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(54) **BURNER AND GAS WATER HEATER PROVIDED WITH SAME**

BRENNER UND DAMIT AUSGESTATTETER GASWASSERERHITZER

BRÛLEUR ET CHAUFFE-EAU À GAZ POURVU DE CELUI-CI

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Description

FIELD

[0001] The present disclosure relates to a technical field of household appliances, and more particularly to a combustor and a gas water heater having the same.

BACKGROUND

[0002] As ecological environment is increasingly deteriorating, human suffers more and more severe harm. People attach more and more attention to air pollution. All industries are responding to the national call to conduct energy conservation and emission reduction. With a rapid development of urban fuel gas, a gas water heater is becoming more and more popular with people as it is convenient and efficient. However, in existing gas water heaters, as combustion of the fuel gas will produce harmful gas inevitably and especially the content of nitrogen oxides in fume is high, which cause severe environmental pollution.

[0003] JP 2014 126217 A describes making a flame rod not detect a flame in a stage that oxygen is in deficiency without increasing a supply amount of secondary air, in a combustion device JP 2014 126217 A may be considered as closest prior art for the present invention.

[0004] US 2015/253035 A1 describes a burner which includes a first burner port that generates a first flame, a gap that surrounds the first burner port, and a plurality of second burner ports that are disposed on either side of the gap, the second burner ports generating second flames to hold the first flame.

[0005] JP H07 269813 A describes providing a burner in which flame failure at a thick fuel burner port is prevented when a mixing rate of combustion air is raised in a thick and thin fuel combustion burner and which can always stably burn.

SUMMARY

[0006] Embodiments of the present invention seek to solve at least one of the problems existing in the related art to at least some extent. To this end, a combustor is provided by the present invention, the combustor may reduce emission of nitrogen oxides in fume and reduce environment pollution.

[0007] A gas water heater having the combustor is further provided by the present invention.

[0008] The combustor according to a first aspect of the present invention includes the features of claim 1.

[0009] According to some embodiments of the present invention, the maximum width of the lean combustion flame port is denoted by W_3 and a height of the rectifying device is denoted by H , in which, $W_3/H=0.03\sim0.30$.

[0010] According to some embodiments of the present invention, a ratio of the amount of air to that of fuel gas in theory for complete combustion of fuel gas is denoted

by Φ_S and a mixture ratio of the amount of air to that of fuel gas at the rich combustion injection port is denoted by Φ_R , in which, $\Phi_R/\Phi_S=0.5\sim0.8$.

[0011] According to some embodiments of the present invention, the ratio of amount of the air to that of fuel gas in theory for complete combustion of fuel gas is denoted by Φ_S , a mixture ratio of the amount of air to that of fuel gas at the lean combustion injection port is denoted by Φ_L , in which, $\Phi_L/\Phi_S=1.5\sim2.0$.

[0012] According to some embodiments of the present invention, the combustor shell includes a first lean combustion shell portion and a second lean combustion shell portion, in which the first lean combustion shell portion and the second lean combustion shell portion are connected together and define the lean combustion cavity and the lean combustion opening, and the rectifying device is disposed between the first lean combustion shell portion and the second lean combustion shell portion and located at the lean combustion opening; a first rich combustion shell portion and a second rich combustion shell portion, in which the first rich combustion shell portion is connected to the first lean combustion shell portion and located outside of the first lean combustion shell portion, the first rich combustion shell portion and the first lean combustion shell portion define the first rich combustion cavity and the first rich combustion flame port together, the second rich combustion shell portion is connected to the second lean combustion shell portion and is located at an outer side of the second lean combustion shell portion, the second rich combustion shell portion and the second lean combustion shell portion define the second rich combustion cavity and the second rich combustion flame port together.

[0013] Optionally, the combustor shell further includes a plurality of connecting slats, in which two ends of each connecting slat are connected to the first rich combustion shell portion and the second rich combustion shell portion respectively, and the plurality of connecting slats divide each of the first rich combustion flame port, the second rich combustion flame port and the lean combustion flame port into a plurality of segments.

[0014] Optionally, the combustor shell further includes a lean combustion injector, connected to the first lean combustion shell portion and the second lean combustion shell portion, in which the lean combustion injection port is disposed on the lean combustion injector; and a rich combustion injector, connected to the first rich combustion shell portion and the second rich combustion shell portion and in communication with the first rich combustion cavity and the second rich combustion cavity, in which the rich combustion injector is located above the lean combustion injector and the rich combustion injection port is disposed on the rich combustion injector.

