opposite to the reheat burner 107 in the reheat furnace 108, combustion gas 107a discharged from the reheat burner 107 and the combustion air 11b supplied through the combustion air supply portion 12 collide head-on with each other, which facilitates mixing of the combustion gas 107a with the combustion air 11b. Consequently, temperature unevenness of the combustion gas 107a at the outlet of the reheat furnace 108 can be reduced.

[0020] Fig. 3 is an illustrative view of the temperature distribution of the combustion gas at the outlet of the reheat furnace illustrated in Fig. 1A. As indicated in Fig. 3, by providing the combustion air supply portion 12 at the position opposite to the reheat burner 107 in the reheat furnace 108 and supplying the combustion air 11b into the reheat furnace 108, the temperature distribution of the combustion gas 107a near the outlet of the reheat furnace 108 (indicated by the letter B in Figs. 1A and 2) falls within a range from 600 to 800 degrees Celsius, for example. With the average temperature being kept about 700 degrees Celsius, this range is narrower than the temperature distribution of the combustion gas 107a near the outlet of the reheat furnace 108 (indicated by the letter B in Figs. 6 and 7) included in the conventional reheat boiler 100 as indicated in Fig. 7.

[0021] By thus supplying the combustion air 11 into the reheat furnace 108 from the position opposite to the reheat burner 107, temperature unevenness near the outlet of the reheat furnace 108 can be suppressed compared with the temperature of the combustion gas 107a near the outlet of the reheat furnace 108 (indicated by the letter B in Figs. 6 and 7) included in the conventional reheat boiler as indicated in Fig. 7.

[0022] In the reheat boiler 10A according to the present embodiment, the combustion air 11b that remains after subtracting the combustion air 11a to be supplied to the reheat burner 107 from the combustion air 11 is supplied through the combustion air supply portion 12 preferably by a rate of 50% or less. This is because allocating a majority of the combustion air 11 to the combustion air 11b will cause incomplete combustion of fuel in the reheat burner 107.

[0023] In the reheat boiler 10A according to the present embodiment, the combustion gas 107a is first burned with the combustion air 11a supplied into the reheat burner 107 and then with the combustion air 11b supplied through the combustion air supply portion 12 in a step-by-step manner. Burning the combustion gas 107a in two stages with the combustion air 11a and the combustion air 11b can suppress the formation of NO_x .

[0024] In the reheat boiler 10A according to the present embodiment, the air volume of the combustion air 11b supplied through the combustion air supply portion 12 is adjusted with, for example, a damper or other air volume adjusters.

[0025] In the reheat boiler 10A according to the present embodiment, by supplying the combustion air 11b into the reheat furnace 108 through the combustion air supply portion 12 provided at the position opposite to the reheat burner 107 in the reheat furnace 108, the flow patterns of the combustion gas 107a discharged from the reheat burner 107 can be changed. Accordingly, temperature unevenness of the combustion gas 107a on the outlet side of the reheat furnace 108 can be reduced. This configuration prevents heat conductivity drops of the reheat furnace 108 and the reheater 109 and also prevents high-temperature corrosion of reheater tubes and strength drops of support members in the reheater 109.

Second Embodiment

[0026] A reheat boiler according to a second embodiment of the present invention will now be described with reference to Figs. 4 and 5.

Fig. 4 is a schematic of the configuration of the reheat boiler according to the second embodiment of the present invention, extracting its reheat furnace and reheater alone.

The reheat boiler according to the present embodiment has a similar configuration to that of the reheat boiler according to the first embodiment; therefore, like elements have like reference numerals, and repeated descriptions will be omitted. Referring to Fig. 4, this reheat boiler 10B according to the present embodiment includes three-staged combustion air supply portions 12-1 to 12-3 disposed at intervals in the height direction of the reheat furnace 108 and at positions opposite to the reheat burner 107 in the reheat furnace 108.

[0027] By supplying the combustion air 11b-1 to 11b-3 into the reheat furnace 108 through the air supply portions 12-1 to 12-3, the mixture degrees of combustion gas with the combustion air 11b-1 to 11b-3 can be adjusted desirably, whereby the temperature distribution of the combustion gas near the outlet of the reheat furnace 108 can be controlled.

