(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 136 014 A1

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

(43) Date of publication:
01.03.2017 Bulletin 2017/09

(21) Application number: **15782498.8**

(22) Date of filing: **21.04.2015**

(51) Int Cl.:
F24H 1/36 *(2006.01)* ***F24H 9/00*** *(2006.01)*

(86) International application number:
PCT/KR2015/003962

(87) International publication number:
WO 2015/163667 (29.10.2015 Gazette 2015/43)

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

(30) Priority: **22.04.2014 KR 20140047842**

(71) Applicant: **Choi, Young-Hwan**
Seoul 140-854 (KR)

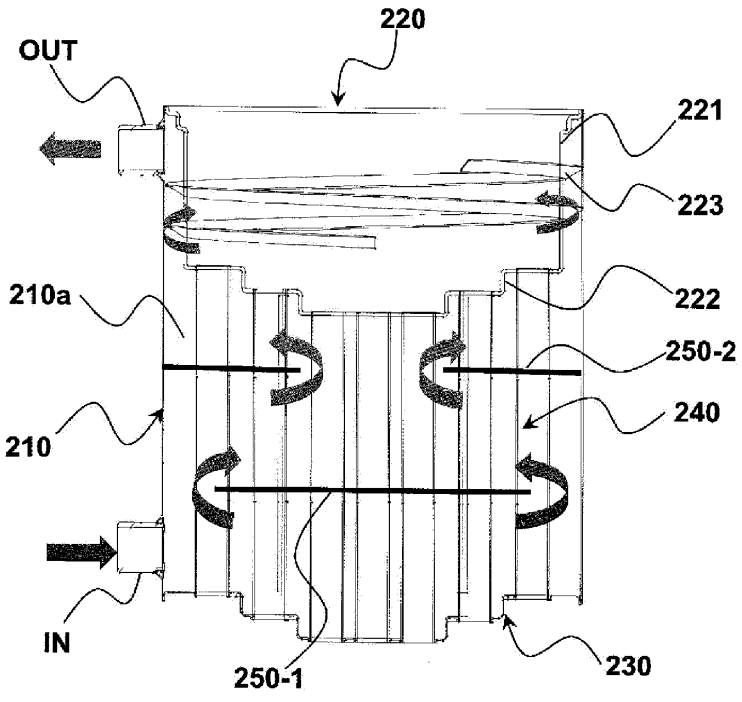
(72) Inventor: **Choi, Young-Hwan**
Seoul 140-854 (KR)

(74) Representative: **Spengler, Robert**
Potthast & Spengler Patentanwälte
Küfergasse 11
89073 Ulm (DE)

(54) HEAT EXCHANGER HAVING CIRCULATION GUIDE

(57) The present invention relates to a heat exchanger having a circulation guide and, more particularly, to a heat exchanger having a circulation guide, which induces circulation to prevent water exchanging heat with combustion gas at a high temperature from stagnating. In particular, the present invention relates to a heat exchanger having a circulation guide, which includes a spiral guide disposed on the side of a discharge port to force water to be introduced to a discharge side and a plate-shaped guide disposed on the side of an inlet port to force water to be supplied to the discharge side.

[Fig. 5]



EP 3 136 014 A1

Description

[Invention Title]

HEAT EXCHANGER HAVING CIRCULATION GUIDE

[Technical Field]

[0001] The present invention relates to a heat exchanger having a circulation guide and, more particularly, to a heat exchanger having a circulation guide, which induces circulation to prevent water exchanging heat with a combustion gas at a high temperature from stagnating.

[0002] In particular, the present invention relates to a heat exchanger having a circulation guide, which includes a spiral guide disposed on the side of a discharge port to force water to be introduced to a discharge side and a plate-shaped guide disposed on the side of an inlet port to force water to be supplied to the discharge side.

[Background Art]

[0003] In general, a boiler used in a home, an office, a factory, and various types of public buildings, includes a burner for supplying a heat source (flames and a combustion gas at a high temperature) and a heat exchanger that performs heat-exchanging between the heat source supplied by the burner and water.

[0004] For example, a boiler disclosed in Korean Patent Laid-open Publication No. 2013-0085090, as illustrated in FIGS. 1 and 2, includes a combustion device 150 having a blower fan 152 and a fuel suction port 153 in addition to a burner 151, and a heat exchanger installed below the combustion device 150.

[0005] The heat exchanger includes a boiler casing 110, a water tank 120, a top end plate 121, a bottom end plate 122, and a combustion pipe 130. In this case, water supplied via a direct water supply pipe 112a passes through the water tank 120 corresponding to a water chamber and then is discharged to a discharge pipe 112b.

[0006] Thus, a heat source, such as flames and a combustion gas at a high temperature, is supplied by the burner 151 connected to a fire chamber 111, and the combustion gas heats water while passing through the combustion pipe 130. The combustion gas of which heat is dissipated due to water, is discharged to the outside via a discharge portion 140.

[0007] However, in the above-described related art, while water supplied via the direct water supply pipe 112a passes through the water tank 120, stagnation, such as an eddy or a counter current, occurs in a particular portion of the water tank 120.