[0015] According to some embodiments of the present invention, the combustion unit further includes a rich combustion nozzle configured to provide the rich combustion injection port with the fuel gas and corresponding to the rich combustion injection port; and a lean combustor

tion nozzle configured to provide the lean combustion injection port with the fuel gas and corresponding to the lean combustion injection port.

[0016] Optionally, a sectional area S3 of a gas jet port of the rich combustion nozzle and a sectional area S4 of a gas jet port of the lean combustion nozzle satisfy: $S3/S4=0.25\sim0.65$.

[0017] According to some embodiments of the present invention, a plurality of combustion units are provided and arranged along a width direction of the combustion unit.

[0018] According to a second aspect of embodiments of the present invention, the gas water heater having the combustor of the above embodiments is provided.

[0019] As the combustor according to the above embodiments of the present invention, has the above technical effects, hence the gas water heater according to embodiments of the present invention also has the above technical effects. That is to say, the gas water heater according to embodiments of the present disclosure is provided with the combustor according to the above embodiments, thereby the stability of flame structure may be improved, the temperature of the flame may be reduced and the emission of nitrogen oxides in fume of the gas water heater may be reduced.

[0020] Additional aspects and advantages of embodiments of present invention will be given in part in the following descriptions, become apparent in part from the following descriptions, or be learned from the practice of the embodiments of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021]

Fig. 1 is a schematic view of a combustion unit of a combustor according to embodiments of the present invention from a perspective;

Fig. 2 is a schematic view of a combustion unit of a combustor according to embodiments of the present invention from another perspective;

Fig. 3 is a cross sectional view along a line A-A shown in Fig. 2;

Fig. 4 is a top view of a combustion unit of a combustor according to embodiments of the present invention;

Fig. 5 is an exploded view of a combustion unit of a combustor according to embodiments of the present invention;

Fig. 6 is a schematic view of a combustion unit of a combustor according to another embodiment of the present invention;

Fig. 7 is sectional view along a line B-B shown in Fig. 6;

Fig. 8 is an enlarged view of a portion C shown in Fig. 7;

Fig. 9 is a schematic view of a combustor according to embodiments of the present invention;

Fig. 10 is a sectional view of a combustor according to embodiments of the present invention along a vertical direction;

Fig. 11 is a front view of a combustor according to embodiments of the present invention along a horizontal direction;

Fig. 12 is a sectional view along a line D-D shown in Fig. 11.

10 Reference numerals:

[0022]

100: combustor;

1: combustion unit;

11: combustor shell, 111: first rich combustion shell portion, 1111: first rich combustion cavity, 112: second rich combustion shell portion, 1121: second rich combustion cavity, 113: first lean combustion shell portion, 114: second lean combustion shell portion, 1141: lean combustion cavity, 115: lean combustion opening, 116: first blind passage, 117: second blind passage, 118: first rich combustion flame port, 119: second rich combustion flame port;

12: lean combustion injector, 121: lean combustion injection port;

13: rich combustion injector, 131: rich combustion injection port;

14: rectifying device, 141: lean combustion flame port;

15: rich combustion nozzle;

16: lean combustion nozzle;

17: connecting slat;

2: primary air adjusting plate, 21: pressure balancing chamber;

3: secondary air adjusting plate.

DETAILED DESCRIPTION

[0023] Reference will be made in detail to embodiments of the present invention. The embodiments described herein with reference to drawings are explanatory, illustrative, and used to generally understand the present invention. The embodiments shall not be construed to limit the present invention.

[0024] In the specification, it is to be understood that terms such as "central," "longitudinal," "lateral," "length," "width," "thickness," "upper," "lower," "front," "rear," "left," "right," "vertical," "horizontal," "top," "bottom," "inner," "outer," "clockwise," and "counterclockwise" should be construed to refer to the orientation as then described or as shown in the drawings under discussion. These relative terms are for convenience of description and do not require that the present invention be constructed or operated in a particular orientation.

[0025] In addition, terms such as "first" and "second" are used herein for purposes of description and are not intended to indicate or imply relative importance or sig-

nificance or to imply the number of indicated technical features. Thus, the feature defined with "first" and "second" may comprise one or more of this feature. In the description of the present invention, "a plurality of" means two or more than two, unless specified otherwise.

[0026] In the present invention, unless specified or limited otherwise, the terms "mounted," "connected," "coupled," "fixed" and the like are used broadly, and may be, for example, fixed connections, detachable connections, or integral connections; may also be mechanical or electrical connections; may also be direct connections or indirect connections via intervening structures; may also be inner communications of two elements, which can be understood by those skilled in the art according to specific situations.

