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(54) GAS BOILER HAVING A HYBRID OPEN-AND-CLOSED-TYPE EXPANSION TANK

(57) The present invention relates to a gas boiler having a hybrid open-and-closed-type expansion tank that is controlled to adopt an open configuration when water must be added into the boiler so as to enable water to be easily added regardless of the water pressure of a tap, and adopt a closed configuration when the boiler operates after water is added so as to maintain the pressure within the expansion tank at a suitable level during switching, to thereby enable heating water to flow smoothly and the boiler to operate smoothly. For this purpose, a gas boiler of the present invention, having an expansion tank for storing circulated heating water therein and absorbing pressure changes in the heating water, comprises: a water level sensor for sensing whether or not the water level of heating water in the expansion tank lies within a set water level range; an air vent provided at one side of the expansion tank, for opening and closing an air outlet that is in communication with the atmosphere in accordance with changes in the water level in the expansion tank; and an overpressure safety valve provided at an upper portion of the expansion tank, for maintaining the pressure inside the expansion tank below a certain pressure.

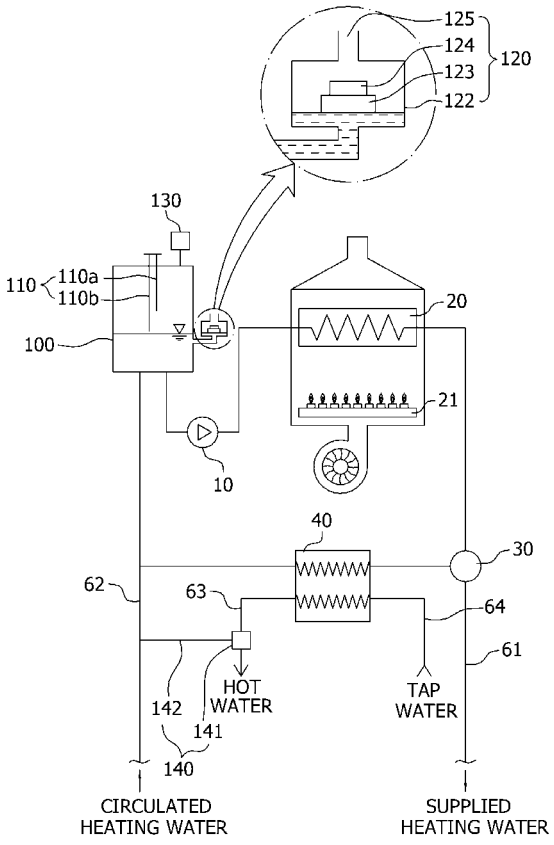

Fig. 3

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Description

TECHNICAL FIELD

[0001] The present invention relates to a gas boiler having a hybrid open-and-closed type expansion tank, and more particularly, to a gas boiler having a hybrid open-and-closed type expansion tank that can be controlled to adopt an open configuration when the boiler is refilled with water so as to enable smooth water refilling regardless of the water pressure of a tap, and can be controlled to switch into a closed configuration when the boiler operates after the water refilling so as to maintain the pressure within the expansion tank at a level suitable for smooth flows of heating water and stable operations of the gas boiler.

BACKGROUND ART

[0002] Examples of gas boilers include an open type gas boiler opened to the atmosphere and a closed type gas boiler closed to the atmosphere.

[0003] FIG. 1 is a schematic view illustrating an open type gas boiler of the related art.

[0004] The open type gas boiler is opened to the atmosphere and includes: an circulation pump 10 to circulate heating water; a main heat exchanger 20 to which heating water is pumped by the circulation pump 10 so as to heat the heating water with a burner 21; a three-way valve 30 configured to supply heating water to a heating pipe line (a place to be heated) in heating mode and to a hot water heat exchanger 40 in hot water supply mode; the hot water heat exchanger 40 configured to supply hot water by heating tap water in hot water supply mode; and an expansion tank 50 in which circulated heating water is stored and capable of absorbing pressure variations caused by temperature variations of heating water.

[0005] Reference numeral 61 denotes a heating water supply pipe, reference numeral 62 denotes heating water return pipe, reference numeral 63 denotes a tap water pipe, and reference numeral 64 denotes a hot water pipe.

[0006] A water level sensor 51 is disposed in the expansion tank 50 to detect whether the level of heating water in the expansion tank 50 is within a predetermined water level range, and an overflow pipe 52 is provided so that the heating water can flow to the outside through the overflow pipe 52 if the level of the heating water exceeds a predetermined level. The heating water is opened to the atmosphere through the overflow pipe 52.

[0007] The open type gas boiler has a simple structure and is inexpensive. However, since a heating water circulation system is opened to the atmosphere, the open type gas boiler cannot be disposed at a position lower than the heating pipe line (a place to be heated). That is, the installation position of the open type gas boiler is limited. In addition, since oxygen can be introduced into heating water, the heating pipe line may corrode.

[0008] FIG. 2 is a schematic view illustrating a closed type gas boiler of the related art.

[0009] Like the open type gas boiler, the closed type gas boiler includes a circulation pump 10, a main heat exchanger 20, a burner 21, a three-way valve 30, and a hot water heat exchanger 40. However, the closed type gas boiler includes an expansion tank 70 not opened to the atmosphere, a gas-liquid separator 71, an overpressure safety valve 72, and a pressure gauge 73.

