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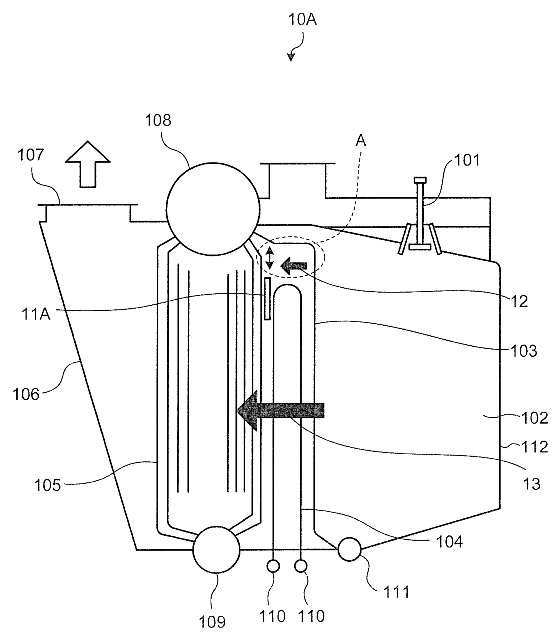
(54) BOILER AND STEAM TEMPERATURE REGULATION METHOD OF BOILER

(57) A boiler according to the present invention is a boiler configured to make combustion gas originating from combustion in a burner (101) flow from a furnace (102) and pass through a super heater (SH) (104) and an evaporation tube bank (105). The boiler includes a downstream shield plate (11A) that is slidable in the vertical direction of the super heater (104) at a position downstream of the combustion gas flowing above the super heater (104), thereby regulating the flow rate of combustion gas entering the upper space A of the super heater (104). By regulating the flow rate of bypass gas (12) with the downstream shield plate (11A) and in turn regulating the flow rate of mainstream gas (13), the temperature of steam output from the super heater (104) is controlled.

FIG.1



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Description

TECHNICAL FIELD

[0001] The present invention relates to a boiler configured to regulate the amount of combustion gas originating from combustion in a burner and passing the upper side of a super heater, and to a method for adjusting the temperature of steam output from such a boiler.

BACKGROUND ART

[0002] Fig. 6 is a schematic of an exemplary configuration of a marine boiler having a super heater that has been conventionally adopted. As illustrated in Fig. 6, this conventional boiler 100 includes a burner 101, a furnace 102, a front tube bank 1.03, a super heater (SH) 104, and an evaporation tube bank (rear tube bank) 105. Combustion gas 120 originating from combustion in the burner 101 flows from the furnace 102 and passes through the front tube bank 103, the super heater 104, and the evaporation tube bank 105 while exchanging heat therewith. The combustion gas 120 flows through an outlet gas duct 106 and then flows out from a gas outlet 107. The steam collected in a steam drum 108 is then supplied to some devices (not shown) as a driving source (see Patent Document 1).
In Fig. 6, the numeral 109 indicates a water drum, the numerals 110, 111 indicate headers, and the numeral 112 indicates a wall tube.
[0003] To control the temperature of the steam generated in the super heater 104, the conventional boiler 100 extracts a part of the steam in the midstream of the super heater 104, reduces the temperature of the steam with the water drum 109, makes the steam exchange heat with the super heater 104 again, and thus adjusts the outlet temperature of the steam generated in the super heater 104. Such a method is called a control desuper heater (CDSH).
[0004] For an efficient operation of the boiler 100, the combustion gas 120 needs to equally flow through an entire heat exchange tube bank that is made up of the super heater 104, the evaporation tube bank 1.05, and the like. The conventional boiler 100 controls the steam temperature so that the boiler 100 is operated efficiently.
[0005] [Patent Document 1] Japanese Patent Application Laid-open No. 2002-243106

DISCLOSURE OF INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0006] Because the super heater 104 is U-shaped, as illustrated in Fig. 7, when the combustion gas 120 bypasses an upper space A on the upper side of the super heater 104 as bypass gas 113 without passing the super heater 104, the combustion gas 120 flowing in the upper space A does not contribute to heat absorption of the super heater 104. Therefore, heat exchange with the heat exchange tube bunk made up of the super heater 104 and the evaporation tube bank 105 does not take place. This causes problems of lowering the heat exchange rate in the super heater 104 and short of steam temperature.
[0007] Rated operation may not be available when the steam temperature changes out of a CDSH adjustable range, that is, for example, when the steam temperature rises to equal to or higher than 560 degrees Celsius or, the steam temperature is insufficient at, for example, equal to or lower than 515 degrees Celsius.
[0008] In view of the problems, an object of the present invention is to provide a boiler configured to regulate flow patterns of combustion gas originating from combustion in a burner, adjust the temperature of steam generated in a super heater, and enable efficient operation, and a method for adjusting the temperature of steam output from such a boiler.

