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(54) HEAT EXCHANGER AND GAS WATER HEATING APPLIANCE USING THE SAME

(57) The present invention discloses a heat exchanger including a number of fins and a heat absorbing water pipe extending through the number of fins. The number of fins includes at least a first fin section and a second fin section, wherein an average density of the fins in the second fin section is larger than an average density of the fins in the first fin section. In this way, a gas water heating appliance employing this heat exchanger can work at a very low minimum load without causing a condensation, and in the meantime, the appliance can keep higher heat transfer efficiency when working at a full load.

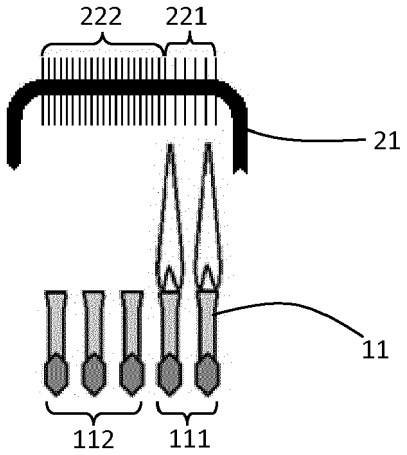

Fig. 3

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to a heat exchanger, also relates to a gas water heating appliance using the heat exchanger.

BACKGROUND OF THE INVENTION

[0002] Gas water heating appliances generally includes gas water heaters and gas boilers. A typical gas water heater includes a burner, a heat exchanger, and a number of pipes connected with the heat exchanger. The burner generally includes a number of blades arranged side by side, and each burner has a gas-air mixing passage defined therein. Gas and air can be introduced into the passage and mix therein, then the gas-air mixture passes through the passage and reaches burning holes disposed on top of each blade to be ignited for combustion. The heat exchanger usually locates above the burner, and it can be in form of a finned tube heat exchanger. This type of heat exchanger typically includes multiple heat absorbing fins contained in a shell, and a heat absorbing pipe passing through the multiple heat absorbing fins. Heat generated by the burner is absorbed by the fins, and the heat is further transferred to water passing through the heat absorbing pipe, then the heated water is extracted through pipes for domestic sanitary use, such as use in the kitchen, laundry, and bath. A typical gas boiler can also offer domestic sanitary water, besides, the gas boiler is operable to heat water which is pumped around a boiler circuit that is connected to space heaters, such as radiators, so as to be used for central heating purposes.

[0003] Current burners are able to work at various stages. Figs. 6 and 7 show a traditional staged combustion burner that consists of a number of blades 81. As shown in Fig. 7, when the burner works at a minimum load, for example, a small volume of hot water is needed at this time, only a part of the blades 811 of the burner is ignited, and the heat generated is mainly absorbed by a section of the fins that is above and corresponding to this part of the blades and then transferred to water passing through the pipe 91. As shown in Fig. 6, when the burner works at a full load, the blades including the part 811 and the part 812 are all ignited. Generally, designers hope the minimum working load reaches a value as low as possible, so that the working load can be adjusted within a large range, thereby allowing the appliance has a finer heat control to avoid a sudden hot and cold in turn for users when the appliance is running, so as to improve the user experience.

[0004] Nevertheless, for current heat exchangers, fins 92 are uniformly distributed along a direction parallel to the side-by-side blades, as a result, the appliance can not be set to a very low minimum load. This is because, if the appliance works at a working load lower than a critical value, the moisture in the flue gas passing through the fins may be condensed, obviously, the condensed water can corrode the heat exchanger. Some designers have tried to reduce the heat exchange area by reducing the density of the fins, as a result, the heat exchange efficiency is reduced, and the minimum working load can be set to a very low value without causing a condensation. However, since the heat exchange efficiency is decreased, the performance of the appliance when working at a full load is also reduced, of course, this is not desired by designers.

SUMMARY OF THE INVENTION

[0005] It is an object of present invention to provide a heat exchanger that can help a gas water heating appliance employing such heat exchanger to reduce a minimum load without causing a condensation, and in the meantime, to keep higher heat transfer efficiency when the appliance is working at a full load.

[0006] It is another object of present invention to provide a gas water heating appliance employing the heat exchanger.

[0007] According to one aspect of the present invention there is provided a heat exchanger comprising a plurality of fins and a heat absorbing water pipe extending through the plurality of fins. The plurality of fins comprises at least a first fin section and a second fin section, wherein an average density of the fins in the second fin section is larger than an average density of the fins in the first fin section.