[0027] A combustor 100 according to embodiments of the present invention will be described with reference to drawings in the following.

[0028] Referring to Figs. 1-12, the combustor 100 according to embodiments of the present invention may include at least one combustion unit 1, each combustion unit 1 includes a combustor shell 11, a rectifying device 14, a primary air adjusting plate 2 and a secondary air adjusting plate 3.

[0029] The combustor shell 11 defines a first rich combustion cavity 1111, a second rich combustion cavity 1121 and a lean combustion cavity 1141 therein. The combustor shell 11 is provided with a rich combustion injection port 131 in communication with the first rich combustion cavity 1111 and the second rich combustion cavity 1121, a lean combustion injection port 121 in communication with the lean combustion cavity 1141, a first rich combustion flame port 118 in communication with the first rich combustion cavity 1111, a second rich combustion flame port 119 in communication with the second rich combustion cavity 1121 and a lean combustion opening 115 in communication with the lean combustion cavity 1141 thereon. The rectifying device 14 is disposed in the lean combustion opening 115 and the rectifying device 14 is provided with a plurality of lean combustion flame ports 141 in communication with the lean combustion cavity 1141, the first rich combustion flame port 118 and the second rich combustion flame port 119 are located at both sides of the plurality of lean combustion flame ports 141 respectively.

[0030] In other words, the combustor 100 may include one or more combustion units 1, for example, the combustor 100 may include a plurality of combustion units 1, the plurality of combustion units 1 are arranged side by side and are arrayed along a width direction of the combustion unit 1. The width direction refers to a left-right direction shown in Fig. 5 and Fig. 7. Each combustion unit 1 includes the combustor shell 11 and the rectifying device 14, the rectifying device 14 is disposed in the combustor shell 11.

[0031] The combustor shell 11 defines the first rich combustion cavity 1111, the second rich combustion cavity 1121 and the lean combustion cavity 1141 therein.

The combustor shell 11 is provided with the rich combustion injection port 131, the lean combustion injection port 121, the first rich combustion flame port 118, the second rich combustion flame port 119 and the lean combustion opening 115 thereon. The rich combustion injection port 131 is configured to introduce air for the rich combustion and the lean combustion injection port 121 is configured to introduce air for the lean combustion. Referring to Fig. 1- Fig. 3 and Fig. 6, the rich combustion injection port 131 is located above the lean combustion injection port 121.

[0032] The rich combustion injection port 131 is in communication with the first rich combustion cavity 1111 and the second rich combustion cavity 1121, the first rich combustion cavity 1111 is in communication with the first rich combustion flame port 118, the second rich combustion cavity 1121 is in communication with the second rich combustion flame port 119, the lean combustion injection port 121 is in communication with the lean combustion cavity 1141, as well the lean combustion cavity 1141 is in communication with the lean combustion opening 115.

[0033] In this way, the air is introduced in from the rich combustion injection port 131 and is mixed with fuel gas to form rich combustion gas, the rich combustion gas after being mixed may enter the first rich combustion cavity 1111 and the second rich combustion cavity 1121, then be led to the first rich combustion flame port 118 and the second rich combustion flame port 119 respectively. The air introduced in by the lean combustion injection port 121 is mixed with the fuel gas to form lean combustion gas which flows to the lean combustion cavity 1141 then. Referring to Figs. 5-8, the rectifying device 14 is disposed in the lean combustion opening 115, the rectifying device 14 is provided with the plurality of lean combustion flame ports 141, the lean combustion cavity 1141 is in communication with the plurality of lean combustion flame ports 141, and the lean combustion gas may be led to the plurality of lean combustion flame ports 141.

[0034] Referring to Fig. 4, Fig. 5, Fig. 7 and Fig. 8, the first rich combustion flame port 118 and the second rich combustion flame port 119 are disposed at both sides of the lean combustion opening 115 respectively, the plurality of lean combustion flame ports 141 are located between the first rich combustion flame port 118 and the second rich combustion flame port 119. In this way, a structure having a middle configured to be the lean combustion flame ports 141 and two sides configured to be the rich combustion ports may be formed at the top of each combustion unit 1. That is to say, the combustion unit 1 may allow a flame structure having a lean flame in the middle and rich flames at the two sides during the combustion, so that stability of the flame may be improved, and temperature of the combustion flame may be reduced, controlling emission of nitrogen oxides in fume.