MEANS FOR SOLVING PROBLEM

[0009] According to an aspect of the present invention, a boiler that flows combustion gas produced by combustion in a burner through a super heater and an evaporation tube bank from a furnace, includes: a shield plate that is configured to be slidable in a vertical direction of the super heater or to be rotatable about one end as a rotation axis in order to allow adjustment of an opening degree thereof, the shield plate being provided at any one or both of an upstream side and a downstream side of the combustion gas flowing above the super heater. A flow rate of the combustion gas entering an upper space of the super heater is regulated.
[0010] Advantageously, in the boiler, a temperature of a part of steam extracted in midstream of the super heater is reduced with a water drum, and the steam is provided to the super heater again, so that a temperature of steam of the super heater is adjusted.
[0011] According to another aspect of the present invention, a method for adjusting a temperature of steam of a boiler that flows combustion gas produced by combustion in a burner through a super heater and an evaporation tube bank from a furnace, includes: providing a shield plate that is configured to be slidable in a vertical direction of the super heater or to be rotatable about one end as a rotation axis in order to allow adjustment of an opening degree thereof, the shield plate being provided at any one or both of an upstream side and a downstream side of the combustion gas flowing above the super heater; and adjusting a flow rate of the combustion gas entering an upper space of the super heater by adjusting a sliding degree or the opening degree of the shield plate.
[0012] Advantageously, in the method for adjusting a temperature of steam of a boiler, a part of steam is extracted in midstream of the super heater, a temperature of the steam thus extracted is reduced with a water drum, and the steam is provided to the super heater again, so that a temperature of steam of the super heater is ad-

justed.

EFFECT OF THE INVENTION

[0013] According to the present invention, by providing a shield plate that is slidable in the vertical direction of the super heater or that has a rotation axis on one end to enable adjustment of its opening degree at any one of a position upstream and downstream or both of the combustion gas flowing above the super heater, the flow patterns of combustion gas originating from combustion in the burner can be regulated. The amount of combustion gas that contributes to heat absorption of the super heater can be thus changed. Accordingly, the temperature of steam generated in the super heater can be controlled, and a controllable temperature range can be extended, whereby the boiler can be efficiently operated.

[0014] The temperature of the steam generated in the super heater can be controlled by extracting a part of the steam in the midstream of the super heater; reducing the temperature of the steam with a water drum; supplying the steam to the super heater again; and thus adjusting the temperature of the steam in the super heater.

BRIEF DESCRIPTION OF DRAWINGS

[0015]

[Fig. 1] Fig. 1 is a schematic of the configuration of a boiler according to a first embodiment of the present invention.

[Fig. 2] Fig. 2 is an illustrative view of flows of bypass gas and mainstream gas passing through a super heater.

[Fig. 3A] Fig. 3A is an illustrative view of a downstream shield plate when incorporated in an existing boiler.

[Fig. 3B] Fig. 3B is an illustrative view of a downstream shield plate when incorporated in a newly manufactured boiler.

[Fig. 4] Fig. 4 is a schematic of the configuration of the boiler according to a second embodiment of the present embodiment.

[Fig. 5A] Fig. 5A is an illustrative view of flows of combustion gas in the boiler according to the first embodiment of the present invention.

[Fig. 5B] Fig. 5B is an illustrative view of flows of combustion gas in the boiler according to the second embodiment of the present invention.

[Fig. 6] Fig. 6 is a schematic of an exemplary configuration of a boiler including a conventional super heater.

[Fig. 7] Fig. 7 is an illustrative view of flows of combustion gas in the conventional boiler.

EXPLANATIONS OF LETTERS OR NUMERALS

[0016]

10A, 10B	boiler
11A, 11C	downstream shield plate
11B	upstream shield plate
12	bypass gas
13	mainstream gas
101	burner
102	furnace
103	front tube bank
104	super heater (SH)
105	evaporation tube bank (rear tube bank)
106	outlet gas duct
107	gas outlet
108	steam drum
109	water drum
110, 111	header
112	wall tube
120	combustion gas
A	upper space
H0	total height of the height of the super heater and the upper space
H1, H2	height of the super heater
h1, h2	height of the upper space A

BEST MODE(S) FOR CARRYING OUT THE INVENTION

[0017] 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]

[0018] A boiler according to a first embodiment of the present invention will now be described with reference to some drawings.

The boiler according to the present embodiment has a similar configuration to that of a conventional boiler as shown in Fig. 6; therefore, like elements have like reference numerals, and repeated descriptions will be omitted.

Fig. 1 is a schematic of the configuration of the boiler according to the first embodiment of the present invention.

As illustrated in Fig. 1, this boiler 10A according to the present embodiment is a boiler configured to make combustion gas originating from combustion in the burner 101 flow from the furnace 102 and pass through the super heater (SH) 104 and the evaporation tube bank 105. The boiler includes a downstream shield plate 11A that is slidable in the vertical direction of the super heater 104 at a position downstream of the combustion gas flowing above the super heater 104, thereby regulating the flow rate of combustion gas entering the upper space A of the super heater 104.

Among the whole combustion gas, combustion gas entering the upper space A of the super heater 104 is referred to as bypass gas 12 and combustion gas passing through the super heater 104 is referred to as mainstream gas 13 in the present embodiment.

[0019] In the boiler 10A according to the present embodiment, the downstream shield plate 11A is oriented perpendicular to the flow direction of the combustion gas. The downstream shield plate 11A provided at a position downstream of the combustion gas flowing above the super heater 104 is slidable in the vertical direction. By regulating the flow rate of the bypass gas 12 entering the upper space A of the super heater 104 with the downstream shield plate 11A, the flow rate of the mainstream gas 13 passing through the super heater 104 is in turn regulated.

[0020] Fig. 2 is an illustrative view of the flows of the bypass gas and the mainstream gas passing through the super heater. As illustrated in Fig. 2, by making the downstream shield plate 11A slide in the vertical direction, the flow rate of the bypass gas 12 can be regulated, and the flow rate of the mainstream gas 13 is in turn regulated.
Specifically, the conventional boiler 100 employs a straightening vane, for example, to regulate the flow of combustion gas and make the combustion gas flow evenly into the super heater 104 and the evaporation tube bank 105. By contrast, the boiler 10A according to the present embodiment employs the downstream shield plate 11A that is slidable, and makes the downstream shield plate 11A slide in the vertical direction, thereby directly regulating the flow rate of the bypass gas 12 entering the upper space A of the super heater 104, and in turn regulating the flow rate of the mainstream gas 13 passing through the super heater 104. The temperature of steam generated in the super heater 104 can thus be controlled.

