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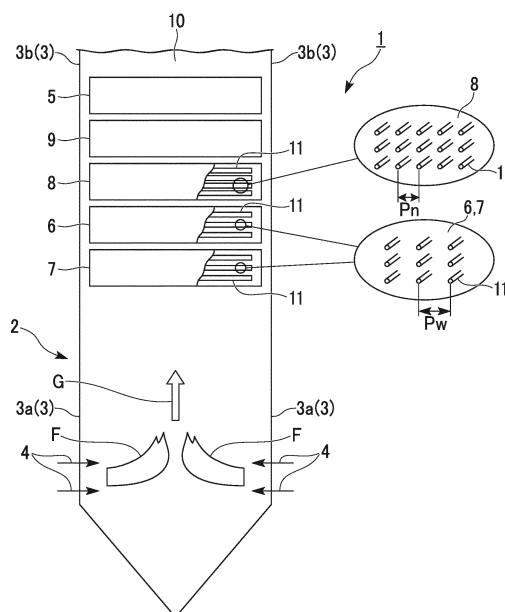
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(54) **TOWER BOILER**

(57) This tower type boiler (1) includes: a furnace wall (3) that forms a boiler main body (2) and that performs a heat exchange with combustion gas (G) that is generated inside this boiler main body (2) ; and a heat transfer section that is positioned at a top portion the boiler main body (2) and that performs a heat exchange with the combustion gas (G) that is generated within the boiler main body (2). The heat transfer section is provided with a plurality of superheaters (6~8), and an adjacent pitch (Pw) between heat transfer pipes in at least those superheaters (6, 7) from among the plurality of superheaters (6~8) that are located closest to the furnace wall bottom portion (3a) is set wider than an adjacent pitch (Pn) between heat transfer pipes (11) in that superheater (8) that is located furthest away from the furnace wall bottom portion (3a).

FIG. 1



Description

[Field of the Invention]

[0001] The present invention relates to a tower type boiler.

[0002] Priority is claimed on Japanese Patent Application No. 2011-160529, filed July 22, 2011, the contents of which are incorporated herein by reference.

[Background Art]

[0003] A tower type boiler is a boiler that is suitable for being installed in a limited space. An example thereof is the tower type boiler disclosed in Patent document 1.

[0004] This tower type boiler is provided with a boiler main body, a burner that injects fuel into the interior of the boiler main body and burns this fuel, and a heat transfer section that performs a heat exchange with the combustion gas that is generated as a result of the fuel being injected from the burner into the interior of the boiler main body and burned therein. A reduction in the size of this boiler (i.e., in the surface area occupied by this boiler) can be achieved by placing superheaters, a reheater, and an economizer that make up the heat transfer section on a top portion of a box-shaped furnace wall.

[0005] The heat transfer section, for example, the superheaters are provided with a long heat transfer pipe that is folded back and forth several times so as to form a pipe bundle, and the greater the adjacent pitch between the heat transfer pipes (i.e., the greater the distance between mutually adjacent heat transfer pipes) in this bundled state, the greater the volume of the superheater becomes. Because the size of the superheaters directly affects the size of the boiler, in a conventional tower type boiler, superheaters (i.e., a heat transfer section) having the narrowest possible adjacent pitch are employed.

[0006] In this manner, if superheaters having a narrow adjacent pitch are employed, then not only is it possible to obtain highly efficient heat transfers, but the size of the boiler can also be reduced. However, when a combustion gas that contains ash is introduced into a superheater having a narrow adjacent pitch, then if the temperature of the combustion gas exceeds the melting point of the ash, the ash becomes adhered to the heat transfer pipe and the fluidity of the combustion gas is constricted by the amount that the adjacent pitch of the heat transfer pipe is narrowed. As a result, effective heat transfer becomes impossible.

[0007] In this type of conventional tower type boiler, in order to avoid a situation in which ash becomes blocked between mutually adjacent heat transfer pipes in a superheater, the surface area of the heat transfer surface (i.e., of the furnace wall in which a number of furnace wall pipes have been arranged in a vertical direction) as far as the superheater that is closest to the bottom portion of the furnace wall is increased so as to absorb a suitable amount of heat. By doing this, the temperature of the

combustion gas that is introduced into the superheaters is prevented from exceeding the melting point of the ash.