[0008] In particular, a wide flow space (a first space portion) is formed in a lower portion of the top end plate 121 that constitutes the fire chamber 111, whereas a narrow flow path (a second space portion) is formed between sidewalls of the fire chamber 111 and the boiler casing 110, so that severe stagnation occurs in a section in which water is introduced from the second space portion to the first space portion.

[0009] Thus, when water is excessively heated in a local area where stagnation occurs, water-boiling noise (i.e., boiling noise) occurs, and foreign substances, such as lime, are generated in the stagnation area and are attached thereto, heat-exchanging efficiency with the heat source is lowered, and a wobble phenomenon (i.e., ± temperature difference) of temperature of hot water or heating water being supplied occurs.

[Disclosure]

[Technical Problem]

[0010] The present invention is directed to providing a heat exchanger having a circulation guide, which induces circulation to prevent water exchanging heat with a combustion gas at a high temperature from stagnating.

[Technical Solution]

[0011] One aspect of the present invention provides a heat exchanger having a circulation guide, including: a heat exchanger body having a water chamber formed inside thereof; an inlet port, which is connected to a bottom end of the heat exchanger body and through which water is supplied to the water chamber; a discharge port, which is connected to a top end of the heat exchanger body and through which water is discharged from the water chamber; a top body tube installed at a top end of an inside of the heat exchanger body and having a fire chamber formed inside thereof; a bottom end plate installed at a bottom end of the inside of the heat exchanger body; and a plurality of combustion pipes, which each have a top end connected to pass through a floor surface of the top body tube and a bottom end connected to pass through the bottom end plate and through which a combustion gas at a high temperature introduced through the fire chamber is discharged, wherein sidewalls that constitute the top body tube are spaced apart from each other inwardly from an inner circumferential surface of the heat exchanger body, and a spiral guide that protrudes along a spiral shape is installed at inner circumferential surfaces of the sidewalls.

[0012] Ends of the spiral guide in a protrusion direction thereof may be in contact with the inner circumferential surface of the heat exchanger body.

[0013] The heat exchanger may further include a plate-shaped guide that is assembled to be passed through by the combustion pipes inside the heat exchanger body and closes a part of the water chamber of the heat exchanger body to force the flow of water to be changed.

[0014] The plate-shaped guide may include a plurality of sub-guides, and the plurality of sub-guides may be installed in the heat exchanger body in a height direction to be spaced apart from each other.

[0015] The plurality of sub-guides may include: a central side flow guide installed to extend from the center of the heat exchanger body outwardly by a predetermined length; and a peripheral side flow guide installed to extend from the inner circumferential surface of the heat exchanger body inwardly by a predetermined length.

[0016] The peripheral side flow guide may be installed above the central side flow guide.

[Advantageous Effects]

[0017] As described above, according to the present invention, a circulation guide is installed in a water chamber in which water flows, so that water exchanging heat with a combustion gas at a high temperature can be prevented from stagnating in a local area of a heat exchanger.

[0018] In particular, a spiral guide that forces water to be introduced to a discharge side and a plate-shaped guide that forces water to be supplied to the discharge side are provided so that water can be effectively prevented from stagnating.

[0019] Thus, water-boiling noise is prevented from occurring due to water in a stagnation area excessively heated, or heat-exchanging efficiency is prevented from being lowered due to foreign substances, such as lime, generated in the stagnation area, or a temperature difference is prevented from occurring in hot water or heating water.

[Description of Drawings]

[0020]

FIG. 1 is a cross-sectional view of a boiler according to the related art.

FIG. 2 is a perspective view of a heat exchanger of the boiler according to the related art.

FIG. 3 is a cross-sectional view of a heat exchanger having a circulation guide according to a first embodiment of the present invention.

FIG. 4 is a perspective view of a spiral guide according to the first embodiment of the present invention.

FIG. 5 is a cross-sectional view of a heat exchanger having a circulation guide according to a second embodiment of the present invention.

FIG. 6 is a plan view of a plate-shaped guide according to the second embodiment of the present invention.

[Modes of the Invention]

[0021] Hereinafter, a heat exchanger having a circulation guide according to exemplary embodiments of the present invention will be described with the accompanying drawings in detail.

[0022] However, hereinafter, a downward type in which a burner is installed at an upper side to spout out flames in a downward direction, will be illustrated, but the present invention may be applied to an upward type, and it is obvious that up and down directions can be freely changed depending on the downward type or the upward type.

[0023] First, as illustrated in FIG. 3, in a heat exchanger having a circulation guide according to a first embodiment of the present invention, a spiral guide 223 is illustrated as the circulation guide that prevents stagnation of water.

[0024] Meanwhile, the heat exchanger having the circulation guide according to the present invention includes a heat exchanger body 210 having a water chamber 210a formed inside thereof, a top body tube 220 installed at a top end of the heat exchanger body 210 and having a fire chamber 220a formed inside thereof, a bottom end plate 230 that closes a bottom end of the heat exchanger body 210, and a combustion pipe 240 through which a combustion gas at a high temperature is discharged.