[0021] Specifically, by making the downstream shield plate 11A slide in the vertical direction, regulating the flow rate of the bypass gas 12 entering the upper space A of the super heater 104, and in turn regulating the flow rate of the mainstream gas 13, the amount of combustion gas that contributes to heat absorption of the super heater 104 can be changed. Accordingly, the temperature of steam output from the super heater 104 can be controlled.

[0022] The downstream shield plate 11A preferably has a height equal to or more than that of the upper space A of the super heater 104 to enable control over the bypass gas 12 entering the upper space A with the downstream shield plate 11A.

[0023] In the boiler 10A according to the present embodiment, the downstream shield plate 11A preferably has a height ranging from 10% to 15%, inclusive, of the total height of the super heater 104 and the upper space A. More specifically, given that the upper space A is approximately 15% as high as the total height of the super heater 104 and the upper space A, the downstream shield plate 11A shields the upper space A, whereby the temperature of steam generated in the super heater 104 can be controlled by approximately 25%, and further by approximately 30%, better than other cases involving no downstream shield plate 11A shielding the upper space A.

[0024] The downstream shield plate 11A may be incorporated in an existing boiler or a newly manufactured boiler, both as the boiler 10A according to the present embodiment.
Incorporating the downstream shield plate 11A in an existing boiler that has been installed enables regulation of the flow rate of the bypass gas 12 with the downstream shield plate 11A by a height h1 of the upper space A relative to a total height H0 of a height H1 of the super heater 104 and the upper space A as illustrated in Fig. 3A, whereby the flow rate of the mainstream gas 13 can be regulated.

[0025] By contrast, incorporating the downstream shield plate 11A in a new boiler that is newly manufactured makes a height H_2 of the super heater 104 smaller than the height H_1 of the super heater 104 in the existing boiler as illustrated in Fig. 3B, thereby increasing a height h2 of the upper space A. This increases the flow rate of the bypass gas 12 that is regulatable with the downstream shield plate 11A in association with the increased height h2 of the upper space A compared with the existing boiler, thereby in turn increasing the regulatable amount of the flow rate of the mainstream gas 13. Consequently, the fluctuation range of the amount of combustion gas that contributes to heat absorption of the super heater 104 can be increased, and thus the controllable range of the temperature of steam output from the super heater 104 can be made large.

[0026] In the boiler 10A according to the present embodiment, the height of the upper space A of the super heater 104 may be increased to extend the controllable range of the temperature of steam generated in the super heater 104. By increasing the height of the upper space A of the super heater 104 and increasing the slidable range of the downstream shield plate 11A in the vertical direction, the flow rate of the mainstream gas 13 can be regulated, and the controllable range of the temperature of steam generated in the super heater 104 can be extended.

[0027] Like in a method for controlling the temperature of steam that is employed with the conventional boiler 100, the boiler 10A according to the present embodiment may also incorporate a so-called CDSH, which extracts a part of the steam in the midstream of the super heater 104, reduces the temperature of the steam with the water drum 109, makes the steam exchange heat with the super heater 104 again, and thus adjusts the outlet temperature of steam generated in the super heater 104. By using the so-called CDSH to control generated steam, as well as controlling the flow of combustion gas with the downstream shield plate 11A used in the boiler 10A according to the present embodiment and controlling the temperature of the steam, the controllable range of the temperature of steam generated in the super heater 104 can be further extended.

[0028] Accordingly, with the boiler 10A according to the present embodiment, by regulating the flow rate of the bypass gas 12 entering the upper space A of the super heater 104 with the downstream shield plate 11A, the flow rate of the mainstream gas 13 passing through the super heater 104 can be regulated. The amount of combustion gas that contributes to heat absorption of the super heater 104 can be thus changed, whereby the temperature of steam generated in the super heater 104 can be controlled.

[0029] Further by increasing the height of the upper space A, the flow rate of the bypass gas 12 that is regulatable with the downstream shield plate 11A can be increased, and the regulatable amount of the flow rate of the mainstream gas 13 is in turn increased. Therefore, the controllable range of the temperature of steam output from the super heater 104 can be made large.

[Second Embodiment]

[0030] A boiler according to a second embodiment of the present invention will now be described with reference to Fig. 4.

Fig. 4 is a schematic of the configuration of the boiler according to the present embodiment.

The boiler according to the present embodiment has a similar configuration to that of the boiler according to the first embodiment; therefore, like elements have like reference numerals, and repeated descriptions will be omitted.

As illustrated in Fig. 4, this boiler 10B according to the present embodiment includes an upstream shield plate 11B at a position upstream of combustion gas flowing above the super heater 104 in the boiler 10A shown in Fig. 1, and a downstream shield plate 11C replacing the downstream shield plate 11A at a position downstream of combustion gas flowing above the super heater 104 and having a rotation axis on one end to enable adjustment of its opening degree.

Specifically, the downstream shield plate 11C has a rotation axis on its upper or lower end to enable adjustment of its opening degree. Referring to Fig. 4, the downstream shield plate 11C has a rotation axis on its lower end to enable adjustment of its opening degree.