[Related Art Documents]

[Patent documents]

[0008] [Patent document 1] Japanese Patent Application, First Publication No. H09-243004

[Disclosure of the Invention]

[Problems to be Solved by the Invention]

[0009] If the tower type boiler disclosed in the aforementioned Patent document 1 is a tower type boiler that is capable of generating steam in high-steam conditions (i.e., high-temperature, high-pressure conditions) with the purpose of improving plant efficiency, then the fuel input quantity is reduced thanks to the improvement in plant efficiency, however, as well as this, the flow rate of the steam that is supplied from the tower type boiler to the turbine is reduced. In other words, because the water supply flow rate is reduced, this results in the temperature of the water or steam that is flowing through the furnace wall pipes increasing compared with a tower type boiler in conventional steam conditions. Moreover, there are also cases in which the amount of heat recovered by the water supply heater is increased in order to further improve the plant efficiency. In such cases, the temperature of the water supply that is introduced into the boiler increases, and the temperature of the water or steam flowing through the furnace wall pipes further increases.

[0010] On the other hand, in a tower type boiler that is used in high-steam conditions as well, as is described above, it is essential for the temperature of the combustion gas that is introduced into the superheater that is closest to a bottom of the furnace wall to be lowered to less than the melting point of the ash. Because of this, it is not possible to reduce the surface area of the heat transfer surface of a bottom portion of the furnace wall, and to lower the temperature of the water or steam that is flowing through the furnace wall pipe.

[0011] In other words, when the water flowing through the interior of the furnace wall pipes in the furnace wall has changed to high-temperature water or steam in the furnace wall, because it rises towards a drum or separator that is placed in the top portion of the boiler main body, the steam temperature inside the pipes in the top portion of the furnace wall becomes extremely high and there is a possibility of failure of the materials the pipe occurring.

[0012] In this case, even if a material that is able to withstand high-temperature steam, for example, if a 7CrMoVTiB10-10 composition, known as T24, is used for the furnace wall at the top portion of the boiler main body, it is difficult with current welding technology for this material to be used to form a furnace wall. Accordingly, for the operation that is performed under high-steam con-

ditions, technology is desired that will prevent the steam temperature inside the pipe at the top portion of the furnace wall from becoming too hot.

[0013] The present invention was conceived in view of the above-described problems in the conventional technology, and it is an object thereof to provide a tower type boiler that is able to generate steam under high-steam conditions with the purpose of improving plant efficiency without having to use materials that are able to withstand high-temperature steam for the furnace walls.

[Means for Solving the Problem]

[0014] A first aspect of the present invention is a tower type boiler that includes: a furnace wall that forms a boiler main body and that performs a heat exchange with combustion gas that is generated inside this boiler main body; and a heat transfer section that is positioned at a top portion of the boiler main body and that performs a heat exchange with the combustion gas that is generated within the boiler main body, wherein the heat transfer section is provided with a plurality of superheaters, and an adjacent pitch between heat transfer pipes in at least the superheaters from among the plurality of superheaters that are located closest to the furnace wall bottom portion is set wider than an adjacent pitch between heat transfer pipes in that superheater that is located furthest away from the furnace wall bottom portion.

[0015] A second aspect of the present invention is the tower type boiler according to the above-described first aspect in which the respective adjacent pitches between the heat transfer pipes in the plurality of superheaters become gradually narrower in each superheater as they are positioned away from the furnace wall bottom portion.

[0016] A third aspect of the present invention is the tower type boiler according to the above-described first or second aspects in which the respective pitches between the heat transfer pipes in the plurality of superheaters are set such that the temperature of the combustion gas becomes lower than the melting point of ash that is contained in the combustion gas before the combustion gas is introduced into the superheater that has the narrowest adjacent pitch between heat transfer pipes.