[0008] Preferably, the fins in each of the first and the second fin sections are distributed uniformly.

[0009] Preferably, the amount of the fins in the second fin section is more than the amount of the fins in the first fin section.

[0010] Preferably, the length of the second fin section is longer than the length of the first fin section in an extending direction of the heat absorbing water pipe.

[0011] According to another aspect of the present invention there is provided a gas water heating appliance comprising a burner and a heat exchanger. The burner includes at least a first combustion portion and a second combustion portion, wherein said first combustion portion is ignited when the burner works at a minimum load. The heat exchanger includes a plurality of fins and a heat absorbing water pipe extending through the plurality of fins. The plurality of fins includes at least a first fin section and a second fin section corresponding to the first combustion portion and the second combustion portion respectively, wherein an average density of the fins in the second fin section is larger than an average density of the fins in the first fin section.

[0012] Preferably, the fins in each of the first and the second fin sections are distributed uniformly.

[0013] Preferably, the first fin section is positioned above and right against the first combustion portion, and the second fin section is positioned above and right

against the second combustion portion.

[0014] Preferably, the amount of the fins in the second fin section is more than the amount of the fins in the first fin section.

[0015] Preferably, the burner includes a plurality of blades arranged side by side, and the length of the second fin section is longer than the length of the first fin section in a direction parallel to the side-by-side direction of the plurality of blades.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] For a more complete understanding of the present invention, and the advantages thereof, reference is now made to the following descriptions taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a diagram showing the configuration of a heat exchanger in accordance with one embodiment of present invention;

Fig. 2 is a diagram showing the heat exchanger of Fig. 1 working with a burner, wherein the burner is working at a full load;

Fig. 3 is similar to Fig. 2, wherein the burner is working at a minimum load;

Fig. 4 is a diagram showing a gas water heating appliance employing the heat exchanger of Fig. 1 in accordance with one embodiment of present invention, wherein a front plate of the appliance is removed to show the internal configuration of the appliance;

Fig. 5 is a diagram showing a heat exchanger in accordance with another embodiment of present invention working with a burner, wherein the burner is working at a minimum load;

Fig. 6 is a diagram showing a heat exchanger in the state of art working with a burner, wherein the burner is working at a full load;

Fig. 7 is similar to Fig. 6, wherein the burner is working at a minimum load.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0017] Reference will now be made to the drawing figures to describe the preferred embodiments of the present invention in detail. However, the embodiments can not be used to restrict the present invention. Changes such as structure, method and function obviously made to those of ordinary skill in the art are also protected by the present invention.

[0018] A gas water heater will be exemplified hereinafter for illustrating the gas water heating appliance of present invention. Gas water heaters could be fired with combustible gas, such as natural gas, city gas, liquefied petroleum gas, methane, etc., thereby supplying hot water for domestic sanitary usage by burning the combustible gas. As shown in Fig. 4, a gas water heater 1 in accordance with one embodiment of present invention, includes a housing 50, and a burner 10, a heat exchanger 20, an exhaust gas device 30, an air supply fan 40 that are all contained in the housing 50.

[0019] The housing 50 may be composed of a number of plates, such as a front plate, a back plate, a top plate, a bottom plate, and a pair of side plates. The housing 50 can be mounted to a wall of a building with its back plate facing the wall.

[0020] The burner 10 includes a burner casing (not labeled) and burner elements contained in the casing. The burner elements may be constituted by a number of burner blades 11 arranged side by side. Each burner blade generally defines therein a gas-air mixture passage for mixing fuel gas supplied from the gas supply pipe 53 and primary air. The gas-air mixture can be delivered to top of the blade for being ignited and burning. As the configurations of burner blades are well known in the art, a detailed explanation is omitted for sake of brevity. In this embodiment, the burner 10 is able to work in different combustion stages.

[0021] Refer to Fig. 3, the burner 10 includes a first combustion portion 111 and a second combustion portion 112. The first combustion portion 111 consists of a small amount of blades 11 for being ignited when the appliance needs to work at a minimum load. When the appliance needs to work at a full load, the burner blades 11 of the first and the second combustion portions 111, 112 are all ignited. The appliance 1 has a proportional valve 13 and a gas distribution device assembly that work together with proportional valve 13 to realize various combustion stages of the burner 10. The proportional valve 13 is connected with the gas supply pipe 53 to control the amount of gas supplied to the burner 10. The gas distribution device assembly includes a first gas distribution device 121 for supplying gas to the first combustion portion 121 and a second gas distribution device 122 for supplying gas to the second combustion portion 122. The proportional valve 13 adjusts the introduced gas in a linear proportion, and distributes it into the first gas distribution device 121 or the second gas distribution device 122 according to working load required by the appliance, then the gas together with the primary air is ejected into corresponding combustion portion of the burner 10 to be mixed and ignited.