[0035] Referring to Fig. 9-Fig. 12, the primary air adjusting plate 2 is disposed in front of the rich combustion

injection port 131 and the lean combustion injection port 121, so as to adjust an amount of injection air. Thus, the amount of air introduced into the rich combustion injection port 131 and the lean combustion injection port 121 may be adjusted through the primary air adjusting plate 2, thereby further controlling a ratio of the air to the fuel gas at the rich combustion injection port 131 and the ratio of the air to the fuel gas at the lean combustion injection port 121.

[0036] The secondary air adjusting plate 3 is disposed below the combustion unit 1, the primary air adjusting plate 2 extends downwardly and defines a pressure balancing chamber 21 between the primary air adjusting plate 2 and the secondary air adjusting plate 3. Specifically, the primary air adjusting plate 2 is disposed in front of the rich combustion injection port 131 and the lean combustion injection port 121 to adjust the amount of injection air, the secondary air adjusting plate 3 is disposed below the combustion unit 1 to adjust the amount of air in a combustion chamber, a lower end of the primary air adjusting plate 2 extends downwardly and defines the pressure balancing chamber 21 between the primary air adjusting plate 2 and the secondary air adjusting plate 3. In this way, air flow produced by an air blower of the gas water heater flows to the rich combustion injection port 131 and the lean combustion injection port 121 through the pressure balancing chamber 21, so that primary air entering the rich combustion injection port 131 and the lean combustion injection port 121 is more evenly, so as to improve the combustion effect.

[0037] Thus, in the combustor 100 according to embodiments of the present invention, the first rich combustion flame port 118 and the second rich combustion flame port 119 of the combustion unit 1 are located at two sides of the plurality of lean combustion flame ports 141 respectively, so as to form the stable flame structure having the lean combustion flame in the middle and the rich combustion flames at both sides, thereby reducing the flame temperature and controlling emission of the nitrogen oxides in the fume after the combustion.

[0038] Moreover the primary air adjusting plate 2 is disposed in front of the rich combustion injection port 131 and the lean combustion injection port 121 to adjust the amount of injection air. The secondary air adjusting plate 3 is disposed below the combustion unit 1, the lower end of the primary air adjusting plate 2 extends downwardly and defines the pressure balancing chamber 21 between the primary air adjusting plate 2 and the secondary air adjusting plate 3. In this way, the air flow produced by the air blower of the gas water heater flows to the rich combustion injection port 131 and the lean combustion injection port 121 through the pressure balancing chamber 21, so that the primary air entering the rich combustion injection port 131 and the lean combustion injection port 121 is more evenly, so as to further control the structural stability of the combustion flame, improving the combustion effect and reducing the emission of nitrogen oxides.

[0039] In some embodiments of the present invention, a first blind passage 116 and a second blind passage 117 may be defined between the rectifying device 14 and two side walls of the lean combustion opening 115 respectively, the first blind passage 116 is located between the first rich combustion flame port 118 and the plurality of lean combustion flame ports 141, and the second blind passage 117 is located between the second rich combustion flame port 119 and the plurality of lean combustion flame ports 141. As shown in Fig. 7 and Fig. 8, the rectifying device 14 is disposed in the lean combustion opening 115 and is connected to the two side walls of the lean combustion opening 115. The rectifying device 14 defines the first blind passage 116 and the second blind passage 117 with the two side walls of the lean combustion opening 115 respectively, neither the first blind passage 116 nor the second blind passage 117 is in communication with the lean combustion cavity 1141. The first rich combustion flame port 118 may be spaced apart from the plurality of lean combustion flame ports 141 through the first blind passage 116, and the second rich combustion flame port 119 may be spaced apart from the plurality of lean combustion flame ports 141 through the second blind passage 117, thereby the flame structure being more stable, the emission of nitrogen oxides in fume being effectively controlled.

[0040] According to the invention, as shown in Fig. 8, a top surface of an outer side wall of the first blind passage 116 is flush with a top surface of an outer side wall of the second blind passage 117 and is higher than a top surface of the rectifying device 14. A top surface of an outer side wall of the first rich combustion flame port 118 is flush with that of the second rich combustion flame port 119 and is higher than the top surface of the outer side wall of the first blind passage 116 and the top surface of the outer side wall of the second blind passage 117. A height difference between the top surface of the outer side wall of the first blind passage 116 and the top surface of the rectifying device 14 and a height difference between the top surface of the outer side wall of the second blind passage 117 and the top surface of the rectifying device 14 are denoted by H1, and a height difference between the top surface of the outer side wall of the first rich combustion flame port 118 and the top surface of the rectifying device 14 and a height difference between the top surface of the outer side wall of the second rich combustion flame port 119 and the top surface of the rectifying device 14 are denoted by H2, in which $H2 \geq H1$, thereby facilitating control of stability of the air flow at the rich combustion flame ports and the lean combustion flame port 141, further improving the stability of the combustion flame.