[0028] In the boiler 10B according to the present embodiment, the flow rates of the combustion air 11b-1 to 11b-3 supplied through the air supply portions 12-1 to 12-3, respectively, are adjustable thereby. By adjusting the flow rates of the combustion air 11b-1 to 11b-3 supplied into the reheat furnace 108, the mixture degrees of the combustion gas 107a with the combustion air 11b-1 to 11b-3 can be adjusted, whereby the temperature distribution near the outlet of the reheat furnace 108 can be controlled.

For example, by making the air volume of the combustion air 11b-1 relatively large and the air volumes of the combustion air 11b-2 and the combustion air 11b-3 even, the temperature distribution near the outlet of the reheat furnace 108 can be smoothed.

[0029] Fig. 5 is an illustrative view of the temperature distribution of the combustion gas near the outlet of the reheat furnace illustrated in Fig. 4. By adjusting the flow rates of the combustion air 11b-1 to 11b-3 supplied through the combustion air supply portions 12-1 to 12-3 as illustrated in Fig. 4, temperature unevenness of the combustion gas 107a on the outlet side of the reheat furnace 108 can be reduced as indicated in Fig. 5.

[0030] By thus supplying the combustion air 11b into the reheat furnace 108 in multiple stages, the temperature distribution of the combustion gas 107a near the outlet of the reheat furnace 108 (indicated by the letter B in Fig. 4) falls within a range from 620 to 780 degrees Celsius, for example. With the average temperature being kept about 700 degrees Celsius, this range is narrower than the temperature distribution of the combustion gas 107a near the outlet of the reheat furnace 108 (indicated by the letter B in Fig. 6) included in the conventional reheat boiler 100 as indicated in Fig. 7.

[0031] This configuration can achieve a smoother temperature distribution than the temperature distribution of the combustion gas 107a near the outlet of the reheat furnace 108 (indicated by the letter B in Fig. 2) included in the reheat boiler 10A according to the first embodiment as indicated in Fig. 3.

[0032] By thus supplying the combustion air 11b-1 to 11b-3 into the reheat furnace 108 from the positions opposite to the reheat burner 107 and finely adjusting the air volumes of the combustion air 11b-2 and the combustion air 11b-3, temperature unevenness near the outlet of the reheat furnace 108 can be suppressed.

[0033] Fine adjustment of the flow rates of the combustion air 11b-1 to 11b-3 can in turn adjust temperature, retention time, and other conditions of an area where reduction takes place, thereby suppressing the formation of NO_x . For example, making the flow rate of the combustion air 11b-1 small and the flow rate of the combustion air 11b-3 large to cause a shortage of air in the reheat furnace 108 can suppress the formation of NO_x .

[0034] Accordingly, in the reheat boiler 10B according to the present embodiment, by delivering the combustion air 11b-1 to 11b-3 through the combustion air supply portions 12-1 to 12-3 disposed at intervals in the height direction and at the positions opposite to the reheat burner 107 in the reheat furnace 108 and finely adjusting the flow rates of the combustion air 11b-1 to 11b-3 supplied into the reheat furnace 108, the gas flow patterns from the reheat burner 107 can be changed. Consequently, temperature unevenness of the combustion gas 107a on the outlet side of the reheat furnace 108 can be further reduced. This configuration prevents heat conductivity drops of the reheat furnace 108 and the reheater 109 and also prevents high-temperature corrosion of the reheater tubes and strength drops of the support members in the reheater 109.

[0035] The mixture degrees of the combustion gas 107a with the combustion air 11b-1 to 11b-3 can be finely adjusted, whereby the temperature distribution at the outlet of the reheat furnace 108 can be controlled. Furthermore, fine adjustment of the air volumes of the combustion air 11b-1 to 11b-3 can in turn adjust conditions of an area where reduction takes place in the reheat furnace 108, thereby suppressing the formation of NO_x .

[0036] While three stages of the combustion air supply portions 12-1 to 12-3 are disposed at intervals in the height direction of the reheat furnace 108 in the reheat boiler 10B according to the present embodiment, the present invention is not limited thereto. Three or more stages of such air supply portions 12 may be provided.