[0010] The expansion tank 70 is not opened to the atmosphere, and a rubber plate 70a is disposed in the expansion tank 70. The inside of the expansion tank 70 is divided by the rubber plate 70a into a gas storing part 70b in which gas (for example, nitrogen) is filled and a heating water storing part 70c in which heating water is filled. The rubber plate 70a can be deformed according to pressure, and thus pressure variations of heating water can be absorbed by the rubber plate 70a.

[0011] As described above, unlike the open type gas boiler, the installation position of the closed type gas boiler is not limited, and heating water is not exposed to oxygen because a heating water circulation system is closed to the atmosphere. However, the closed type gas boiler has a complex structure and is expensive. Moreover, the closed type gas boiler requires the gas-liquid separator but it is difficult to remove bubbles from piping.

[0012] In addition, if the inside pressure of the expansion tank of the closed type gas boiler becomes lower than atmospheric pressure, a vacuum may be formed in the expansion tank, and heating water may not be normally circulated although the circulation pump 10 is operated. In this case, automatic or manual water refilling is necessary after stopping the operation of the circulation pump 10.

[0013] However, for water refilling, the pressure of tap water should be adjusted according to the difference between the pressure of the tap water and the inside pressure of the expansion tank because the expansion tank and heating water pipes of the closed type gas boiler are not opened to the atmosphere, and thus it is difficult to supply water smoothly and quickly.

[0014] Furthermore, if the inside pressure of the expansion tank of the closed type gas boiler is excessively increased, the heating water pipes may be damaged, and the operation of the closed type gas boiler may become unstable.

DISCLOSURE OF THE INVENTION

TECHNICAL PROBLEM

[0015] Exemplary embodiments of the present invention provide a gas boiler having a hybrid open-and-closed type expansion tank that can be smoothly refilled with water regardless of the pressure of tap water.

[0016] Other exemplary embodiments of the present invention provide a gas boiler having a hybrid open-and-closed type expansion tank configured to prevent an excessive pressure increase caused by volumetric expansion of heating water in the expansion tank while the gas boiler operates, thereby ensuring stable operations of the gas boiler.

TECHNICAL SOLUTION

[0017] Embodiments of the present invention provide a gas boiler having a hybrid open-and-closed type expansion tank in which circulated heating water is contained and capable of absorbing pressure variations of the heating water, the gas boiler including: a water level sensor configured to detect whether the heating water contained in the expansion tank is within a preset water level range; an air vent disposed at a side of the expansion tank, an air outlet of the air vent opened to the atmosphere being opened or closed according to variations of a water level in the expansion tank; and an overpressure safety valve disposed at an upper side of the expansion tank to maintain an inside pressure of the expansion tank at a predetermined value or lower.

[0018] The gas boiler may further includes: a heating water refilling part provided at a heating water passage of the gas boiler; and a control unit configured to control refilling of heating water through the heating water refilling part according to a level of the heating water detected by the water level sensor.

[0019] In addition, the water level sensor may include a short conductor and a long conductor that extend downward from an upper side of the expansion tank so as to regulate upper and lower water level limits of the heating water contained in the expansion tank, and during heating water refilling, the control unit may control the heating water refilling part so that heating water can be supplied through the heating water refilling part until the heating water is detected by a lower end of the long conductor of the water level sensor.

[0020] In addition, a connection pipe connecting the air vent and the expansion tank may be positioned at a height immediately above the lower end of the long conductor of the water level sensor.

[0021] In addition, the air outlet of the air vent may be positioned in height between lower ends of the short and long conductors of the water level sensor.

ADVANTAGEOUS EFFECTS

[0022] In the gas boiler having a hybrid open-closed type expansion tank according to the present invention, when the gas boiler is refilled with water, the expansion tank is opened to the atmosphere through the air outlet of the air vent so that the water refilling can be smoothly carried out regardless of the pressure of tap water to be supplied.

[0023] In addition, according to the present invention, when the gas boiler is operated after the gas boiler is refilled with water, since the air outlet of the air vent is closed and thus the expansion tank is closed to the atmosphere, contact between heating water and air can be prevented to protect heating water pipes from corrosion. In addition, since the inside pressure of the expansion tank is maintained at a proper level by the overpressure safety valve disposed at an upper side of the expansion tank, heating water can be smoothly flow through a heating water passage, and the gas boiler can be stably operated.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] FIG. 1 is a schematic view illustrating an open type gas boiler of the related art.

[0025] FIG. 2 is a schematic view illustrating a closed type gas boiler of the related art.

[0026] FIG. 3 is a schematic view illustrating a gas boiler including a hybrid open-and-closed expansion tank according to an embodiment of the present invention.

[0027] FIG. 4 is a view illustrating the expansion tank of the gas boiler when the expansion tank is refilled with water according to an embodiment of the present invention, in which (a) illustrates a state immediately after the water refilling, and (b) illustrates a state after a certain period of time from the end of the water refilling.

[0028] FIG. 5 is view illustrating the expansion tank after the gas boiler starts to operate according to an embodiment of the present invention.