[0041] Preferably, H2 and H1 may satisfy $H2 > H1$, thereby further ensuring the stability of the flames at the lean combustion flame port 141 and the rich combustion flame ports, reducing the emission of nitrogen oxides in fume.

[0042] Advantageously, as shown in Fig. 8, the maxi-

imum width of the first blind passage 116 and the maximum width of the second blind passage 117 may be equal and denoted by W_2 , the maximum width of the first rich combustion flame port 118 and the maximum width of the second rich combustion flame port 119 are equal and denoted by W_1 , in which $W_2 \geq W_1$, thereby further ensuring the structural stability of the combustion flames. Specifically, with reference to Fig. 7 and Fig. 8, the maximum width of the first rich combustion flame port 118 refers to the maximum width of a narrow side of the first rich combustion flame port 118 along a left-right direction, the maximum width of the second rich combustion flame port 119 refers to the maximum width of a narrow side of the second rich combustion flame port 119 along the left-right direction. The maximum width of the first blind passage 116 and the maximum width of the second blind passage 117 refer to the maximum widths of narrow sides of the first blind passage 116 and the second blind passage 117 along the left-right direction respectively. The maximum widths of narrow sides of the first blind passage 116 and the second blind passage 117 are equal and configured to be W_2 , the maximum widths of narrow sides of the first rich combustion flame port 118 and the second rich combustion flame port 119 are equal and configured to be W_1 , the maximum widths W_2 of narrow sides of the first blind passage 116 and the second blind passage 117 are larger than or equal to the maximum widths W_1 of narrow sides of the first rich combustion flame port 118 and the second rich combustion flame port 119.

[0043] In some embodiments of the present invention, the maximum width of the lean combustion flame port 141 may be denoted by W_3 , a height of the rectifying device 14 may be denoted by H , in which $W_3/H=0.03\sim0.30$. Specifically, as shown in Fig. 4 and Fig. 5, the rectifying device 14 may include a plurality of rectifying plates. The plurality of rectifying plates define a plurality of finedraw-type passages therebetween. The plurality of lean combustion flame ports 141 are formed at a top of each finedraw-type passage. In which, the maximum width W_3 of the lean combustion flame port 141 refers to the maximum width of a narrow side of a top opening of each finedraw-type passage along the left-right direction, a height H of the rectifying device 14 refers to the height of each finedraw-type passage, preferably, $W_3/H=0.05\sim0.20$. Thereby the structure stability of the rich combustion flames and the lean combustion flames may be further ensured.

[0044] In some embodiments of the present invention, a ratio of the amount of air to that of the fuel gas in theory for complete combustion of fuel gas may be denoted by Φ_S , a mixture ratio of the amount of air to that of the fuel gas at the rich combustion injection port 131 may be denoted by Φ_R , in which, $\Phi_R/\Phi_S=0.5\sim0.8$. Φ_R/Φ_S refers to a primary air ratio of the rich combustion. By designing an port area ratio of the rich combustion injection port 131 to the lean combustion injection port 121, the primary air ratios of the rich combustion and the lean combustion may be adjusted, so that the fuel gas and the air are fully

mixed and have a good combustion ratio, so as to form the stable flame structure and reduce the emission of nitrogen oxides in fume.

[0045] In some embodiments of the present invention, the ratio of the amount of air to that of the fuel gas in theory for complete combustion of fuel gas may be denoted by Φ_S , a mixture ratio of the amount of air to that of the fuel gas at the lean combustion injection port 121 may be denoted by Φ_L , in which, $(D_L/D_S=1.5\sim2.0$. Φ_L/Φ_S refers to a primary air ratio of the lean combustion. By designing an port area ratio of the rich combustion injection port 131 to the lean combustion injection port 121, the primary air ratios of the rich combustion and the lean combustion may be adjusted, so that the fuel gas and the air are fully mixed and have a good combustion ratio, so as to form the stable flame structure and reduce the emission of nitrogen oxides in fume.