[0037] With the reheat boilers 10A and 10B according to the present invention, by supplying a part 11b of the combustion

air into the reheat furnace 108 from the position(s) opposite to the reheat burner 107 in the reheat furnace 108, the flow patterns of the combustion gas are changed, whereby temperature unevenness of the combustion gas on the outlet side of the reheat furnace 108 can be reduced. Therefore, they are applicable for marine boilers; however, the present invention is not limited thereto.

INDUSTRIAL APPLICABILITY

[0038] As described above, the reheat boilers and methods for adjusting the temperature of gas output from a reheat boiler according to the present invention can change the flow patterns of combustion gas by supplying a part of combustion air into a reheat furnace through at least one combustion air supply portion disposed at intervals in the height direction of the reheat furnace and at position(s) opposite to a reheat burner in the reheat furnace. Therefore, they are applicable for marine reheat boilers intended to reduce temperature unevenness of the combustion gas on the outlet side of the reheat furnace.

Claims

1. A reheat boiler that includes a main boiler in which combustion gas produced by combustion in a burner flows through a super heater and an evaporation tube bank from a furnace, a reheat furnace with a reheat burner provided downstream of the evaporation tube bank, and a reheater provided on an upper side of the reheat furnace, the reheat boiler comprising:

a combustion air supply portion that is provided at a position opposite to the reheat burner in the reheat furnace to supply a part of combustion air.

2. The reheat boiler according to claim 1, wherein at least two stages of such combustion air supply portions are provided in a height direction of the reheat furnace.
3. The reheat boiler according to claim 1, wherein a part of the combustion air is supplied to the combustion air supply portion by a rate of 50% or less.
4. The reheat boiler according to claim 1, wherein at least two stages of such combustion air supply portions are provided in a height direction of the reheat furnace, and each stage of the combustion air supply portions supplies a different volume of the combustion air.
5. A gas temperature controlling method of the reheat boiler according to any one of claims 1 to 4, the method comprising: supplying a part of the combustion air into the reheat furnace from a position opposite to the reheat burner to reduce temperature unevenness of the combustion gas on an outlet side of the reheat furnace.