[0017] In the tower type boiler of the present invention, prior to combustion gas that contains ash being introduced into a superheater that has narrow adjacent pitches between its heat transfer pipes and that is located on the further side from the furnace wall bottom portion, it is necessary for the temperature of this combustion gas to be lowered to less than the melting point of the ash. For this reason, the superheater that is located on the side that is closest to the bottom portion of the furnace wall, namely, the superheater having a wide adjacent pitch between its heat transfer pipes performs the role of a heat transfer surface that lowers the temperature of the combustion gas. Accordingly, the amount of heat that is absorbed by the furnace walls in which the plurality of furnace wall pipes in the bottom portion of the furnace

wall have been arranged running in a vertical direction is relatively small, and the steam temperature inside the pipes in the top portion of the furnace wall is kept low.

[0018] In this case, when the respective adjacent pitches between heat transfer pipes in the plurality of superheaters become sequentially narrower in each superheater as they are positioned away from the bottom portion of the furnace wall, then in each superheater, not only is it possible to avoid blockages caused by the ash and to prevent the size of the boiler becoming too large, but it also becomes possible to achieve highly efficient heat exchange.

[0019] In the tower type boiler of the present invention, combustion gas whose gas temperature exceeds the melting point of the ash is introduced into the superheater that is located closest to the bottom side of the furnace wall. Accordingly, if the adjacent pitch between heat transfer pipes in this superheater is set to a narrow value, blockages in the superheater that are caused by the ash becoming adhered to the heat transfer pipe may be concerned. In contrast, if the adjacent pitch between heat transfer pipes in this superheater is set to a wide value, then it is inevitable that the size of the boiler will have to be increased.

[0020] Accordingly, the adjacent pitch between heat transfer pipes in the superheater that is located closest to the bottom side of the furnace wall is set to a value that prevents blockages caused by the ash and also avoids any increase in the boiler size. For example, if combustion gas having a temperature of approximately 1600 °C that has been generated by combustion is to be cooled to below approximately 1200 °C, which is the melting point of the ash, before it is introduced into the superheater that is located on the side furthest away from the bottom portion of the furnace wall, then it is desirable for the adjacent pitch between heat transfer pipes to be between 1000 and 2000 mm. In this case, the adjacent pitch between heat transfer pipes in the superheater that is located on the side furthest away from the bottom portion of the furnace wall is roughly between 600 and 700 mm

[Effects of the Invention]

[0021] In the tower type boiler according to the present invention, by employing the above-described structure, it is possible to perform operations under high-steam conditions with the purpose of improving plant efficiency without having to use materials that are able to withstand high-temperature steam for the furnace walls, namely, without having to alter the material currently being used for the furnace walls.

[Brief description of the drawings]

[0022]

FIG. 1 is a schematic view showing from the side an

embodiment of a tower type boiler according to the present invention.

FIG. 2 is a schematic view showing from the side another embodiment of the tower type boiler according to the present invention.

[Embodiments for Carrying out the Invention]

[0023] Hereinafter, the tower type boiler of the present invention will be described based on the drawings.

[0024] FIG. 1 shows an embodiment of the tower type boiler according to the present invention.

[0025] As is shown in FIG. 1, this tower type boiler 1 is provided with a furnace wall 3 that forms a boiler main body 2, a burner 4 that injects fuel into the interior of the boiler main body 2 and burns this fuel, and a heat transfer section that performs a heat exchange with combustion gas G that is generated as a result of the fuel being injected from the burner 4 into the interior of the boiler main body 2 and burned therein. The heat exchange with the combustion gas G is performed by a furnace wall bottom portion 3a and a furnace wall top portion 3b that are located respectively in a lower portion and an upper portion of the boiler main body 2. The heat transfer section is located within a top portion flow path 10 that is surrounded by the furnace wall top portion 3b of the boiler main body 2, and this heat transfer section is provided with a plurality of superheaters 5 to 8, a reheater 9, and an economizer (not shown).