[0046] In some embodiments of the present invention, as shown in Fig. 5, Fig. 7 and Fig. 8, the combustor shell 11 may include a first lean combustion shell portion 113, a second lean combustion shell portion 114, a first rich combustion shell portion 111 and a second rich combustion shell portion 112. The first lean combustion shell portion 113 and the second lean combustion shell portion 114 are connected together and define the lean combustion cavity 1141 and the lean combustion opening 115. The rectifying device 14 is disposed between the first lean combustion shell portion 113 and the second lean combustion shell portion 114 and located at the lean combustion opening 115.

[0047] The first rich combustion shell portion 111 is connected to the first lean combustion shell portion 113 and is located outside of the first lean combustion shell portion 113. The first rich combustion shell portion 111 and the first lean combustion shell portion 113 define the first rich combustion cavity 1111 and the first rich combustion flame port 118 together. The second rich combustion shell portion 112 is connected to the second lean combustion shell portion 114 and located outside of the second lean combustion shell portion 114. The second rich combustion shell portion 112 and the second lean combustion shell portion 114 define the second rich combustion cavity 1121 and the second rich combustion flame port 119 together.

[0048] As shown in Fig. 7 and Fig. 8, the first rich combustion flame port 118 and the second rich combustion flame port 119 are located at two sides of the lean combustion opening 115 respectively. The rectifying device 14 is disposed at the lean combustion opening 115 and is provided with the plurality of lean combustion flame ports 141. The plurality of lean combustion flame ports 141 are disposed at the top of the rectifying device 14. The first rich combustion flame port 118 and the second rich combustion flame port 119 are located at two sides of the plurality of lean combustion flame ports 141 respectively, thereby facilitating formation of the stable flame structure having the lean combustion flame in the middle and the rich combustion flames at both sides, so

as improving the stability of the flames, reducing the temperature of flames and reducing the emission of nitrogen oxides.

[0049] Advantageously, the combustor shell 11 may further include a plurality of connecting slats 17. Two ends of each connecting slat 17 are connected to the first rich combustion shell portion 111 and the second rich combustion shell portion 112 respectively. The plurality of connecting slats 17 divide each of the first rich combustion flame port 118, the second rich combustion flame port 119 and the lean combustion flame port 141 into a plurality of segments. Thus, the lean combustion flame and the rich combustion flame may be divided into a plurality of segments, thereby increasing a heat dissipation area of the flame and reducing the flame temperature.

[0050] Optionally, the combustor shell 11 may further include a lean combustion injector 12 and a rich combustion injector 13. The lean combustion injector 12 is connected to the first lean combustion shell portion 113 and the second lean combustion shell portion 114. The lean combustion injection port 121 is disposed on the lean combustion injector 12. The rich combustion injector 13 is connected to the first rich combustion shell portion 111 and the second rich combustion shell portion 112 and is in communication with the first rich combustion cavity 1111 and the second rich combustion cavity 1121. The rich combustion injector 13 is located above the lean combustion injector 12, and the rich combustion injection port 131 is disposed on the rich combustion injector 13. Thus, the fuel gas and the introduced air may be led to the first rich combustion cavity 1111 and the second rich combustion cavity 1121 through the rich combustion injector 13, the fuel gas and the air are mixed in the first rich combustion cavity 1111 and the second rich combustion cavity 1121, and the mixed gas is led to the first rich combustion flame port 118 and the second rich combustion flame port 119. At the same time, the fuel gas and the introduced air may be led to the lean combustion cavity 1141 through the lean combustion injector 12, the fuel gas and the air may be mixed in the lean combustion cavity 1141 and the mixed gas and air may be led to the lean combustion flame port 141.

[0051] In some embodiments of the present invention, the combustion unit 1 may further include a rich combustion nozzle 15 and a lean combustion nozzle 16. The rich combustion nozzle 15 may be configured to provide the rich combustion injection port 131 with the fuel gas and the lean combustion nozzle 16 may be configured to provide the lean combustion injection port 121 with the fuel gas. The rich combustion nozzle 15 is in communication with the rich combustion injection port 131 and the lean combustion nozzle 16 is in communication with the lean combustion injection port 121. Thus, the fuel gas may be injected into the rich combustion injection port 131 through the rich combustion nozzle 15. The fuel gas is mixed with the air introduced by the rich combustion injector 13 and is led to the first rich combustion cavity 1111 and the second rich combustion cavity 1121. The fuel

gas may be injected into the lean combustion injection port 121 through the lean combustion nozzle 16. The fuel gas is mixed with the air introduced by the lean combustion injector 12 and is led to the lean combustion cavity 1141.