FIG.1A

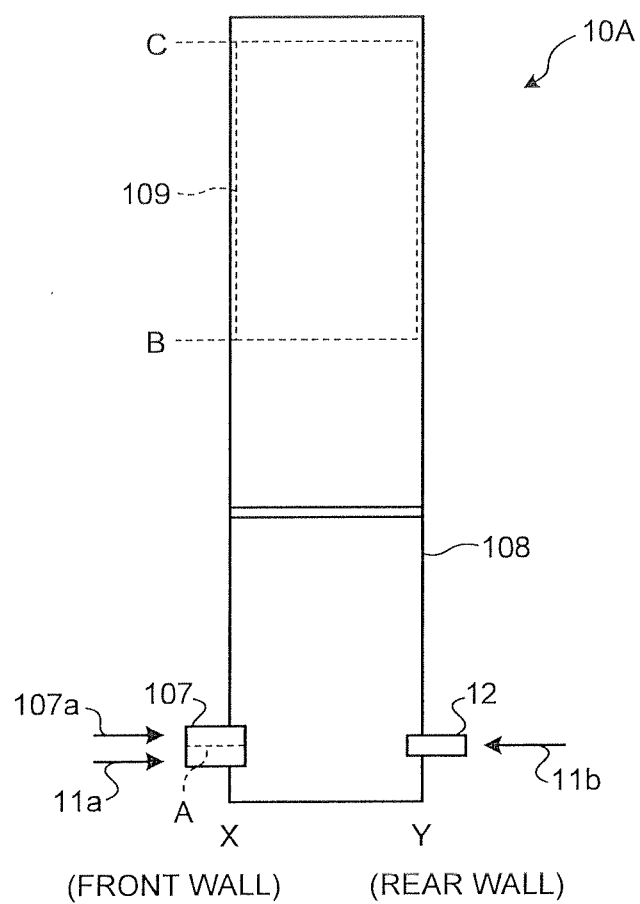


FIG.1B

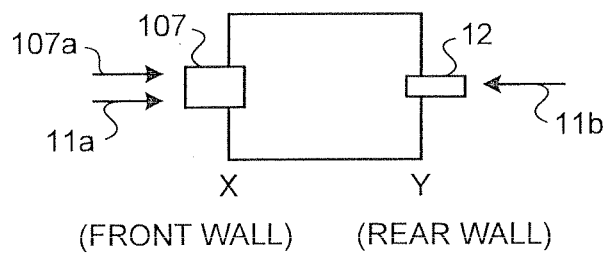


FIG.2

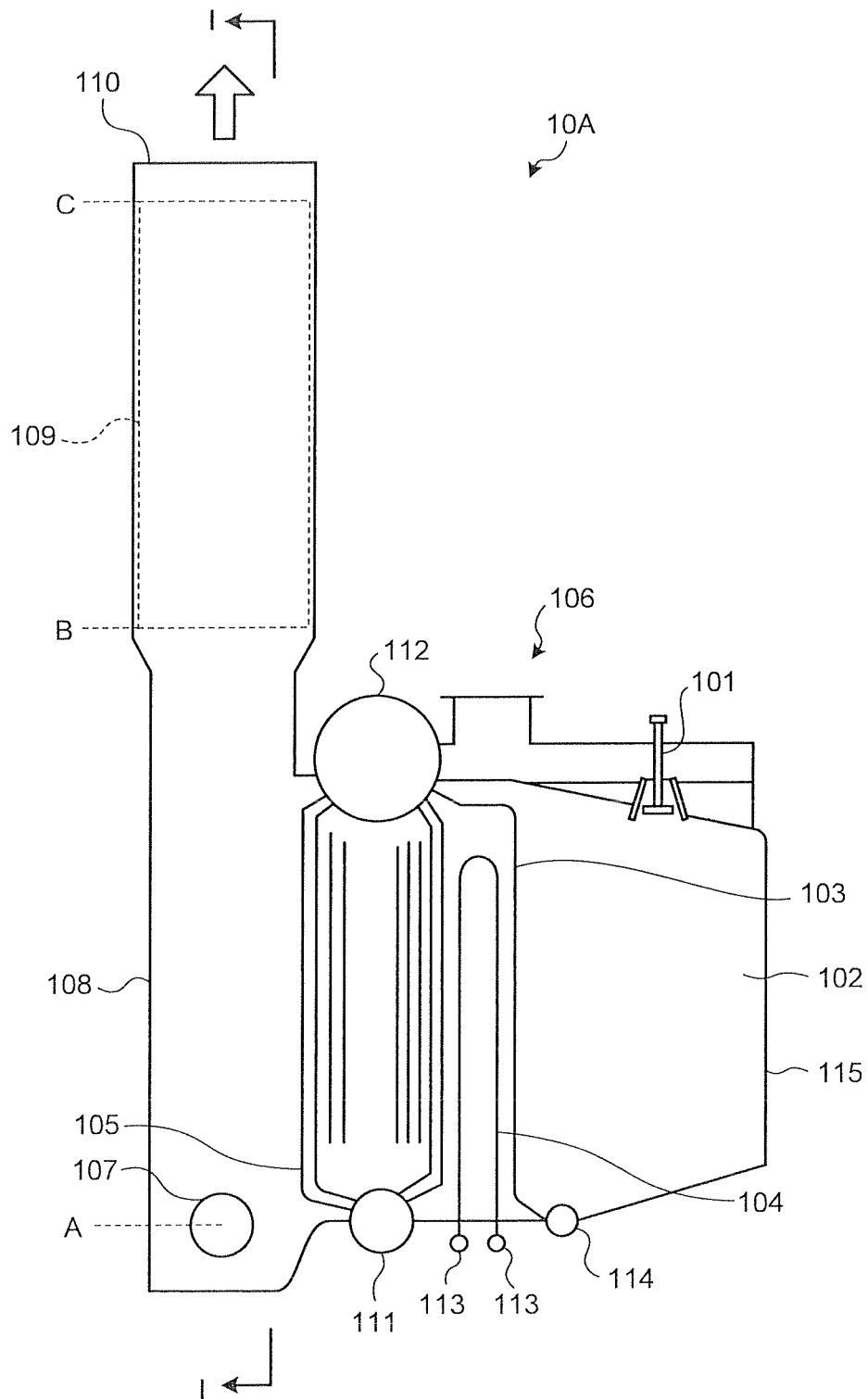