[0025] In particular, the present invention includes the spiral guide 223 disposed at sidewalls 221 of the top body tube 220, unlike in the related art, so that a stagnation phenomenon, such as an eddy or a counter current, is prevented from occurring locally in the water chamber 210a inside the heat exchanger body 210.

[0026] In more detail, the heat exchanger body 210 has the water chamber 210a that is a space portion in which water flows, formed inside thereof. The heat exchanger body 210 has a cylindrical shape, for example, and the entire inside thereof is used as the water chamber 210a.

[0027] In addition, an inlet port IN through which the supply of water occurs, is installed to be connected to the bottom end of the heat exchanger body 210, and a discharge port OUT through which water is discharged from the water chamber 210a, is installed to be connected to the top end of the heat exchanger body 210.

[0028] Thus, direct water at a low temperature or heating circulation water is introduced into the water chamber 210a inside the heat exchanger body 210 through the inlet port IN, and the introduced direct water or heating circulation water is heated by heat-exchanging and then is discharged through the discharge port OUT. The water discharged through the discharge port OUT is used as hot water or heating water.

[0029] The top body tube 220 is installed at a top end of an inside of the heat exchanger body 210 and covers the top end of the opened heat exchanger body 210. To this end, the top body tube 220 includes cylindrical sidewalls 221 and a floor surface 222 disposed at a lower portion of the top body tube 220.

[0030] Thus, the fire chamber 220a is provided in an inside space of the top body tube 220 surrounded by the sidewalls 221 and the floor surface 222. A burner (see 151 of FIG. 1) is installed at an upper portion of the opened fire chamber 220a to spout out flames and a combustion gas at a high temperature generated in the burner in a downward direction.

[0031] In addition, the sidewalls 221 of the top body

tube 220 are spaced apart from each other inwardly from an inner circumferential surface of the heat exchanger body 210. Thus, water introduced into a space therebetween is discharged to the outside through the discharge port OUT.

[0032] In addition, the floor surface 222 of the top body tube 220 serves as a top end plate that closes the upper portion of the heat exchanger body 210. A plurality of assembly holes are formed through the floor surface 222 of the top body tube 220 so that a top end of the combustion pipe 240 is inserted into the top body tube 220 through the plurality of assembly holes.

[0033] The bottom end plate 230 is installed at a bottom end of the inside of the heat exchanger body 210 and closes the bottom end of the opened heat exchanger body 210.

[0034] In addition, a plurality of assembly holes are also formed through the bottom end plate 230 so that a bottom end of the combustion pipe 240 is inserted into the bottom end plate 230 through the plurality of assembly holes.

[0035] The number of the assembly holes formed in the bottom end plate 230 is the same as that of the assembly holes formed in the floor surface 222 of a top end plate, and positions thereof are the same as those of the assembly holes formed in the floor surface 222 of the top end plate.

[0036] Thus, the combustion pipe 240 is coupled between the floor surface 222 of the top body tube 220 and the bottom end plate 230, which are disposed in parallel in the vertical direction, so that the combustion gas generated in the fire chamber 220a passes through the combustion pipe 240 and is discharged to the outside.

[0037] The combustion pipe 240 is used as a path on which the combustion gas at the high temperature is discharged, and a plurality of combustion pipes 240 are provided to smoothly discharge the combustion gas spouted out to the fire chamber 220a, and the plurality of combustion pipes 240 are spaced apart from each other and increase a heat-exchanging surface area within the water chamber 210a.

[0038] In this case, top ends of the plurality of combustion pipes 240 are connected to each other to pass through the floor surface 222 of the top body tube 220, and bottom ends of the plurality of combustion pipes 240 are connected to each other to pass through the bottom end plate 230. Thus, the combustion gas at the high temperature introduced via the fire chamber 220a is discharged, and in this procedure, the combustion gas at the high temperature heat-exchanges with water filled in the water chamber 210a.

[0039] However, heat-exchanging fins (see 130a of FIG. 2), as known from FIG. 2, are disposed on inner circumferential surfaces of the combustion pipes 240 so as to improve heat-exchanging efficiency between the combustion gas and water.

[0040] Meanwhile, as known from (a) and (b) of FIG. 4 in more detail, the spiral guide 223 is installed at inner circumferential surfaces of the sidewalls 221 that constitute the top body tube 220. The spiral guide 223 prevents water from stagnating in the water chamber 210a inside the heat exchanger body 210.

[0041] To this end, the spiral guide 223 is formed at the inner circumferential surfaces of the sidewalls 221 to have a spiral shape that circles in a height direction. In this case, the spiral guide 223 protrudes from the sidewalls 221 inwardly by a predetermined length.

[0042] Thus, when water (i.e., direct water or heating circulation water) introduced through the inlet port IN due to an operation of a pump flows in an upward direction and inflow of the water occurs in a narrow flow path formed between the heat exchanger body 210 and the sidewalls 221 of the top end plate, the water spirals due to the spiral guide 223.