[0022] The heat exchanger 20 is placed above the burner 10. Refer to Figs. 1, 2, and 3, the heat exchanger 20 can be a finned tube heat exchanger that includes multiple heat absorbing fins 22 contained in a shell and a heat absorbing pipe 21 extending through the multiple heat absorbing fins 22. An inlet tube 51 and an outlet tube 52 are positioned upstream and downstream of the heat exchanger 20, and they are connected to the heat

absorbing pipe 21 for introducing cold water and discharging hot water respectively. The gas-air mixture is burnt in a combustion room combined by the casing of the burner 10 and the shell of the heat exchanger 20. Heat generated by the burner 10 is absorbed by the fins 22, and the heat is further transferred to water passing through the heat absorbing pipe 21, then the heated water is extracted through the outlet tube 52 for domestic sanitary use, such as use in the kitchen, laundry, and bath.

[0023] The exhaust gas device 30 is placed upon the heat exchanger 20, which typically includes a hood and an discharging duct disposed on top of the hood. The hood takes form of a shell mounted on top of the heat exchanger 20 for collecting flue gas (the gas may include carbon monoxide and oxides of nitrogen) generated by the burner 10 and discharging it outdoors via the discharging duct. The air supply Fan 40 is provided in a lower portion of the burner 10, which is operated to supply outside air to the burner 10 as combustion air, also, force the flue gas to be discharged outdoors.

[0024] Refer to Fig. 1 through Fig. 3, the heat exchanger 20 includes a first fin section 221 and a second fin section 222 corresponding to the first combustion portion 111 and the second combustion portion 112 respectively. The first fin section 221 is positioned above and right against the first combustion portion 111, and the second fin section 222 is positioned above and right against the second combustion portion 112. It should be noted that, an average density of the fins in the second fin section 222 is larger than an average density of the fins in the first fin section 221. Compared with a conventional heat exchanger, the heat exchanger of this embodiment can be regarded as a reconstruction of the conventional heat exchanger by extracting a certain amount of fins from the first fin section and then inserting them into the second fin section. As a result, the density of fins in the first fin section is decreased, and the density of fins in the second fin section is increased, while the total number of fins of the heat exchanger does not change. Since the density of fins in the first fin section is decreased, the heat exchange area of the first fin section is decreased accordingly, as a result, the minimum working load of the appliance can be reduced to a lower value without causing a condensation, meanwhile, as the total number of fins does not change, the heat exchange area of the heat exchanger in this embodiment keep the same as that of a conventional heat exchanger, consequently, the heat exchange efficiency would not be reduced when the appliance works at a full load.

[0025] In present embodiment as shown in Fig. 1 to Fig. 3, the fins in each of the first and the second fin sections 221, 222 are distributed uniformly. In another embodiment as shown in Fig. 5, the fins in each of the first and the second fin sections 221, 222 can be distributed unevenly, and this structure can also realize a technical advantage equivalent to or slightly worse than that of above embodiment. In a preferred embodiment, the amount of the fins in the second fin section 222 is more than the amount of the fins in the first fin section 221; and the length of the second fin section 222 is longer than the length of the first fin section 221 in a direction parallel to the side-by-side direction of the blades 11, or in an extending direction of the heat absorbing water pipe 21.

[0026] It would be apparent to those skilled in the art that, the heat exchanger can be set with more sections of fins corresponding to more combustion stages of a burner. In addition, the heat exchanger can also be used in a gas boiler or other gas water heating appliance.

[0027] It is to be understood, however, that even though numerous, characteristics and advantages of the present invention have been set forth in the foregoing description, together with details of the structure and function of the invention, the disclosed is illustrative only, and changes may be made in detail, especially in matters of number, shape, size, and arrangement of parts within the principles of the invention to the full extent indicated by the broadest general meaning of the terms in which the appended claims are expressed.

Claims

1. A heat exchanger (20) comprising:

   a plurality of fins (22);
   a heat absorbing water pipe (21) extending through said plurality of fins; **characterized in that**,
   said plurality of fins comprises at least a first fin section (221) and a second fin section (222), wherein an average density of the fins in the second fin section is larger than an average density of the fins in the first fin section.

2. A heat exchanger according to claim 1, wherein the fins in each of the first and the second fin sections are distributed uniformly.