[0026] In this tower type boiler 1, the combustion gas G is made to flow through the heat transfer section inside the top portion flow path 10, namely, the combustion gas G is made to flow to the superheaters 7, 6, and 8, the reheater 9, the superheater 5, and the economizer and to perform a heat exchange therewith, and the combustion gas G after this heat exchange is introduced to a nitrous oxide removal catalyst of a nitrous oxide removal system and an exhaust gas processing device of a desulfurization apparatus and the like that are located further downstream so that components of sulfur compounds and nitrogen compounds and the like are removed therefrom. The combustion gas G is then discharged into the atmosphere.

[0027] Respective heat transfer pipes 11 that make up the superheater 7 that is positioned closest to the furnace wall bottom portion 3a side out of the plurality of superheaters 5 to 8 and that is exposed to the flames F, and the heat transfer pipes 11 that make up the superheater 6 that is positioned on the downstream side of the superheater 7 are folded back and forth several times so as to form a pipe bundle. Furthermore, as is shown in the enlarged portion in FIG. 1, adjacent pitches Pw between the respective heat transfer pipes 11 making up these superheaters 6 and 7 are set wider than the pitches Pn between the heat transfer pipes 11 making up the superheater 8 which is positioned on the side away from the furnace wall bottom portion 3a.

[0028] As has been described above, in the tower type

boiler 1 according to this embodiment, it is necessary to lower the temperature of the combustion gas G to less than the melting point of ash before this combustion gas G is introduced into the superheater 8 which is positioned on the side away from the furnace wall bottom portion 3a, namely, the superheater 8 which has the narrow adjacent pitch Pn between the heat transfer pipes 11. For this reason, the superheater 7 which is positioned closest to the furnace wall bottom portion 3a side and which is exposed to the flames F, and the superheater 6 which is adjacent to the superheater 7, namely, the superheaters 6 and 7 which have the wide adjacent pitch Pw between the heat transfer pipes 11 also perform the role of heat transfer surfaces that lower the temperature of the combustion gas G.

[0029] Accordingly, the amount of heat to be absorbed by the furnace wall bottom portion 3a in which a plurality of furnace wall pipes (not shown) are arranged in upper and lower directions is reduced, and the steam temperature inside the furnace wall pipes in the furnace wall top portion 3b of the boiler main body 2 can be kept to a low value.

[0030] In this manner, in the tower type boiler 1 of this embodiment, even if the amount of heat that is input into the boiler main body 2 is increased, it is still possible to keep the steam temperature within the furnace wall pipes in the furnace wall top portion 3b of the boiler main body 2 at a low level. Because of this, it is possible to perform operations under high-steam conditions with the purpose of improving the plant efficiency without having to use a material for the furnace wall top portion 3b that is able to withstand high-temperature steam, for example, without having to use a 7CrMoVTiB10-10 composition, known as T24, namely, by instead using a furnace wall material that is currently in use, for example, by using a 13CrMo4-5 material known as T12.

[0031] FIG. 2 shows another embodiment of a tower type boiler according to the present invention.

[0032] As is shown in FIG. 2, a tower type boiler 21 according to this embodiment differs from the tower type boiler 1 according to the previous embodiment in that, as is shown by the enlarged portion in FIG. 2, adjacent pitches Pw, Pm, and Pn between the respective heat transfer pipes 11 are set so as to become sequentially narrower as they are positioned away from the furnace wall bottom portion 3a between the superheater 7, which, out of the plurality of superheaters 5 to 8, is positioned closest to the furnace wall bottom portion 3a, and the superheater 8, which is positioned the furthest away therefrom. The remaining structure of the tower type boiler 21 is the same as that of the tower type boiler 1 according to the previous embodiment.

[0033] In this manner, if the adjacent pitches Pw, Pm, and Pn between each of the heat transfer pipes 11 from the superheater 7, which is positioned closest to the furnace wall bottom portion 3a, to the superheater 8, which is positioned the furthest away therefrom, are set so as to become gradually narrower as they are positioned

away from the furnace wall bottom portion 3a, then in each of the superheaters 7, 6, and 8, not only is it possible to avoid blockages caused by the ash and to prevent the size of the boiler becoming too large, but it also becomes possible to achieve highly efficient heat exchange.