[0029] FIG. 6 is a view illustrating the expansion tank of the gas boiler when the expansion tank absorbs a volumetric expansion caused by a temperature increase of heating water.

[0030] FIG. 7 is view illustrating the expansion tank of the gas boiler when the inside air pressure of the expansion

tank is excessively high and compressed air is discharged from the expansion tank through an overpressure safety valve.

<Descriptions of reference numerals>

[0031]

10: circulation pump	20: main heat exchanger
21: burner	30: three-way valve
40:hot water heat exchanger	50, 70, 100: expansion tank
51, 110: water level sensor	52: overflow pipe
61: heating water supply pipe	62: heating water return pipe
63: tap water pipe	64: hot water pipe
71: gas-liquid separator	72, 130: overpressure safety valve
73: pressure gauge	110a: short conductor
110b: long conductor	120: air vent
121: connection pipe	122: air vent body
123: float	124: air outlet plug
125: air outlet	140: heating water refilling part
141: water refilling valve	142: refilling water supply pipe

MODE FOR CARRYING OUT THE INVENTION

[0032] Certain exemplary embodiments of the present invention will now be described in greater detail with reference to the accompanying drawings. In the following description, the same elements as those described in the background art are denoted by the same reference numerals throughout the drawings.

[0033] FIG. 3 is a schematic view illustrating a gas boiler including a hybrid open-and-closed expansion tank according to an embodiment of the present invention.

[0034] Like the gas boiler described in the background art, the gas boiler of the present invention includes: an circulation pump 10 to circulate heating water; a main heat exchanger 20 to which heating water is pumped by the circulation pump 10 so as to heat the heating water with a burner 21; a three-way valve 30 configured to supply heating water to a heating pipe line (a place to be heated) in heating mode and to a hot water heat exchanger 40 in hot water supply mode; the hot water heat exchanger 40 configured to supply hot water by heating tap water in hot water supply mode; a heating water supply pipe 61; a heating water return pipe 62; a tap water pipe 63; and a hot water pipe 64.

[0035] The present invention is characterized in that a water level sensor 110, an air vent 120, and an overpressure safety valve 130 are disposed at the expansion tank 100, and a heating water refilling part 140 is provided on a heating water passage.

[0036] The heating water refilling part 140 includes a water refilling valve 141 disposed on the tap water pipe 63, and a refilling water supply pipe 142 connecting the water refilling valve 141 and the heating water return pipe 62.

[0037] The water level sensor 110 detects the level of heating water contained in the expansion tank 100. The water level sensor 110 includes a short conductor 110a and a long conductor 110b that extend downward from an upper side of the expansion tank 100 for regulating upper and lower water level limits of heating water in the expansion tank 100. If the short conductor 110a or the long conductor 110b makes contact with heating water, an electric signal is transmitted to a control unit (not shown), and the control unit controls the water refilling valve 141 according to the electric signal so as to regulate the amount of heating water in the gas boiler.

[0038] The air vent 120 communicates with a connection pipe 121 disposed at a side of the expansion tank 100. An air outlet 125 of the air vent 120 opened to the atmosphere is opened or closed according to the level of heating water in the expansion tank 100 so that the expansion tank 100 can be opened to the atmosphere when being refilled with water and be switched to be closed to the atmosphere when the gas boiler operates after the water refilling.

[0039] The air vent 120 includes: an air vent body 122 communicating with the connection pipe 121; a float 123 floating on introduced heating water; an air outlet plug 124 coupled to the topside of the float 123; and the air outlet 125 formed in an upper portion of the air vent body 122 for discharging air to the outside.

[0040] The connection pipe 121 is connected to a position immediately above a lower end 110b-1 of the long conductor 110b of the water level sensor 110 for smooth water refilling.

[0041] The air outlet 125 of the air vent 120 is positioned in height between a lower end 110a-1 of the short conductor 110a and the lower end 110b-1 of the long conductor 110b of the water level sensor 110 so that when the gas boiler operates, the expansion tank 100 can be switched from a state where the expansion tank 100 is opened to the atmosphere

to a state where the expansion tank 100 is closed to the atmosphere.

[0042] The overpressure safety valve 130 is disposed on an upper side of the expansion tank 100 to prevent the inside air pressure of the expansion tank 100 from increasing to a value greater than an allowable value. The overpressure safety valve 130 is configured by a check valve that allows air to flow out of the expansion tank 100 when the inside air pressure increases but does not allow air to flow into the expansion tank 100.

[0043] Hereinafter, operations of the above-described gas boiler will be explained with reference to FIGS. 4 to 7.

[0044] FIG. 4 is a view illustrating the expansion tank of the gas boiler when the expansion tank is refilled with water according to an embodiment of the present invention, in which (a) illustrates a state immediately after the water refilling, and (b) illustrates a state after a certain period of time from the end of the water refilling.

[0045] When the gas boiler is first filled with water or if the level of heating water filled in the expansion tank 100 decreases below the lower end 110b-1 of the long conductor 110b of the water level sensor 110 while the gas boiler operates and thus the amount of heating water in the gas boiler is insufficient, the water level sensor 110 generates a signal to the control unit, and then the control unit stops the operation of the gas boiler and opens the water refilling valve 141 to refill the expansion tank 100 with water.