[0031] The upstream shield plate 11B provided at a position upstream of the combustion gas flowing above the super heater 104 is slidable in the vertical direction, and the downstream shield plate 11C provided at a position downstream of the combustion gas flowing on the upper side of the super heater 104 has a rotation axis on its lower end to enable adjustment of its opening degree. With this arrangement, the flow rate of the mainstream gas 13 passing through the super heater 104 is regulated.

[0032] Fig. 5A is an illustrative view of flows of combustion gas in the boiler according to the first embodiment of the present invention. Fig. 5B is an illustrative view of flows of combustion gas in the boiler according to the second embodiment of the present invention. Referring to Fig. 5B, the downstream shield plate 11C has a rotation axis on its upper end to enable adjustment of its opening degree.

Among the whole combustion gas in the boiler 10A according to the first embodiment of the present invention, the bypass gas 12 is controlled to flow into the super heater 104 on the downstream of the super heater 104 with the downstream shield plate 11A as illustrated in Fig. 5A; therefore, the bypass gas 12 on the upstream of the super heater 104 does not contribute to heat absorption. By contrast, in the boiler 10B according to the second embodiment of the present invention, by making the upstream shield plate 11B slide upward as illustrated in Fig. 5B, the bypass gas 12 can be merged with the mainstream gas 13.

[0033] The downstream shield plate 11C when closed can prevent the bypass gas 12 or the mainstream gas 13 ascending toward the upper space A of the super heater 104 from leaking out of the upper space A of the super heater 104. Accordingly, the flow rate of the mainstream gas 13 can be increased in ratio. By controlling the flows into the super heater 104 on both the upstream and the downstream of the super heater 104, the bypass gas 12 and the mainstream gas 13 can contribute to heat absorption of the super heater 104 on both the upstream and the downstream of the super heater 104.

[0034] The use of the boiler 10B according to the second embodiment of the present invention can thus further extend the controllable range of the temperature of steam generated in the super heater 104.

[0035] By regulating the flow rate of the bypass gas 12 entering the upper space A of the super heater 104 with the upstream shield plate 11B and the downstream shield plate 11C, the flow rate of the mainstream gas 13 passing through the super heater 104 can be regulated. The amount of combustion gas that contributes to heat absorption of the super heater 104 can be thus changed, whereby the temperature of steam output from the super heater 104 can be controlled.

[0036] In the boiler 10B according to the present embodiment, by regulating the flow rate of the bypass gas 12 entering the upper space A of the super heater 104 with the upstream shield plate 11B and the downstream shield plate 11C, the flow rate of the mainstream gas 13 passing through the super heater 104 can be regulated. The amount of combustion gas that contributes to heat absorption of the super heater 104 can be thus changed, whereby the temperature of steam output from the super heater 104 can be controlled.

[0037] While the boiler 10B according to the present embodiment includes the upstream shield plate 11B and the downstream shield plate 11C above the super heater 104, the present invention is not limited thereto. Any one of the upstream shield plate 11B and the downstream shield plate 11C may be provided above the super heater 104. Alternatively, the downstream shield plate 11A employed in the boiler 10A according to the first embodiment illustrated in Fig. 1 may replace the downstream shield plate 11C and be provided above the super heater 104, together with the upstream shield plate 11B. Furthermore, the upstream shield plate 11B may be a shield plate having a rotation axis on one end to enable adjustment of its opening degree like the downstream shield plate 11C, whereby the shield plates on both the upstream and the downstream above the super heater 104 enable adjustment of their opening degrees.

[0038] In the boilers 10A and 10B according to the present invention, by changing the flow patterns of combustion gas and regulating the flow rate of combustion gas passing through the super heater 104, and thus changing the amount of combustion gas that contributes to heat absorption of the super heater 104, the temperature of steam output from the super heater 104 can be controlled. Therefore, they are applicable for marine boilers; however, the present invention is not limited thereto.

INDUSTRIAL APPLICABILITY

[0039] As described above, the boilers and the methods for adjusting the temperature of steam output from a boiler according to the present invention can regulate the flow rate of combustion gas entering the upper space of a super heater with a shield plate, change the flow patterns of combustion gas, and regulate the flow rate of combustion gas passing through the super heater, thereby changing the amount of combustion gas that contributes to heat absorption of the super heater. The boilers and the methods, therefore, are suitably applicable for boilers that can control the temperature of steam output from the super heater and for methods for adjusting the temperature of steam output from such boilers.

Claims

1. A boiler that flows combustion gas produced by combustion in a burner through a super heater and an evaporation tube bank from a furnace, the boiler comprising:

    a shield plate that is configured to be slidable in a vertical direction of the super heater or to be rotatable about one end as a rotation axis in order to allow adjustment of an opening degree thereof, the shield plate being provided at any one or both of an upstream side and a downstream side of the combustion gas flowing above the super heater, wherein
    a flow rate of the combustion gas entering an upper space of the super heater is regulated.

2. The boiler according to claim 1, wherein
a temperature of a part of steam extracted in midstream of the super heater is reduced with a water drum, and the steam is provided to the super heater again, so that a temperature of steam of the super heater is adjusted.

3. A method for adjusting a temperature of steam of a boiler that flows combustion gas produced by combustion in a burner through a super heater and an evaporation tube bank from a furnace, the method comprising:

    providing a shield plate that is configured to be slidable in a vertical direction of the super heater or to be rotatable about one end as a rotation axis in order to allow adjustment of an opening degree thereof, the shield plate being provided at any one or both of an upstream side and a downstream side of the combustion gas flowing above the super heater; and
    adjusting a flow rate of the combustion gas entering an upper space of the super heater by adjusting a sliding degree or the opening degree of the shield plate.