[0034] The structure of the tower type boiler according to the present invention is not limited to the structures of the tower type boilers according to the above-described embodiments, and as another structure it is also possible, for example, to change the adjacent pitches between the heat transfer pipes 11 within the superheater 6 that is positioned next to the superheater 7, which is positioned closest to the furnace wall bottom portion 3a. It is also possible to change the adjacent pitches Pw, Pm, and Pn between each of the heat transfer pipes 11 from the superheater 7, which is positioned closest to the furnace wall bottom portion 3a, to the superheater 8, which is positioned the furthest away therefrom, such that they become gradually narrower as they are positioned away from the furnace wall bottom portion 3a.

[0035] While preferred embodiments of the invention have been described and illustrated above, it should be understood that these are exemplary of the invention and are not to be considered as limiting. Additions, omissions, substitutions, and other modifications can be made without departing from the spirit or scope of the present invention. Accordingly, the invention is not to be considered as limited by the foregoing description and is only limited by the scope of the appended claims.

[Industrial applicability]

[0036] In this tower type boiler, it is possible to perform operations under high-steam conditions with the purpose of improving plant efficiency without having to alter the material currently being used for the furnace walls.

[Description of the Reference Numerals]

[0037] 1,21 ... Tower type boilers, 2 ... Boiler main body, 3 ... Furnace wall, 3 a ... Furnace wall bottom portion, 3b ... Furnace wall top portion, 5~8 ... Superheaters (Heat transfer sections), 9 ... Reheater (Heat transfer section), 11 ... Heat transfer pipes, G ... Combustion gas, Pn ... adjacent pitch between heat transfer pipes in the superheater that is located furthest away from the furnace wall bottom portion, Pw ... adjacent pitch between heat transfer pipes in the superheater that is located closest to the furnace wall bottom portion, Pm ... adjacent pitch between heat transfer pipes in the superheater that is located between the superheater that is located the furthest away from the furnace wall bottom portion and the superheater that is located closest to the furnace wall bottom portion

Claims

1. A tower type boiler comprising:

5 a furnace wall that forms a boiler main body and that performs a heat exchange with combustion gas that is generated inside this boiler main body; and
10 a heat transfer section that is positioned at a top portion the boiler main body and that performs a heat exchange with the combustion gas that is generated within the boiler main body, wherein
15 the heat transfer section is provided with a plurality of superheaters, and
20 an adjacent pitch between heat transfer pipes in at least the superheaters from among the plurality of superheaters that are located closest to the furnace wall bottom portion is set wider than
25 an adjacent pitch between heat transfer pipes in that superheater that is located furthest away from the furnace wall bottom portion.

2. The tower type boiler according to claim 1, wherein 25 the respective adjacent pitches between the heat transfer pipes in the plurality of superheaters become gradually narrower in each superheater as they are positioned away from the furnace wall bottom portion.

3. The tower type boiler according to claim 1 or 2, wherein 30 the respective pitches between the heat transfer pipes in the plurality of superheaters are set such that the temperature of the combustion gas becomes lower than the melting point of ash that is contained in the combustion gas before the combustion gas is introduced into the superheater that has the narrowest adjacent pitch between heat transfer pipes.