[0046] As the expansion tank 100 is refilled with water, the level of heating water in the expansion tank 100 gradually increases and makes contact with the lower end 110b-1 of the long conductor 110b of the water level sensor 110 as shown in FIG. 4(a), and then the gas boiler gets ready to operate. This state is detected by the water level sensor 110, and the water level sensor 110 generates a detection signal to the control unit. Then, the water refilling valve 141 is closed under the control of the control unit to stop the water refilling.

[0047] When the gas boiler is refilled with water as described above, since the inside air of the expansion tank 100 is opened to the atmosphere through the connection pipe 121 and the air outlet 125 of the air vent 120, the inside pressure of the expansion tank 100 is equal to atmospheric pressure, and thus the gas boiler can be smoothly refilled with water regardless of the pressure of tap water.

[0048] After the water refilling valve 141 is closed to stop the water refilling and a predetermined period of time passes, the level of heating water in the expansion tank 100 has increased a little as shown in FIG. 4(b) due to a time necessary for water to flow from the water refilling valve 141 to the expansion tank 100.

[0049] If the level of heating water increases in the expansion tank 100 as described above, the float 123 and the air outlet plug 124 are moved upward to close the air outlet 125 of the air vent 120, and thus the expansion tank 100 is closed to the atmosphere. That is, when water refilling is finished and the gas boiler gets ready to operate, the expansion tank 100 is switched from an open state to a closed state.

[0050] At this time, the inside air pressure of the expansion tank 100 is slightly higher than atmospheric pressure, and thus when the gas boiler operates, the heating water may smoothly flow along the heating water passage.

[0051] In addition, since the expansion tank 100 can be switched to a closed state, the gas boiler can be disposed at any position such as a position lower than the heating pipe line, and the heating pipe may not corrode because heating water is not opened to the atmosphere.

[0052] FIG. 5 is view illustrating the expansion tank after the gas boiler starts to operate according to an embodiment of the present invention, and FIG. 6 is a view illustrating the expansion tank of the gas boiler when the expansion tank absorbs a volumetric expansion caused by a temperature increase of heating water.

[0053] After the gas boiler starts to operate, the level of heating water in the expansion tank 100 ranges between the lower end 110a-1 of the short conductor 110a and the lower end 110b-1 of the long conductor 110b of the water level sensor 110 as shown in FIG. 5.

[0054] As the operation of the gas boiler continues, the temperature and volume of heating water gradually increase because the heating water is heated by the burner while circulating along the heating water passage, and thus the level of the heating water increases in the expansion tank 100 as shown in FIG. 6. As the level of the heating water becomes higher than the lower end 110a-1 of the short conductor 110a of the water level sensor 110, air filled in the expansion tank 100 is compressed to absorb the volumetric expansion of the heating water.

[0055] FIG. 7 is view illustrating the expansion tank of the gas boiler when the inside air pressure of the expansion tank is excessively high and compressed air is discharged from the expansion tank through the overpressure safety valve.

[0056] If the inside pressure of the expansion tank 100 increases to a level that cannot be absorbed by air filled in the expansion tank 100, the overpressure safety valve 130 is opened by the pressure of compressed air so that the inside air pressure of the expansion tank 100 can be automatically decreased to a predetermined value or lower. Therefore, piping of the gas boiler may not be damaged by an excessive inside pressure of the expansion tank 100, and the gas boiler can be operated under stable pressure conditions as compared with gas boilers of the related art.

Claims

1. A gas boiler having a hybrid open-and-closed type expansion tank in which circulated heating water is contained

and capable of absorbing pressure variations of the heating water, the gas boiler comprising:

a water level sensor configured to detect whether the heating water contained in the expansion tank is within a preset water level range;
an air vent disposed at a side of the expansion tank, an air outlet of the air vent opened to the atmosphere being opened or closed according to variations of a water level in the expansion tank; and
an overpressure safety valve disposed at an upper side of the expansion tank to maintain an inside pressure of the expansion tank at a predetermined value or lower.

2. The gas boiler of claim 1, further comprising:

a heating water refilling part provided at a heating water passage of the gas boiler; and
a control unit configured to control refilling of heating water through the heating water refilling part according to a level of the heating water detected by the water level sensor.

3. The gas boiler of claim 2, wherein the water level sensor comprises a short conductor and a long conductor that extend downward from an upper side of the expansion tank so as to regulate upper and lower water level limits of the heating water contained in the expansion tank, and
during heating water refilling, the control unit controls the heating water refilling part so that heating water is supplied through the heating water refilling part until the heating water is detected by a lower end of the long conductor of the water level sensor.

4. The gas boiler of claim 3, wherein a connection pipe connecting the air vent and the expansion tank is positioned at a height immediately above the lower end of the long conductor of the water level sensor.

5. The gas boiler of claim 3 or 4, wherein the air outlet of the air vent is positioned in height between lower ends of the short and long conductors of the water level sensor.