FIG.3

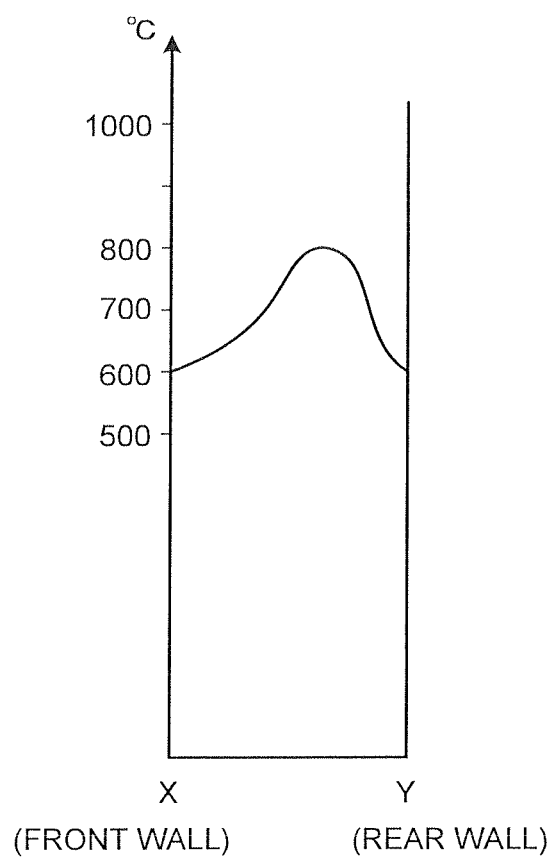


FIG.4

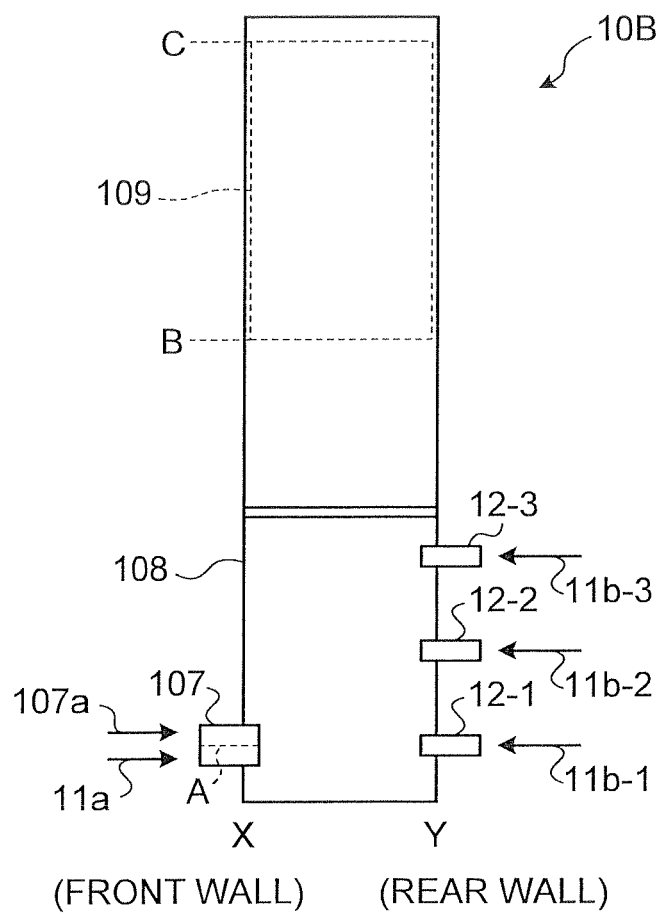


FIG.5