FIG. 1

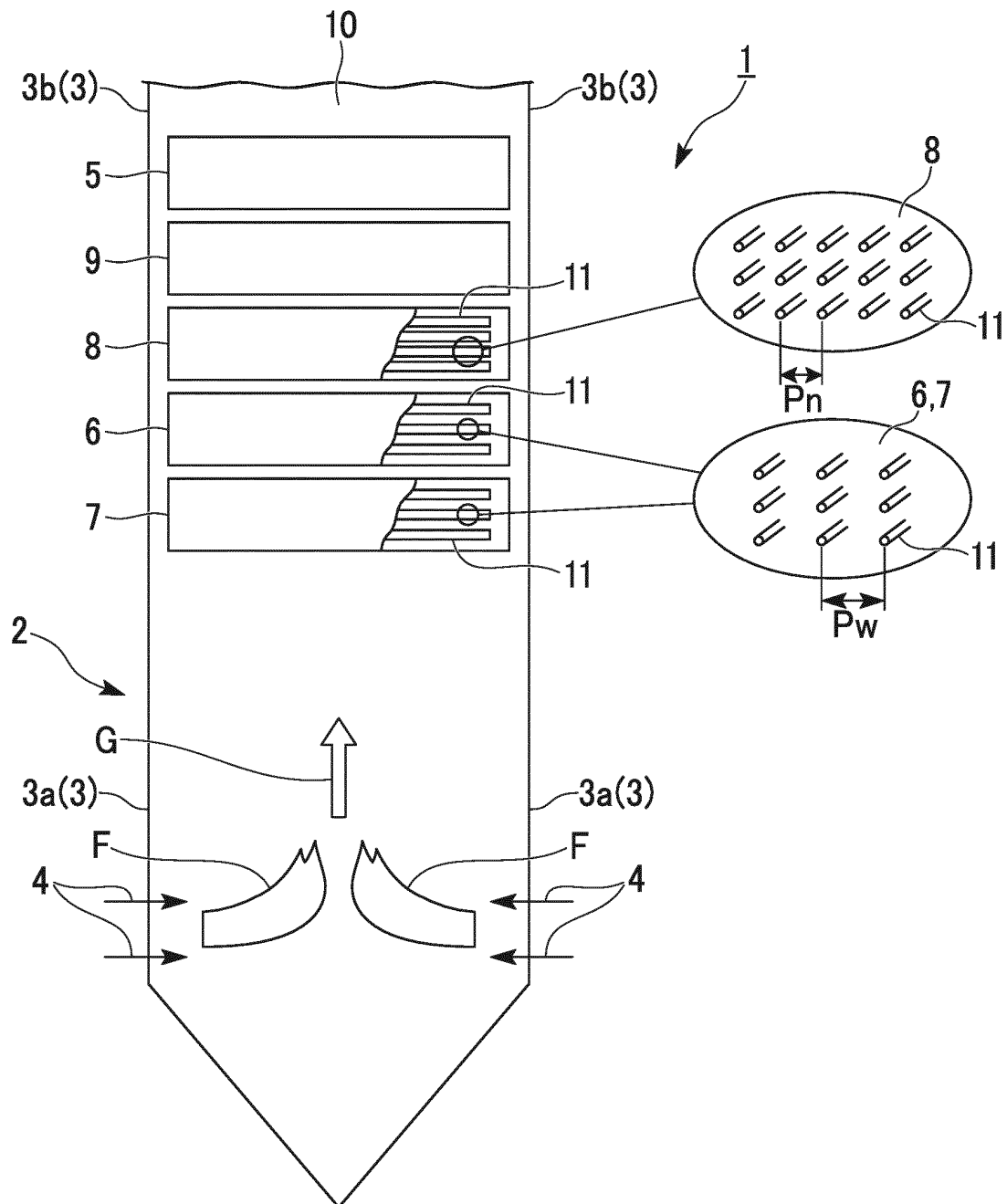
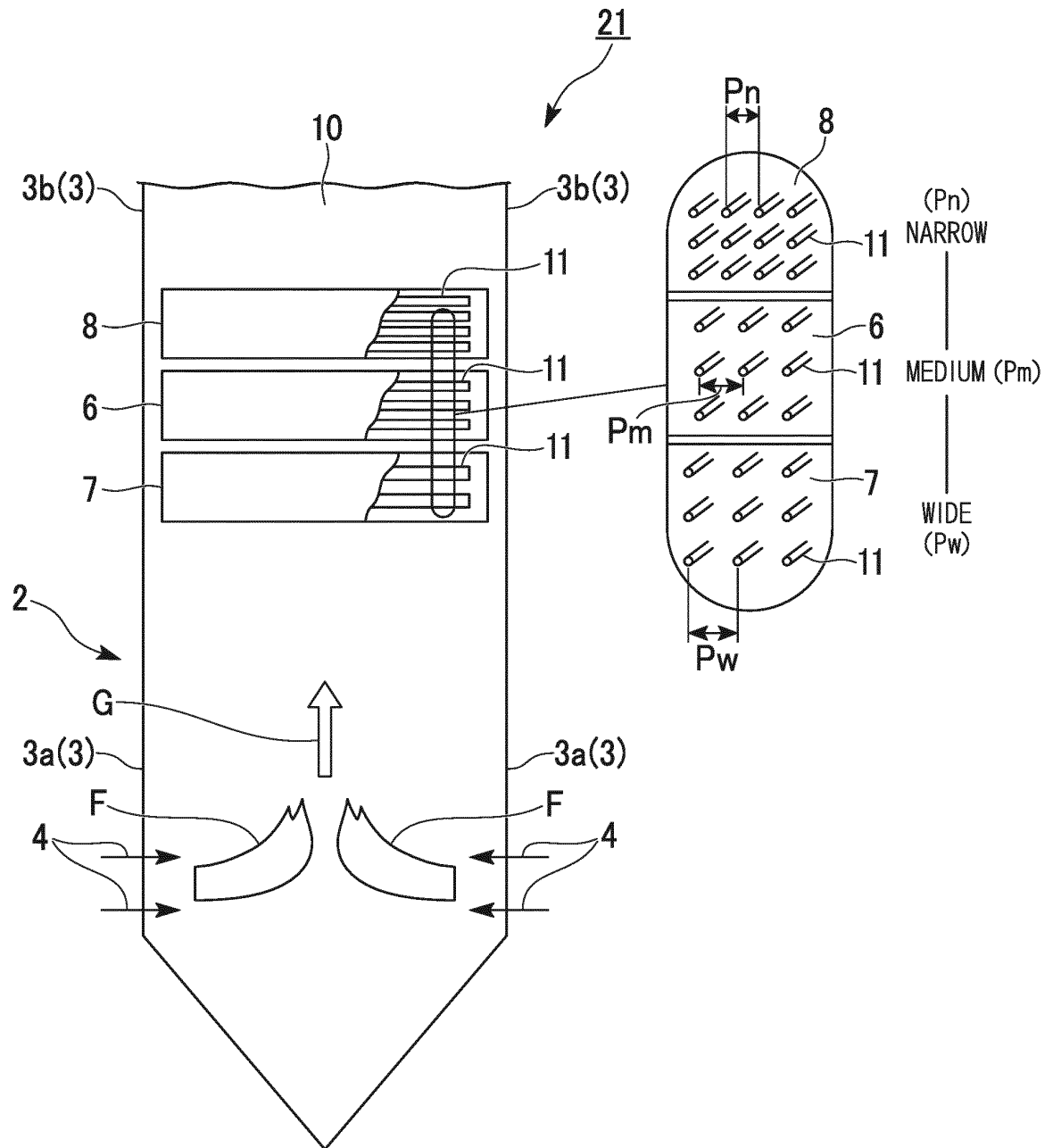