4. The method for adjusting a temperature of steam of a boiler according to claim 3, wherein
a part of steam is extracted in midstream of the super heater, a temperature of the steam thus extracted is reduced with a water drum, and the steam is provided to the super heater again, so that a temperature of steam of the super heater is adjusted.

FIG.1

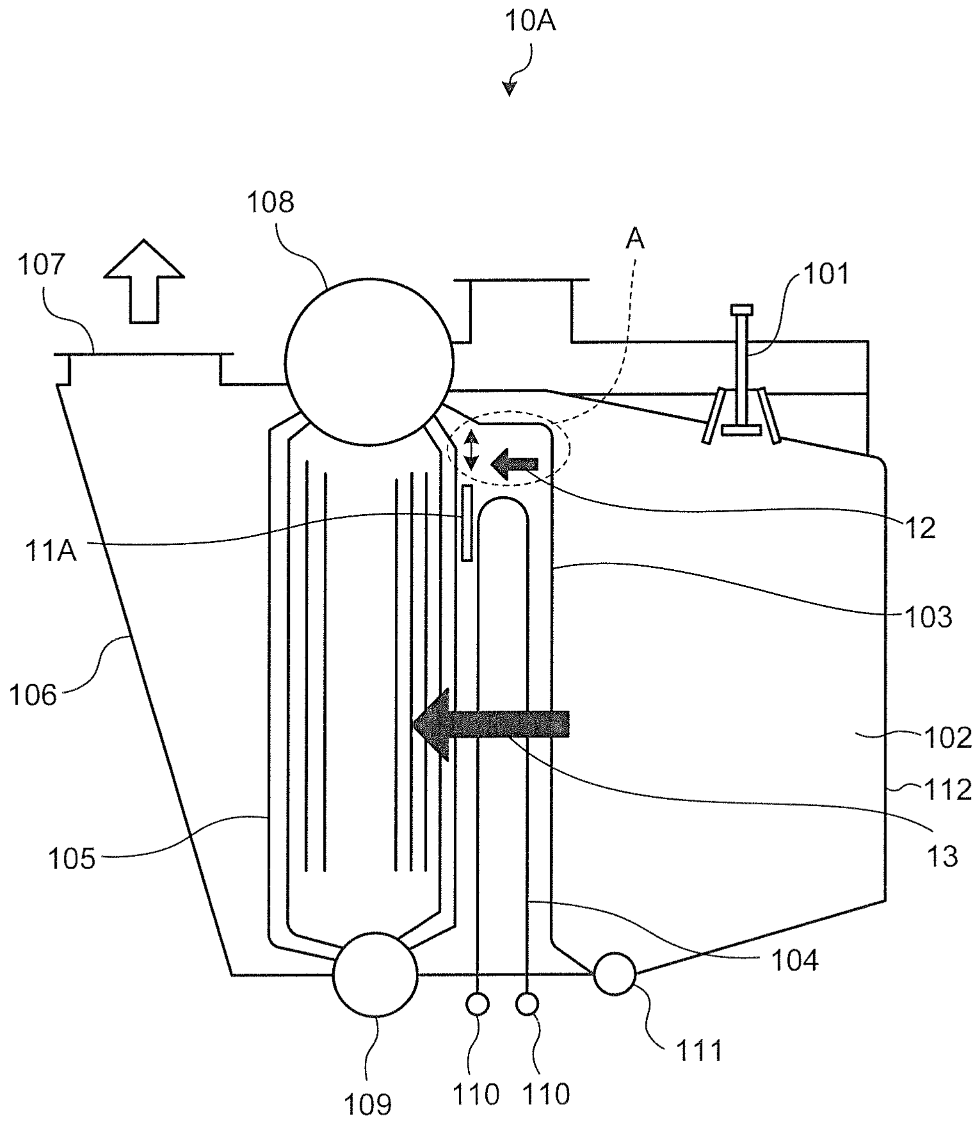

10A
108
A
107
101
12
11A
103
106
102
112
105
13
104
111
109
110
110

FIG.2

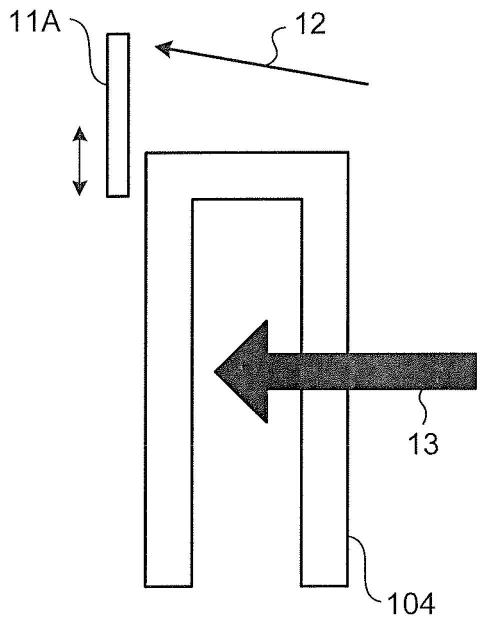


FIG.3A

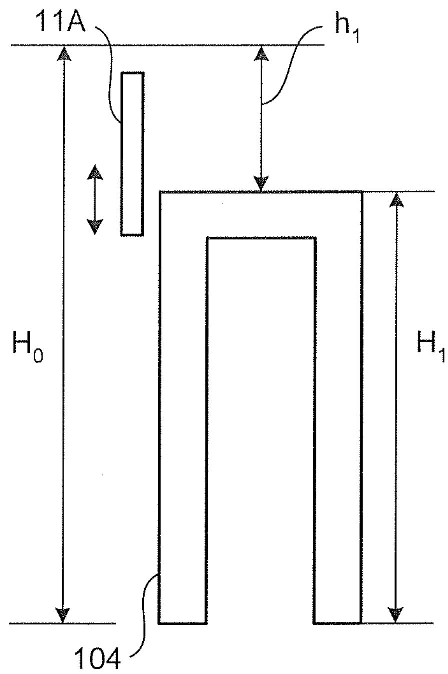