[0043] In addition, when the water is discharged through the discharge port OUT while spiraling due to the spiral guide 223, flowing water is sucked and drawn from the lower portion of the top body tube 220 so that stagnation, such as an eddy or a counter current, does not occur in the water chamber 210a of the heat exchanger body 210.

[0044] In particular, a wide flow space (a first space portion) is formed in the lower portion of the top body tube 220 that constitutes the fire chamber 220a, whereas a narrow flow path (a second space portion) is formed between the sidewalls 221 of the top body tube 220 and the heat exchanger body 210. Stagnation of water is prevented even in a point where water flows into the first space portion from the second space portion.

[0045] Thus, water-boiling noise is prevented from occurring due to water in a stagnation area excessively heated, or heat-exchanging efficiency is prevented from being lowered due to foreign substances, such as lime, generated in the stagnation area, or a temperature difference is prevented from occurring in hot water or heating water.

[0046] However, preferably, ends of the spiral guide 223 in a protrusion direction thereof are in contact with the inner circumferential surface of the heat exchanger body 210. Thus, water passes through the spiral guide 223, and water spirals with a larger force.

[0047] Hereinafter, a heat exchanger having a circulation guide according to a second embodiment of the present invention will be described. The heat exchanger having the circulation guide according to the second embodiment of the present invention is characterized by further including a plate-shaped guide in addition to the above-described spiral guide as the circulation guide for preventing stagnation of water.

[0048] As illustrated in FIG. 5, the heat exchanger having the circulation guide according to the second embodiment of the present invention also includes a heat exchanger body 210 having a water chamber 210a, a top body tube 220 having a fire chamber 220a formed inside thereof, a bottom end plate 230 that closes a bottom end of the heat exchanger body 210, and a combustion pipe

240 through which a combustion gas at a high temperature is discharged.

[0049] In addition, the top body tube 220 includes sidewalls 221 and a floor surface 222, and a spiral guide 223 is installed at the sidewalls 221 of the top body tube 220. These configurations are the same as those of the first embodiment of the present invention.

[0050] Thus, direct water or heating circulation water supplied to the water chamber 210a inside the heat exchanger body 210 through an inlet port IN passes through an inside of the water chamber 210a and is discharged through a discharge port OUT. During discharge, stagnation of water is prevented by the spiral guide 223.

[0051] Furthermore, flames and the combustion gas spout out via a burner connected to the top body tube 220, and the combustion gas is discharged to the outside through the combustion pipe 240. Thus, direct water or heating circulation water supplied to the water chamber 210a heat-exchanges with the flames and the combustion gas and is heated, and heated water is supplied as hot water or heating water.

[0052] Meanwhile, the heat exchanger having the circulation guide according to the second embodiment of the present invention further includes a plate-shaped guide 250, and the plate-shaped guide 250 is assembled to be passed through by the combustion pipe 240 inside the heat exchanger body 210 and closes a part of the water chamber 210a of the heat exchanger body 210 to force the flow of water to be changed.

[0053] The purpose of forcing the flow of water to be changed by the plate-shaped guide 250 is, firstly, to prevent stagnation of water from occurring locally in a particular area of the water chamber 210a, and secondly, to allow water to be uniformly distributed into the water chamber 210a to improve heat-exchanging efficiency.

[0054] Thus, one or a plurality of plate-shaped guides 250 capable of achieving at least the two purposes may be used, and an installation position thereof is also properly selected according to the shape of the heat exchanger body 210.

[0055] However, it is obvious that a plurality of plate-shaped guides 250 are used rather than one plate-shaped guide 250 so that the above two purposes will be more securely satisfied. Thus, the plate-shaped guide 250 includes a plurality of sub-guides 250-1 and 250-2, and the plurality of sub-guides 250-1 and 250-2 are installed in the heat exchanger body 210 in a height direction to be spaced apart from each other.

[0056] In FIG. 5, the plate-shaped guide 250 includes two sub-guides 250-1 and 250-2. The two sub-guides 250-1 and 250-2 include a central side flow guide 250-1 and a peripheral side flow guide 250-2.

[0057] The central side flow guide 250-1 is installed to extend from the center of the heat exchanger body 210 outwardly by a predetermined length. Thus, water flows through an outside periphery of the water chamber 210a having no central side flow guide 250-1 formed inside thereof.

[0058] To this end, as shown (a) of FIG. 6, the central side flow guide 250-1 has a shape of a disc having a smaller diameter than that of the water chamber 210a, and a plurality of first assembly holes 250-1a through which combustion pipes 240 are inserted into and assembled to the central side flow guide 250-1, are formed in the central side flow guide 250-1. The number and position of the plurality of first assembly holes 250-1a are the same as those of the combustion pipes 240 that pass through the central side flow guide 250-1 among the plurality of combustion pipes 240.

[0059] In addition, the peripheral side flow guide 250-2 is installed to extend from an inner circumferential surface of the heat exchanger body 210 inwardly by a predetermined length. Thus, water flows through a central side 250-2b of the water chamber 210a having no peripheral side flow guide 250-2 formed inside thereof.