FIG. 2



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/067118

A. CLASSIFICATION OF SUBJECT MATTER

F22B21/40 (2006.01) i, F22G1/02 (2006.01) i, F22G3/00 (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)

F22B21/40, F22G1/02, F22G3/00

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	1996-2012
Kokai Jitsuyo Shinan Koho	1971-2012	Toroku Jitsuyo Shinan Koho	1994-2012

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 A	JP 2010-525219 A (FENG Weizhong), 22 July 2010 (22.07.2010), paragraph [0027]; fig. 3a & US 2010/0213714 A1 & EP 2154336 A1 & WO 2008/131615 A1 & CN 101042058 A	1, 2 3
Y A	JP 2008-304178 A (Hitachi, Ltd.), 18 December 2008 (18.12.2008), paragraph [0025] & US 2008/0276844 A1 & EP 1990574 A2	1, 2 3
Y A	JP 63-243603 A (Babcock-Hitachi Kabushiki Kaisha), 11 October 1988 (11.10.1988), fig. 3 (Family: none)	1, 2 3

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

* Special categories of cited documents:

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Date of the actual completion of the international search

18 July, 2012 (18.07.12)

Date of mailing of the international search report

31 July, 2012 (31.07.12)

Name and mailing address of the ISA/

Japanese Patent Office

Authorized officer

Facsimile No.

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2011160529 A [0002]
- JP H09243004 B [0008]