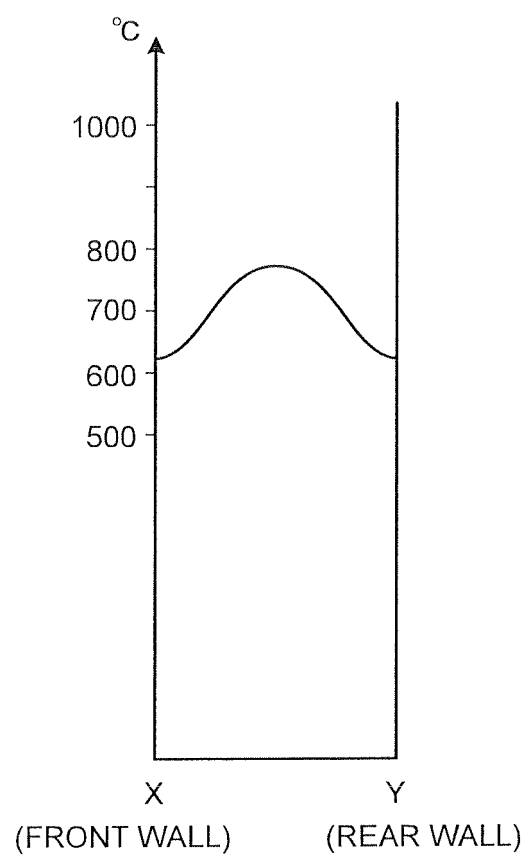


FIG.6

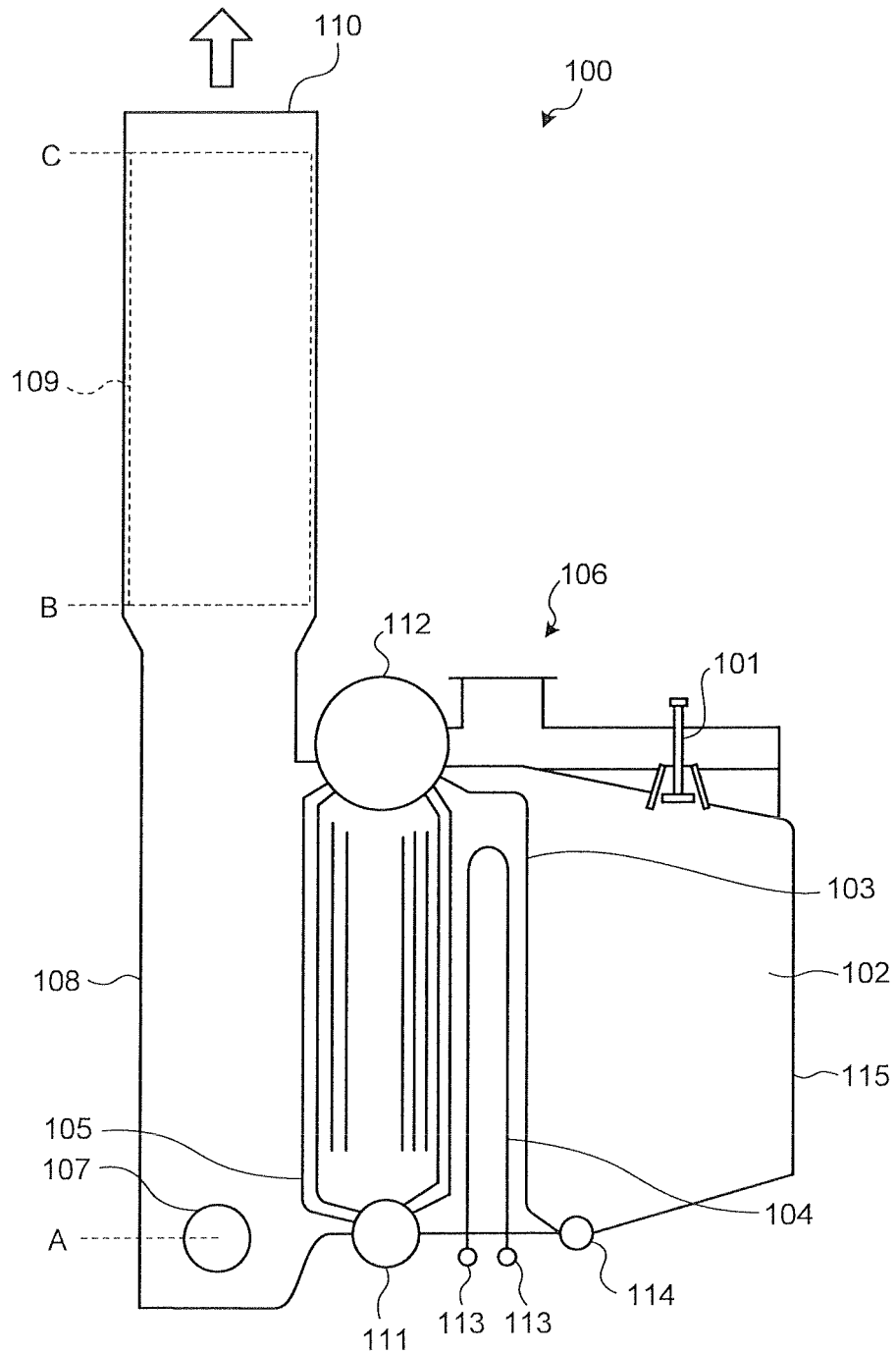
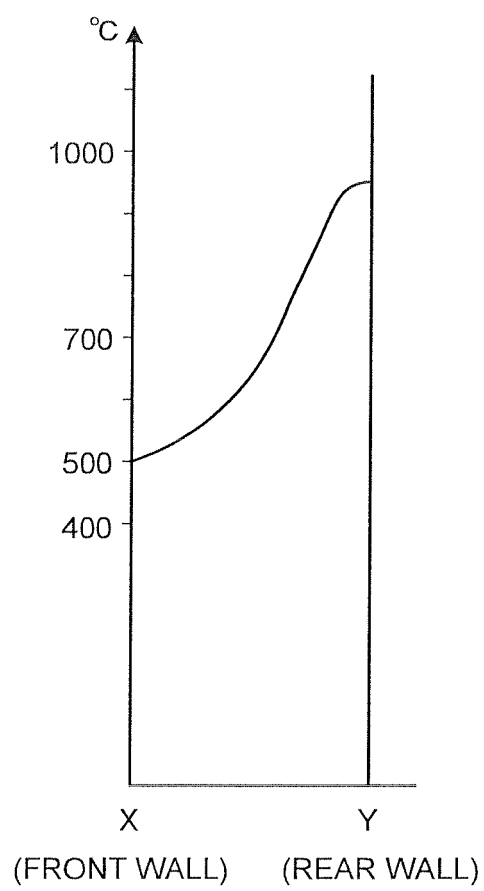