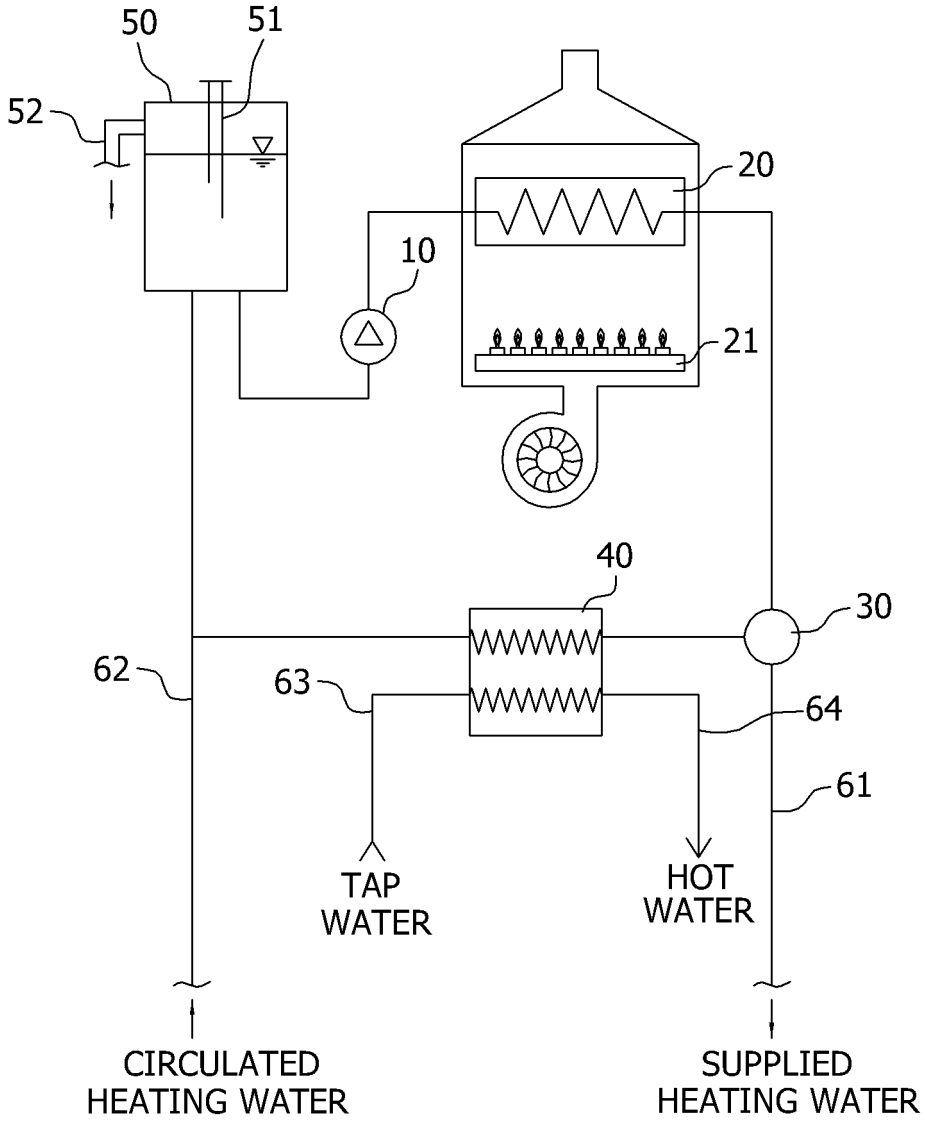
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Fig. 1