[0060] To this end, as shown in (b) of FIG. 6, the peripheral side flow guide 250-2 has a shape of a disc having the same diameter as that of the water chamber 210a, and a plurality of second assembly holes 250-2a through which the combustion pipes 240 are inserted into the peripheral side flow guide 250-2, are formed in the periphery of the peripheral side flow guide 250-2. In addition, a flow hole 250-2b through which water passes, is formed in the center of the peripheral side flow guide 250-2.

[0061] However, preferably, the above-described peripheral side flow guide 250-2 is installed above the central side flow guide 250-1.

[0062] When water passes through the periphery of the water chamber 210a due to the central side flow guide 250-1 disposed below the peripheral side flow guide 250-2 and then passes through the center (i.e., the flow hole) of the peripheral side flow guide 250-2 disposed above the central side flow guide 250-1, water circulates, and a direction of water changes into the periphery of the water chamber 210a. This is because water is naturally guided to a portion where the spiral guide 223 is installed.

[0063] As described above, the plate-shaped guide 250 causes a change in the flow of water supplied by a pump so that stagnation of water is prevented from occurring in a local area of the water chamber 210a.

[0064] Furthermore, as water spirals due to the spiral guide 223 installed at the discharge port OUT, in a state in which a suction force is applied to water below the spiral guide 223, the plate-shaped guide 250 installed at the inlet port IN guides water to the spiral guide 223. Thus, stagnation of water is further prevented.

[Industrial Applicability]

[0065] While the invention has been shown and described with reference to certain exemplary embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

[0066] Thus, because the above-described embodiments are provided to completely inform those skilled in the art of the scope of the invention, it will be understood by those skilled in that art that the embodiments are illustrative in all aspects and nonlimiting, and the present invention is only defined by the claims.

Claims

1. A heat exchanger having a circulation guide, the heat exchanger comprising:

a heat exchanger body (210) having a water chamber (210a) formed inside thereof;
an inlet port (IN), which is connected to a bottom end of the heat exchanger body (210) and through which water is supplied to the water chamber (201a);
a discharge port (OUT), which is connected to a top end of the heat exchanger body (210) and through which water is discharged from the water chamber (210a);
a top body tube (220) installed at a top end of an inside of the heat exchanger body (210) and having a fire chamber (220a) formed inside thereof;
a bottom end plate (230) installed at a bottom end of the inside of the heat exchanger body (210); and
a plurality of combustion pipes (240), which each have a top end connected to pass through a floor surface (222) of the top body tube (220) and a bottom end connected to pass through the bottom end plate (230) and through which a combustion gas at a high temperature introduced through the fire chamber (220a) is discharged,

wherein sidewalls (221) that constitute the top body tube (220) are spaced apart from each other inwardly from an inner circumferential surface of the heat exchanger body (210), and a spiral guide (223) that protrudes along a spiral shape is installed at inner circumferential surfaces of the sidewalls (221).

2. The heat exchanger of claim 1, wherein ends of the spiral guide (223) in a protrusion direction thereof are in contact with the inner circumferential surface of the heat exchanger body (210).

3. The heat exchanger of claim 1 or 2, further comprising a plate-shaped guide (250) that is assembled to be passed through by the combustion pipes (240) inside the heat exchanger body (210) and closes a part of the water chamber (210a) of the heat exchanger body (210) to force the flow of water to be changed.

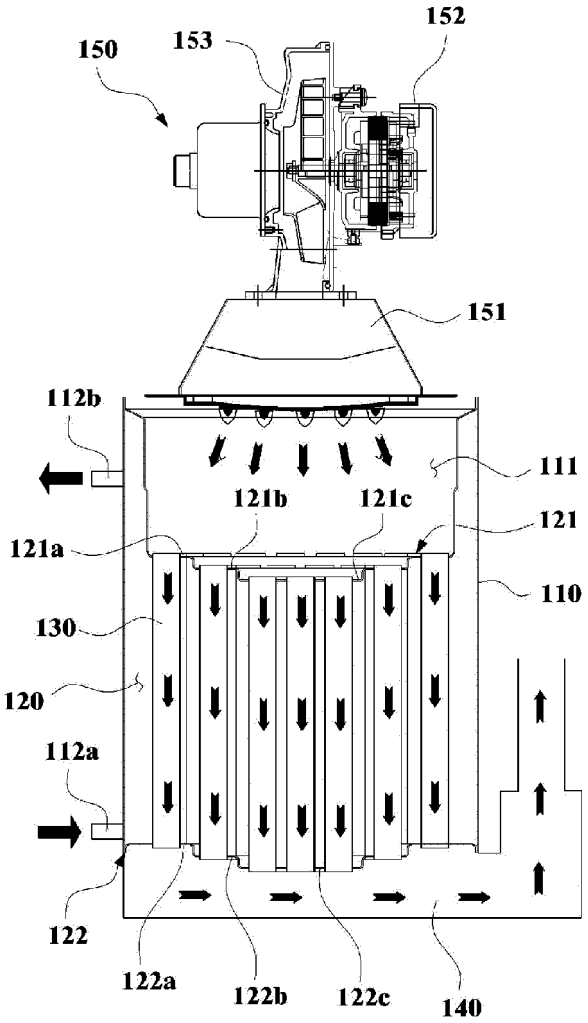
4. The heat exchanger of claim 3, wherein the plate-shaped guide (250) comprises a plurality of sub-guides (250-1, 250-2), and the plurality of sub-guides (250-1, 250-2) are installed in the heat exchanger body (210) in a height direction to be spaced apart from each other.