FIG.7



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2008/060470

| A. CLASSIFICATION OF SUBJECT MATTER <i>F22G1/16</i> (2006.01) i, <i>F22G5/04</i> (2006.01) i, <i>F22G7/12</i> (2006.01) i, <i>F23L9/02</i> (2006.01) i According to International Patent Classification (IPC) or to both national classification and IPC | | |
|--|---|--|
| B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) <i>F22G1/16</i> , <i>F22G5/04</i> , <i>F22G7/12</i> , <i>F23L9/02</i> Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2008 Kokai Jitsuyo Shinan Koho 1971-2008 Toroku Jitsuyo Shinan Koho 1994-2008 Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) | | |
| C. DOCUMENTS CONSIDERED TO BE RELEVANT | | |
| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
| Y | JP 54-103906 A (Mitsubishi Heavy Industries, Ltd.), 15 August, 1979 (15.08.79), Page 1, lower right column, line 15 to page 2, upper left column, line 9; Fig. 2 (Family: none) | 1-5 |
| Y | JP 63-172806 A (Director General, Agency of Industrial Science and Technology), 16 July, 1988 (16.07.88), Page 2, lower left column, lines 8 to 15 (Family: none) | 1-5 |
| <input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex. | | |
| * Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family | | |
| Date of the actual completion of the international search 25 June, 2008 (25.06.08) | | Date of mailing of the international search report 08 July, 2008 (08.07.08) |
| Name and mailing address of the ISA/ Japanese Patent Office | | Authorized officer |
| Facsimile No. | | Telephone No. |

Form PCT/ISA/210 (second sheet) (April 2007)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2008/060470

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|-----------|---|-----------------------|
| Y | JP 5-230785 A (Babcock-Hitachi Kabushiki Kaisha), 07 September, 1993 (07.09.93), Par. Nos. [0016] to [0018]; Fig. 3 (Family: none) | 2, 4, 5 |

Form PCT/ISA/210 (continuation of second sheet) (April 2007)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2002243106 A [0004]