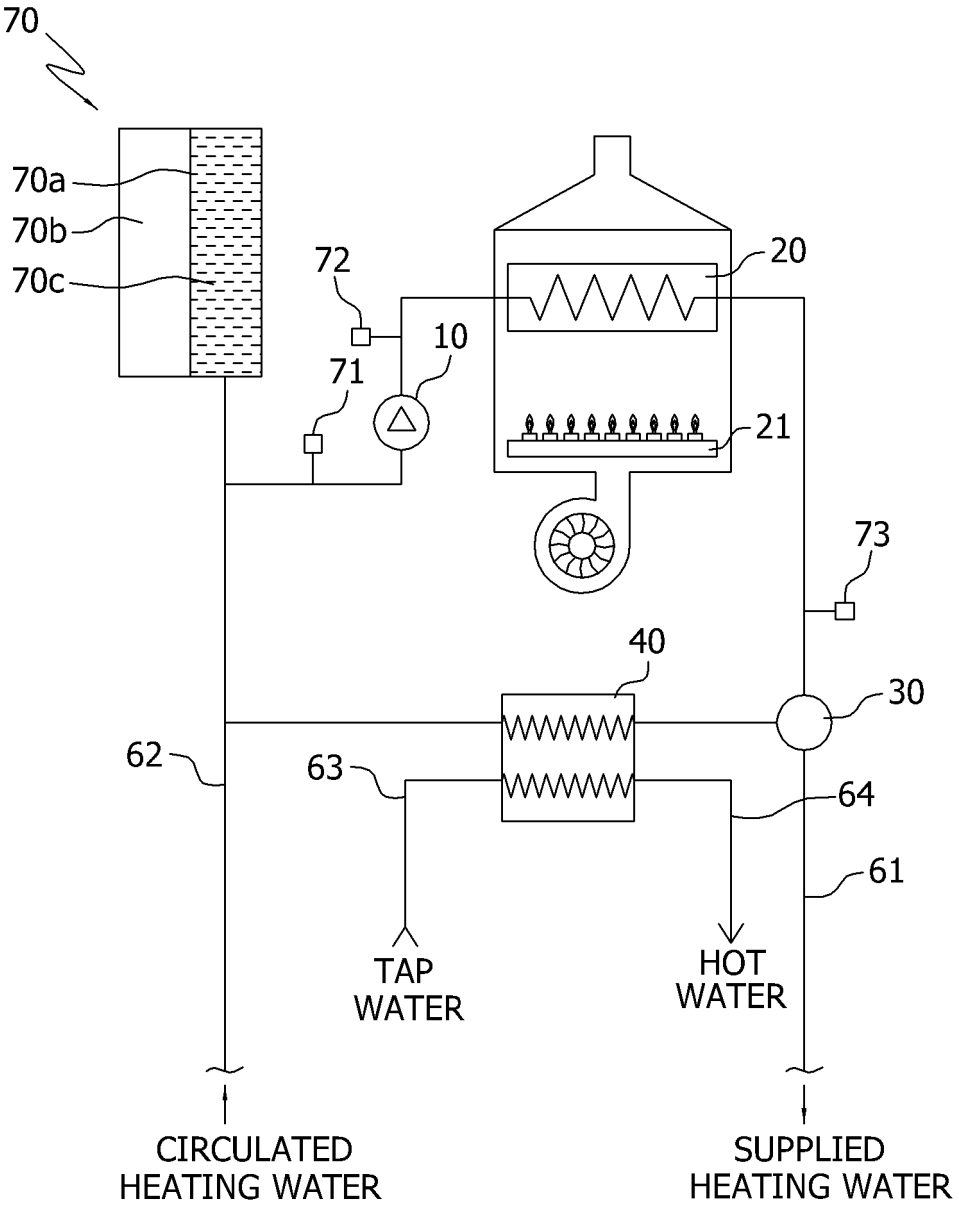
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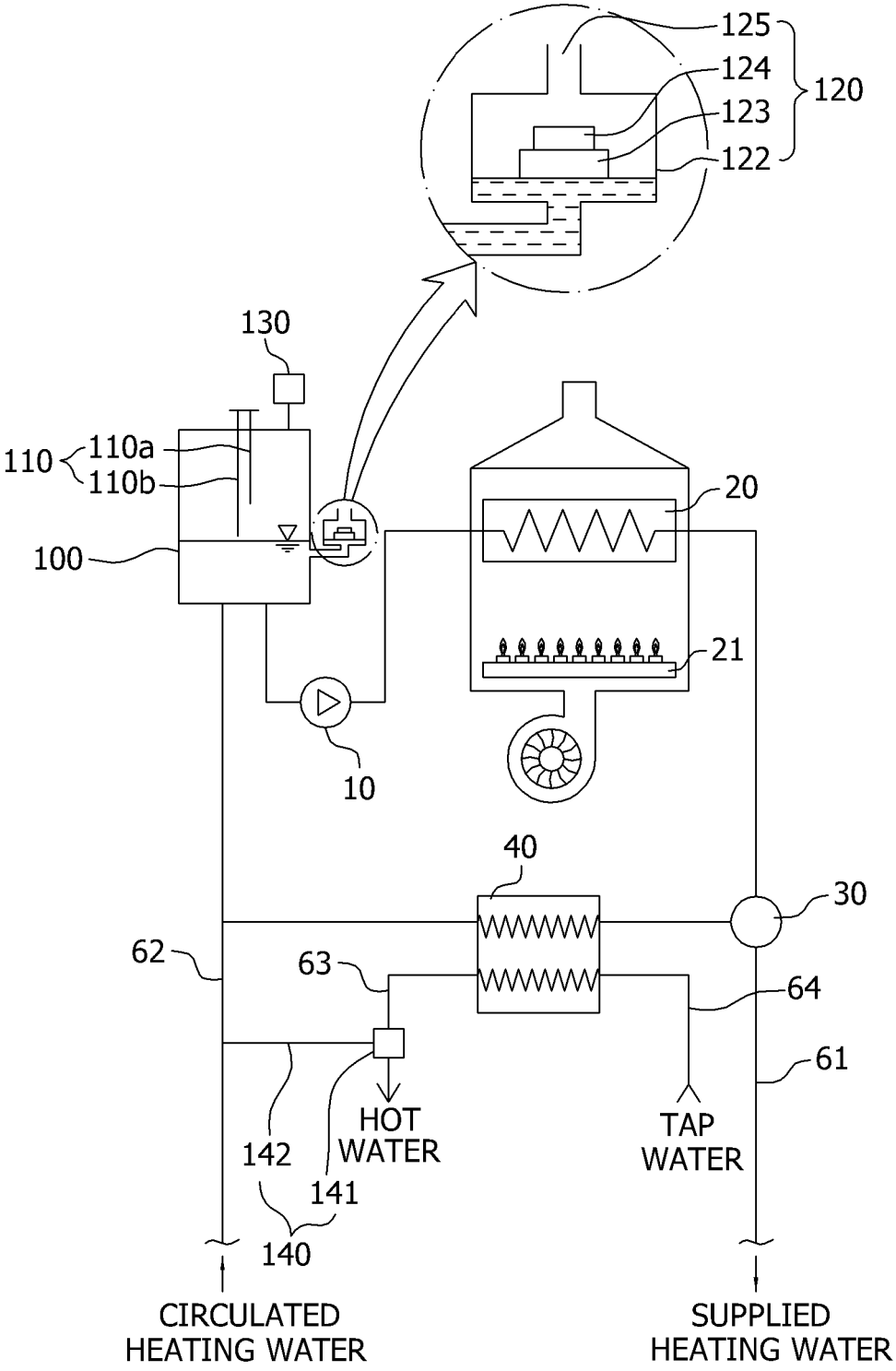
Fig. 2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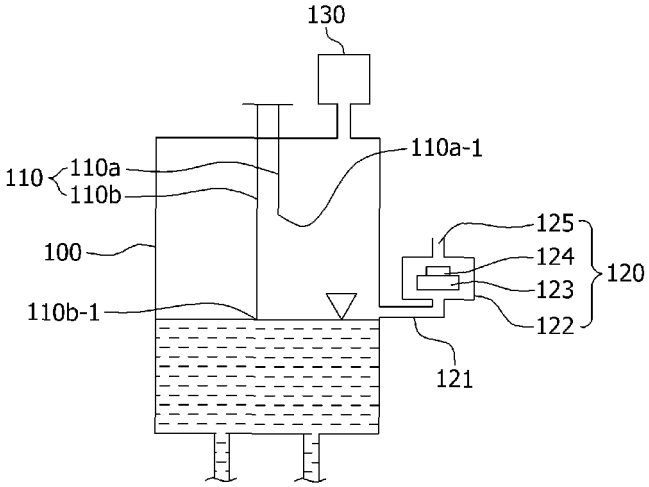
HEATING WATER