[0052] Optionally, a sectional area S3 of a gas jet port of the rich combustion nozzle 15 and a sectional area S4 of a gas jet port of the lean combustion nozzle 16 could satisfy: $S3/S4=0.25\sim0.65$. That is to say, the sectional area of the gas jet port of the rich combustion nozzle 15 is 0.25~0.65 percent of the sectional area of the gas jet port of the lean combustion nozzle 16. Thus, by designing the ratio of the sectional area of the gas jet port of the rich combustion nozzle 15 to that of the lean combustion nozzle 16, the ratio of the amount of fuel gas to that of the air for the rich combustion and the lean combustion may be controlled, so that the amount of air introduced by the lean combustion injection port 121 and the amount of fuel gas injected by the lean combustion nozzle 16, as well as the amount of air introduced by the rich combustion injection port 131 and the amount of fuel gas injected by the rich combustion nozzle 15 could have a good ratio, thereby the rich combustion and the lean combustion being more sufficient, and the emission of nitrogen oxides being reduced.

[0053] Furthermore, a sectional area S1 of the rich combustion injection port 131 and a sectional area S2 of the lean combustion injection port 121 satisfy: $S1/S2=0.20\sim0.40$. In other words, the sectional area of the rich combustion injection port 131 is denoted by S1, the sectional area of the lean combustion injection port 121 is denoted by S2, S1 and S2 may satisfy: $S1/S2=0.20\sim0.40$, that is to say, the sectional area S1 of the rich combustion injection port 131 is 0.20~0.40 percent of the sectional area S2 of the lean combustion injection port 121.

[0054] Thus, the amount of air introduced by the rich combustion injection port 131 and the lean combustion injection port 121 may be controlled, moreover the mixed ratio of the air introduced by the rich combustion injection port 131 to the fuel gas and the mixed ratio of the air introduced by the lean combustion injection port 121 to the fuel gas are good, so as to control the primary air ratio of the rich combustion or the lean combustion. The primary air ratio refers to a ratio of the proportion of the amount of air to that of fuel gas when the fuel gas is mixed with the air in advance, to the proportion of the amount of air to that of fuel gas in theory for a complete combustion of fuel gas. Thereby the stability of the flame structure may be improved effectively, so as to further reduce the emission of nitrogen oxides in fume and reduce the environment pollution.

[0055] A specific embodiment of the combustor 100 according to embodiments of the present invention will be described in detail with reference to drawings in the following. It should be noted that, the following description is just explanatory and could not be construed to limit the present invention.

[0056] As shown in Figs. 1-12, the combustor 100 according to embodiments of the present invention may include the plurality of combustion units 1, the primary air adjusting plate 2 and the secondary air adjusting plate 3, the plurality of combustion units 1 are arranged side by side along the width direction of the combustion unit 1.

[0057] Specifically, each combustion unit 1 includes the combustor shell 11, the rectifying device 14, the rich combustion injector 13, the lean combustion injector 12, the rich combustion nozzle 15 and the lean combustion nozzle 16. As shown in Fig. 5, Fig. 7 and Fig. 8, the combustor shell 11 includes the first lean combustion shell portion 113, the second lean combustion shell portion 114, the first rich combustion shell portion 111 and the second rich combustion shell portion 112. The first lean combustion shell portion 113 and the second lean combustion shell portion 114 are connected together and define the lean combustion cavity 1141 and the lean combustion opening 115. The rectifying device 14 is disposed between the first lean combustion shell portion 113 and the second lean combustion shell portion 114 and located at the lean combustion opening 115.

[0058] The first rich combustion shell portion 111 is connected to the first lean combustion shell portion 113 and is located outside of the first lean combustion shell portion 113. The first rich combustion shell portion 111 and the first lean combustion shell portion 113 define the first rich combustion cavity 1111 and the first rich combustion flame port 118 together. The second rich combustion shell portion 112 is connected to the second lean combustion shell portion 114 and located outside of the second lean combustion shell portion 114. The second rich combustion shell portion 112 and the second lean combustion shell portion 114 define the second rich combustion cavity 1121 and the second rich combustion flame port 119 together.

[0059] The first rich combustion flame port 118 and the second rich combustion flame port 119 are located at two sides of the lean combustion opening 115 respectively. The rectifying device 14 is disposed at the lean combustion opening 115 and is provided with the plurality of lean combustion flame ports 141. The plurality of lean combustion flame ports 141 are disposed at the top of the rectifying device 14. The first rich combustion flame port 118 and the second rich combustion flame port 119 are located at two sides of the plurality of lean combustion flame ports 141 respectively, thereby facilitating formation of the stable flame structure having the lean combustion flame in the middle and the rich combustion flames at both sides, so as improving the stability of the flames, reducing the temperature of flames and reducing the emission of nitrogen oxides.