5. The heat exchanger of claim 4, wherein the plurality of sub-guides (250-1, 250-2) comprise:

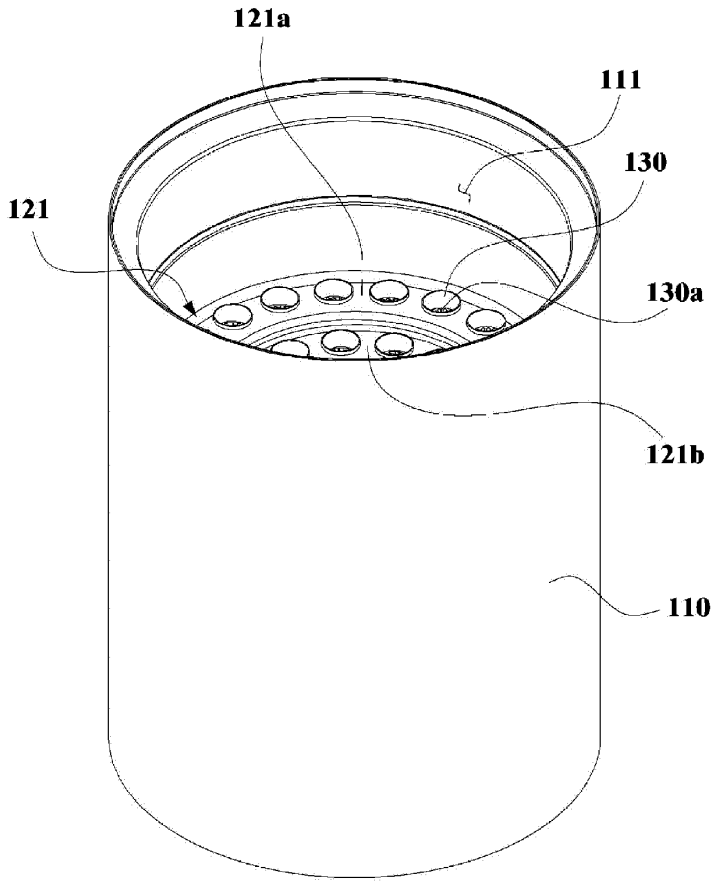
a central side flow guide (250-1) installed to extend from the center of the heat exchanger body (210) outwardly by a predetermined length; and
a peripheral side flow guide (250-2) installed to extend from the inner circumferential surface of the heat exchanger body (210) inwardly by a predetermined length.

6. The heat exchanger of claim 5, wherein the peripheral side flow guide (250-2) is installed above the central side flow guide (250-1).

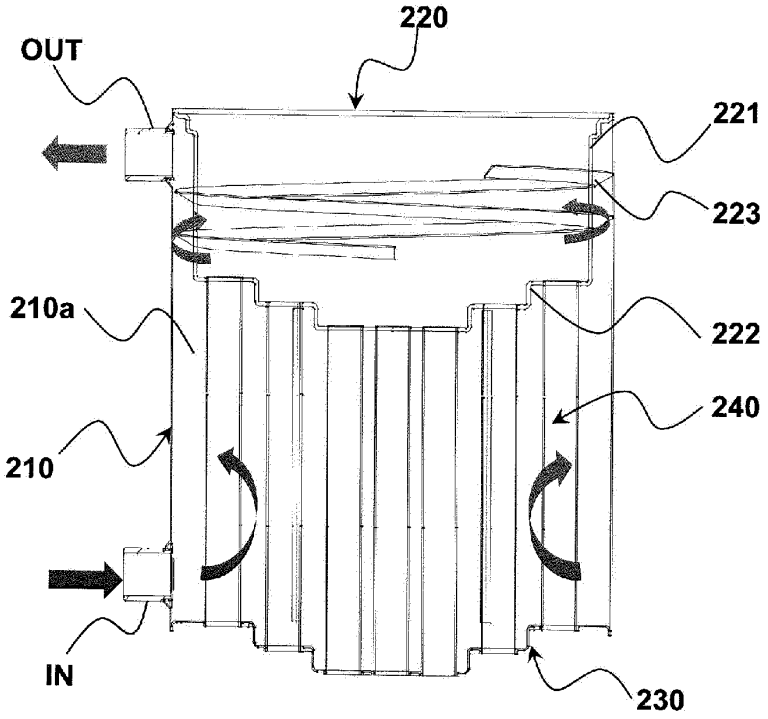
[Fig. 1]