3. A heat exchanger according to claim 1, wherein the amount of the fins in the second fin section is more than the amount of the fins in the first fin section.

4. A heat exchanger according to claim 1, wherein the length of the second fin section is longer than the length of the first fin section in an extending direction of the heat absorbing water pipe.

5. A gas water heating appliance (1) comprising:

   a burner (10) comprising at least a first combustion portion (111) and a second combustion portion (112), wherein said first combustion portion is ignited when the burner works at a minimum load; and
   a heat exchanger (20) comprising a plurality of

fins (22) and a heat absorbing water pipe (21) extending through said plurality of fins; **characterized in that**,
said plurality of fins comprise at least a first fin section (221) and a second fin section (222) corresponding to the first combustion portion (111) and the second combustion portion (112) respectively, wherein an average density of the fins in the second fin section is larger than an average density of the fins in the first fin section.

6. A gas water heating appliance according to claim 5, wherein the fins in each of the first and the second fin sections are distributed uniformly.

7. A gas water heating appliance according to claim 5, wherein the first fin section is positioned above and right against the first combustion portion, and the second fin section is positioned above and right against the second combustion portion.

8. A gas water heating appliance according to claim 5, wherein the amount of the fins in the second fin section is more than the amount of the fins in the first fin section.

9. A gas water heating appliance according to claim 5, wherein the burner comprises a plurality of blades (11) arranged side by side, and the length of the second fin section is longer than the length of the first fin section in a direction parallel to the side-by-side direction of the plurality of blades.