Fig. 3



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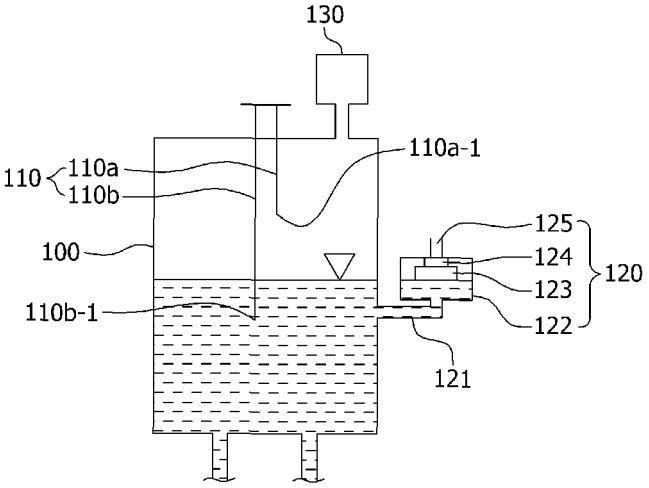

(b)

Fig. 4a + Fig. 4b

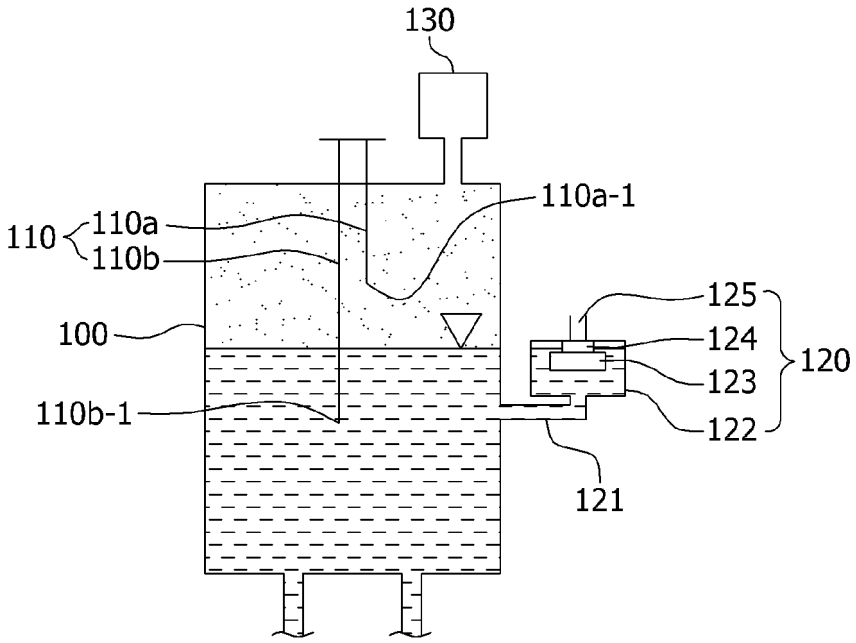

Fig. 5

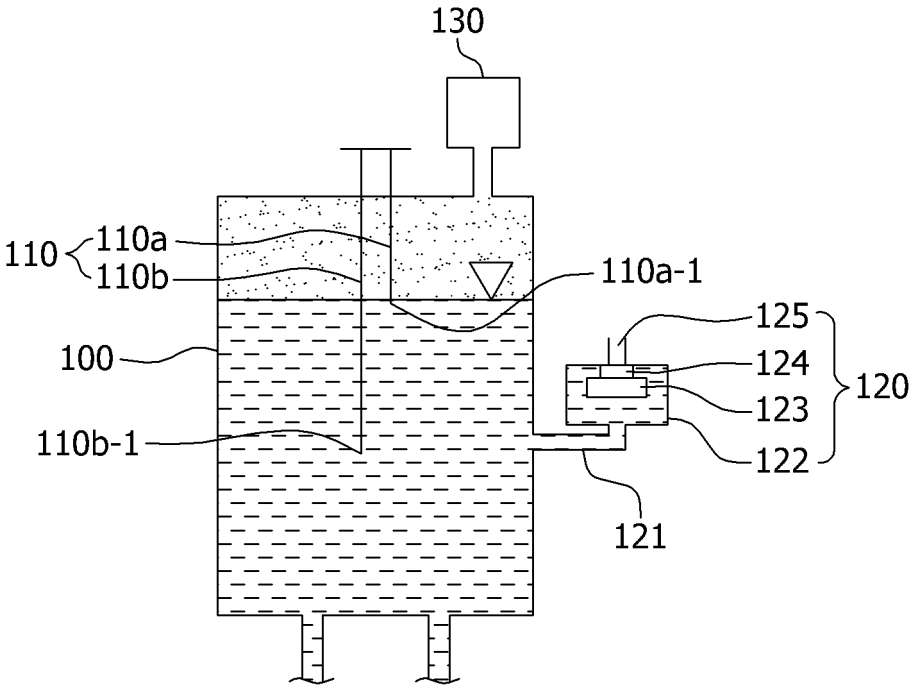

Fig. 6

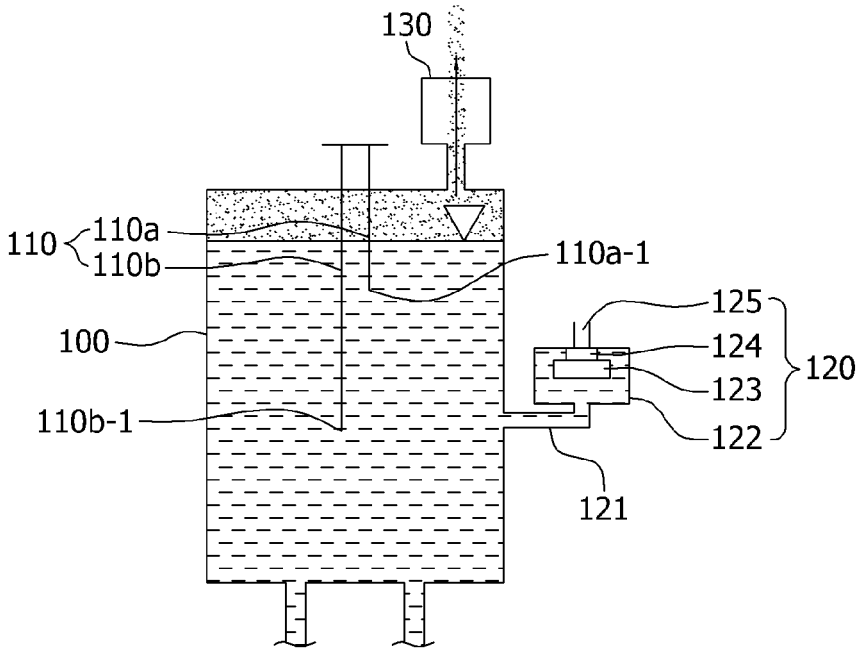

Fig. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2010/007971

A. CLASSIFICATION OF SUBJECT MATTER

F24D 3/10(2006.01)i, F24D 19/10(2006.01)i, F24H 9/18(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)

F24D 3/10; F24H 1/00; F24H 9/00; F24H 9/16; F24H 9/20

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: expansion, tank, check, valve, water level, sensor, air, vent, overpressure, gas, boiler,

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	KR 10-0890116 B1 (I, DONG HO) 24 March 2009 Claim 1 and figures 2, 5a.	1-5
A	KR 10-2008-0050651 A (KYUNGDONG NAVIEN CO., LTD.) 10 June 2008 Claim 1 and figure 3.	1-5
A	KR 10-2009-0093341 A (KYUNGDONG NAVIEN CO., LTD.) 02 September 2009 Claims 1-2 and figure 5.	1-5
A	KR 10-2006-0072424 A (CHOI, SOUNG WHAN) 28 June 2006 Claim 2 and figures 2, 4.	1-5
A	JP 10-141680 A (SANYO ELECTRIC CO LTD) 29 May 1998 Claim 1 and figures 1-2.	1-5

☐ 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
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"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
25 JULY 2011 (25.07.2011)	**25 JULY 2011 (25.07.2011)**
Name and mailing address of the ISA/KR Korean Intellectual Property Office Government Complex-Daejeon, 139 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/KR2010/007971

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