150
153
152
151
112b
111
121b
121c
121
121a
110
130
120
112a
122
122a
122b
122c
140

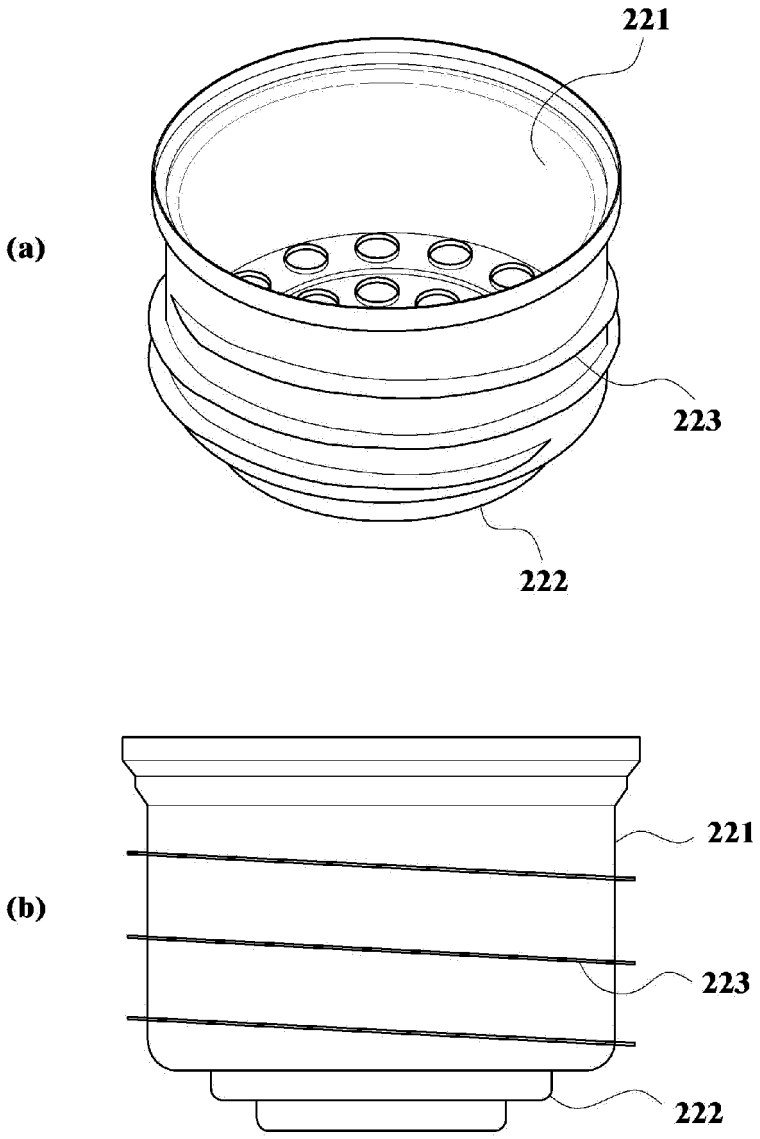
[Fig. 2]


121a
111
130
121
130a
121b
110

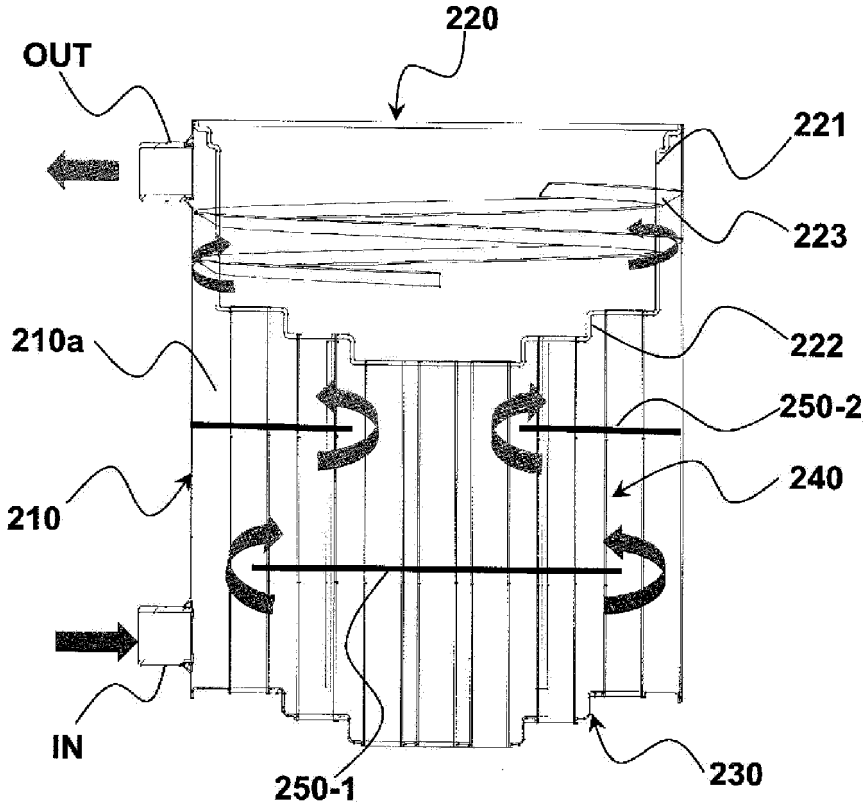
[Fig. 3]