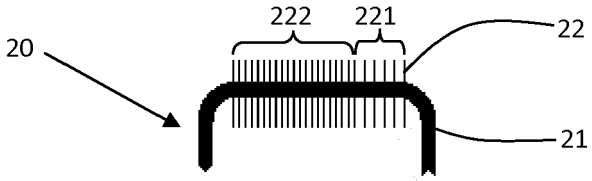

Fig. 1

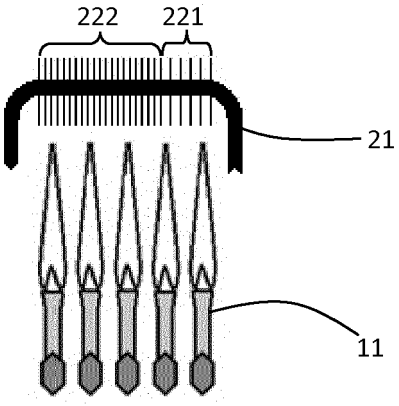

Fig. 2

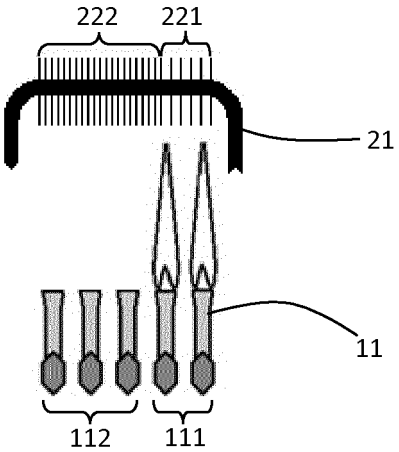

Fig. 3

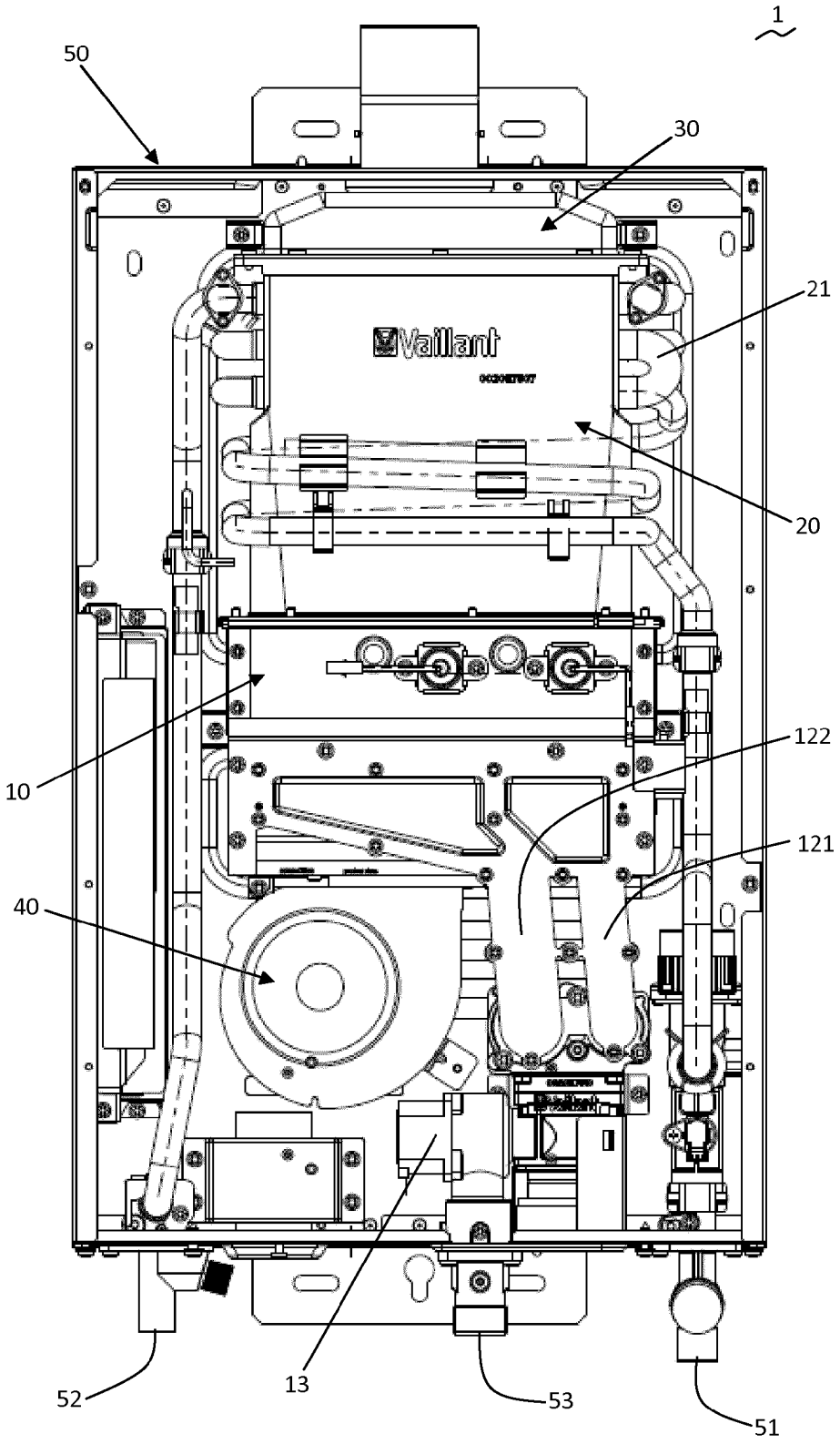

Fig. 4

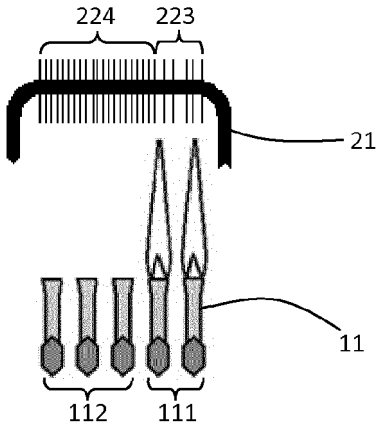

Fig. 5

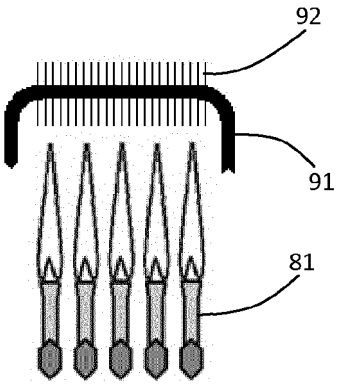

Fig. 6(state of art)

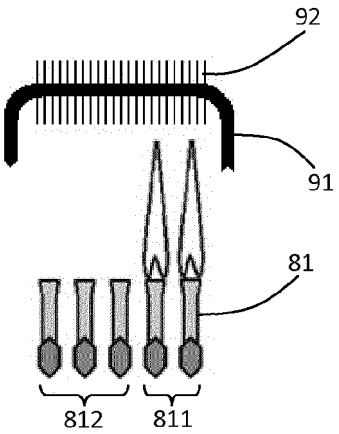

Fig. 7(state of art)

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EUROPEAN SEARCH REPORT

Application Number
EP 15 18 3990

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	22 February 2016	Riesen, Jörg

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EUROPEAN SEARCH REPORT

Application Number
EP 15 18 3990

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