FIG.3B

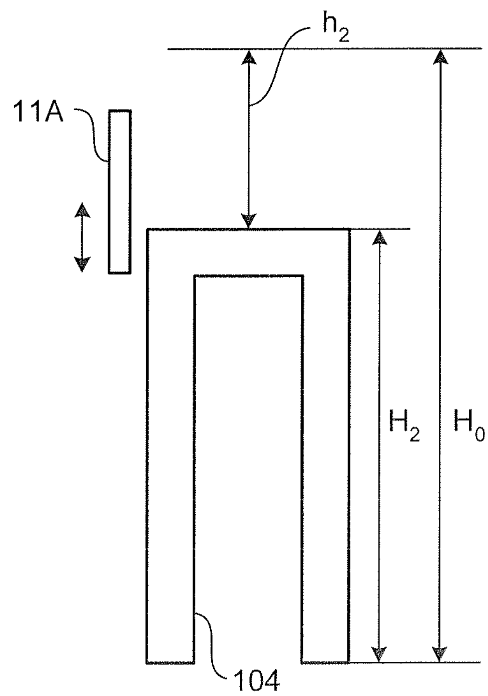


FIG.4

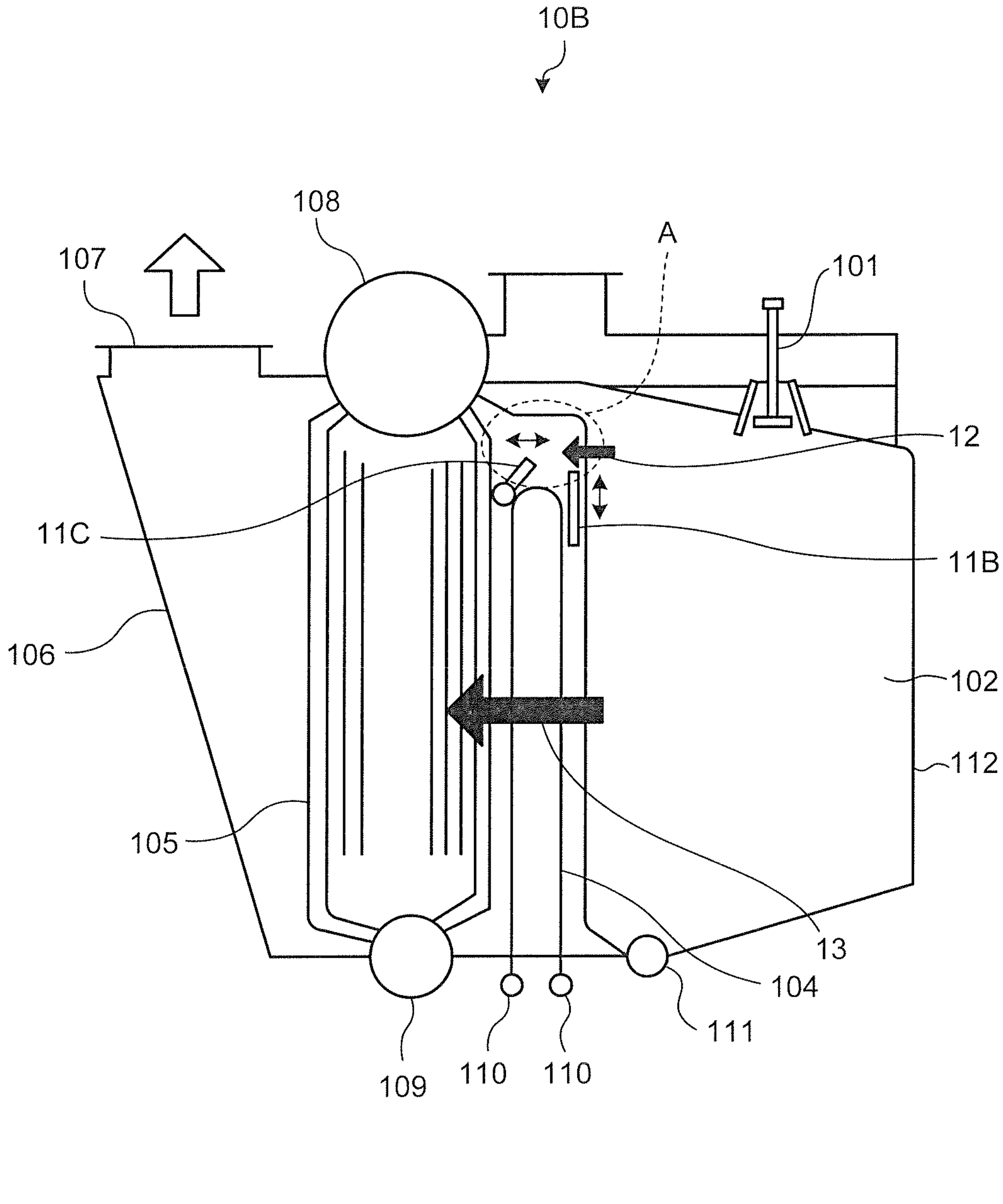

10B
108
107
A
101
12
11C
11B
106
102
112
105
13
104
111
109
110
110

FIG.5A

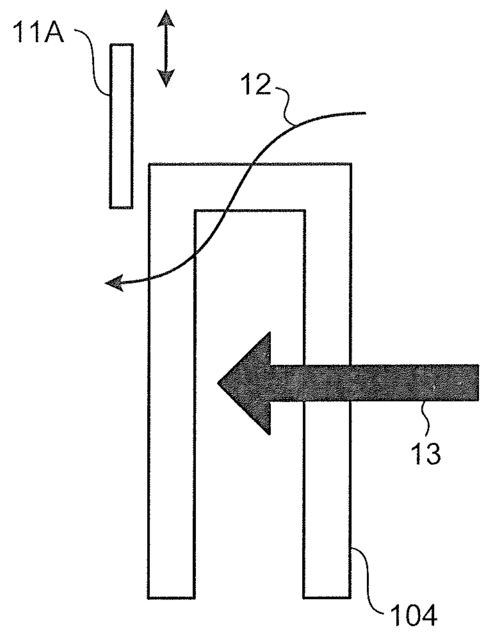


FIG.5B

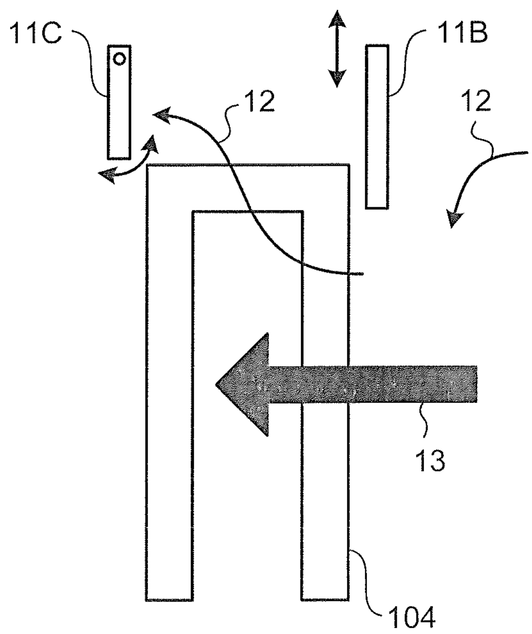


FIG.6

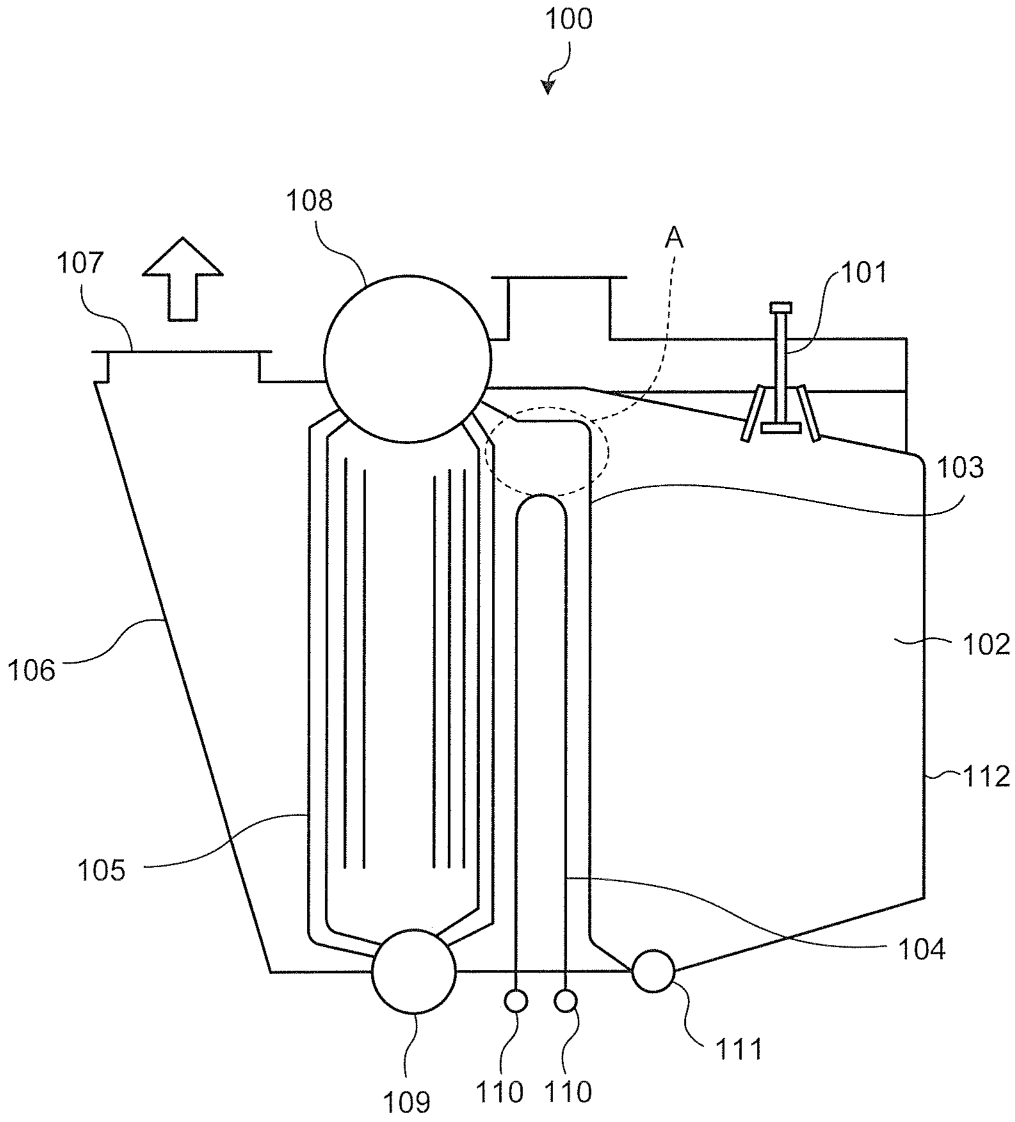
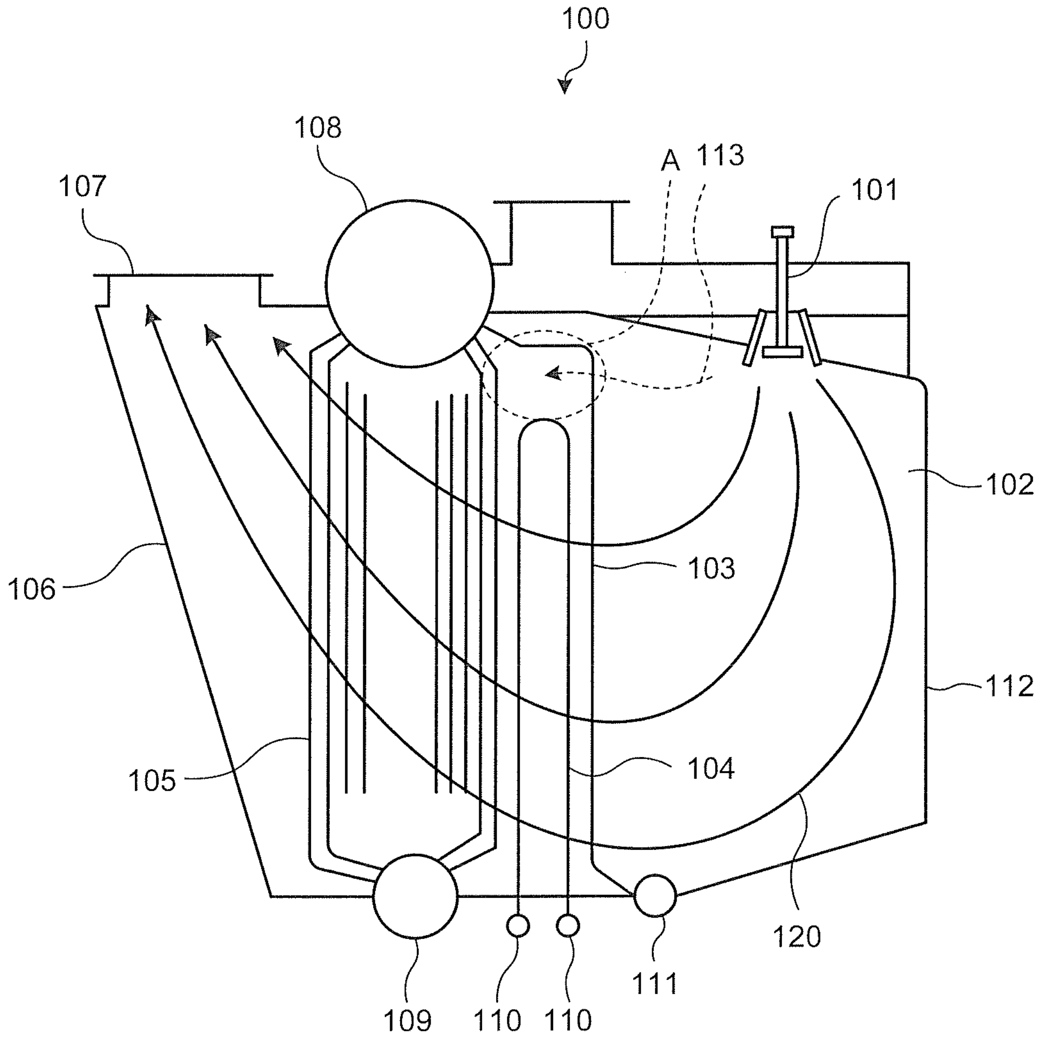


FIG.7



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2008/060471

A. CLASSIFICATION OF SUBJECT MATTER
F22G5/04(2006.01)i, *F22G5/16*(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)
F22G5/04, F22G5/16

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 2002-243106 A (Mitsubishi Heavy Industries, Ltd.), 28 August, 2002 (28.08.02), Par. Nos. [0002] to [0003] (Family: none)	1-4
Y	JP 2002-147701 A (Babcock-Hitachi Kabushiki Kaisha), 22 May, 2002 (22.05.02), Par. Nos. [0014] to [0024] (Family: none)	1-4
Y	JP 8-28808 A (Babcock-Hitachi Kabushiki Kaisha), 02 February, 1996 (02.02.96), Par. Nos. [0014] to [0021] (Family: none)	1-4

☒ Further documents are listed in the continuation of Box C.　☐ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 June, 2008 (24.06.08)	01 July, 2008 (01.07.08)
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/JP2008/060471

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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A	JP 5-248603 A (Babcock-Hitachi Kabushiki Kaisha), 24 September, 1993 (24.09.93), Par. No. [0020]; Fig. 2 (Family: none)	1,3

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

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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