220
OUT
221
223
210a
222
240
210
IN
230

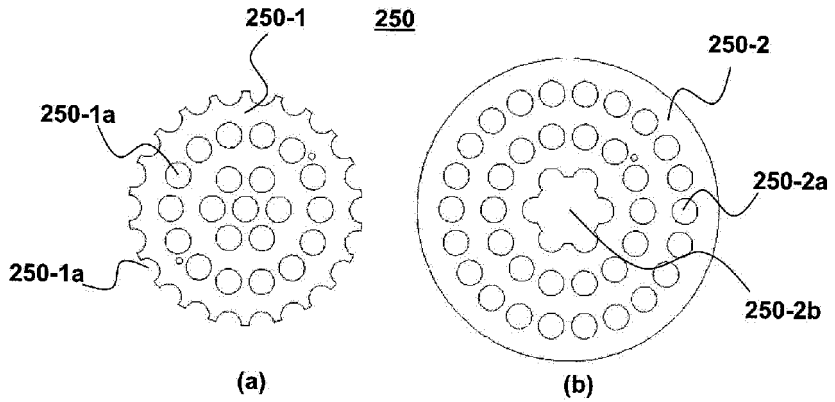
[Fig. 4]



[Fig. 5]


220
OUT
221
223
210a
222
250-2
240
210
IN
250-1
230

[Fig. 6]


250-1
250
250-2
250-1a
250-2a
250-1a
250-2b
(a)
(b)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2015/003962

A. CLASSIFICATION OF SUBJECT MATTER

F24H 1/36(2006.01)i, F24H 9/00(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)

F24H 1/36; F28D 7/02; F28D 1/04; F24H 9/00; B01J 8/06; C07C 45/35

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean Utility models and applications for Utility models: IPC as above
Japanese Utility models and applications for Utility models: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS (KIPO internal) & Keywords: heat exchanger, flue tube, burning chamber and eddy guide

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	KR 10-2013-0085090 A (CHOI, Soung Whan) 29 July 2013 See page 4, line 16 - page 6, line 23 and figures 1-3.	1-6
Y	KR 20-0206338 Y1 (ATEC ENGINEERING CO., LTD.) 01 December 2000 See page 2, line 20 - page 3, line 12 and figures 2, 3.	1-6
Y	JP 2004-000944 A (MITSUBISHI CHEMICALS CORP.) 08 January 2004 See page 3, paragraph [0008] - page 4, paragraph [0015] and figures 1-3.	3-6
A		1-2
A	KR 10-2014-0000938 A (LG ELECTRONICS INC.) 06 January 2014 See abstract and figure 4	1-6

☐ Further documents are listed in the continuation of Box C. ☒ 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	Date of mailing of the international search report
18 JUNE 2015 (18.06.2015)	**19 JUNE 2015 (19.06.2015)**
Name and mailing address of the ISA/**KR** Korean Intellectual Property Office Government Complex-Daejeon, 189 Seonsa-ro, Daejeon 302-701, Republic of Korea Facsimile No. 82-42-472-7140	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2015/003962

Patent document cited in search report	Publication date	Patent family member	Publication date
KR 10-2013-0085090 A	29/07/2013	CN103492814 A	01/01/2014
		EP 2806231 A1	26/11/2014
		US 2014-0373794 A1	25/12/2014
		WO 2013-108977 A1	25/07/2013
KR 20-0206338 Y1	01/12/2000	NONE	
JP 2004-000944 A	08/01/2004	AU 2003-201861 A1	30/07/2003
		CN1277790 C	04/10/2006
		CN1597080 A	23/03/2005
		CN1597080 C	23/03/2005
		CN1597081 A	23/03/2005
		CN1597081 C	23/03/2005
		CN1615289 A	11/05/2005
		CN1615289 C	04/10/2006
		CN1749230 A	22/03/2006
		CN1749230 C	22/03/2006
		EP 1471046 A1	27/10/2004
		EP 2361899 A2	31/08/2011
		EP 2361899 A3	28/03/2012
		JP 04-028392B2	26/12/2007
		JP 04-103416B2	18/06/2008
		JP 04-108521B2	25/06/2008
		JP 04-163021B2	08/10/2008
		JP 2003-265948A	24/09/2003
		JP 2003-267912A	25/09/2003
		JP 2003-306457A	28/10/2003
		US 2004-0249203 A1	09/12/2004
		US 2005-0131254 A1	16/06/2005
		US 7144557 B2	05/12/2006
		US 7297814 B2	20/11/2007
		WO 03-059857 A1	24/07/2003
KR 10-2014-0000938 A	06/01/2014	NONE	

Form PCT/ISA/210 (patent family annex) (July 2009)

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

- KR 20130085090 **[0004]**