[0060] The lean combustion injector 12 is connected to the first lean combustion shell portion 113 and the second lean combustion shell portion 114. The lean combustion injection port 121 is disposed on the lean combustion injector 12. The rich combustion injector 13 is connected to the first rich combustion shell portion 111

and the second rich combustion shell portion 112 and is in communication with the first rich combustion cavity 1111 and the second rich combustion cavity 1121. The rich combustion injector 13 is located above the lean combustion injector 12, and the rich combustion injection port 131 is disposed on the rich combustion injector 13. Thus, the fuel gas and the introduced air may be led to the first rich combustion cavity 1111 and the second rich combustion cavity 1121 through the rich combustion injector 13, the fuel gas and the air are mixed and led to the first rich combustion flame port 118 and the second rich combustion flame port 119. At the same time, the fuel gas and the introduced air may be led to the lean combustion cavity 1141 through the lean combustion injector 12, the fuel gas and the air may be mixed led to the lean combustion flame port 141.

[0061] The rich combustion nozzle 15 may be configured to provide the rich combustion injection port 131 with the fuel gas and the lean combustion nozzle 16 may be configured to provide the lean combustion injection port 121 with the fuel gas. The rich combustion nozzle 15 is corresponding to and in communication with the rich combustion injection port 131. The lean combustion nozzle 16 is corresponding to and in communication with the lean combustion injection port 121. Thus, the fuel gas may be injected into the rich combustion injection port 131 through the rich combustion nozzle 15. The fuel gas is mixed with the air introduced by the rich combustion injector 13 and is led to the first rich combustion cavity 1111 and the second rich combustion cavity 1121. The fuel gas may be injected into the lean combustion injection port 121 through the lean combustion nozzle 16. The fuel gas is mixed with the air introduced by the lean combustion injector 12 and is led to the lean combustion cavity 1141.

[0062] The sectional area S1 of the rich combustion injection port 131 and the sectional area S2 of the lean combustion injection port 121 satisfy: $S1/S2=0.20\sim0.40$. The sectional area S3 of the gas jet port of the rich combustion nozzle 15 and the sectional area S4 of the gas jet port of the lean combustion nozzle 16 could satisfy: $S3/S4=0.25\sim0.65$. Thus, the ratio of the amount of air to that of fuel gas at the rich combustion injection port 131 and the ratio of the amount of air to that of fuel gas at the lean combustion injection port 121 may be controlled, and then the primary air ratio of the rich combustion and the primary air ratio of the lean combustion may be further controlled.

[0063] The ratio of the amount of air to that of fuel gas in theory for a complete combustion of fuel gas may be denoted by Φ_S , the mixture ratio of the amount of air to that of fuel gas at the rich combustion injection port 131 may be denoted by Φ_R , and the mixture ratio of the amount of air to that of fuel gas at the lean combustion injection port 121 may be denoted by Φ_L . The primary air ratio of the rich combustion is configured to be Φ_R/Φ_S and satisfies: $\Phi_R/\Phi_S=0.5\sim0.8$, the primary air ratio of the lean combustion is configured to be Φ_L/Φ_S and satisfies:

$\Phi_L/\Phi_S=1.5\sim 2.0$, so that the fuel gas and the air are mixed fully and have a good combustion proportion, so as forming the stable flame structure and reducing the emission of nitrogen oxides in fume.

[0064] As shown in Fig. 7 and Fig. 8, the first blind passage 116 and the second blind passage 117 may be defined between the rectifying device 14 and two side walls of the lean combustion opening 115 respectively, the first blind passage 116 is located between the first rich combustion flame port 118 and the plurality of lean combustion flame ports 141, and the second blind passage 117 is located between the second rich combustion flame port 119 and the plurality of lean combustion flame ports 141.

[0065] The top surface of the outer side wall of the first blind passage 116 is flush with the top surface of the outer side wall of the second blind passage 117 and is higher than the top surface of the rectifying device 14. The top surface of the outer side wall of the first rich combustion flame port 118 is flush with the top surface of the outer side wall of the second rich combustion flame port 119 and is higher than the top surface of the outer side wall of the first blind passage 116 and the top surface of the outer side wall of the second blind passage 117. The height difference between the top surface of the outer side wall of the first blind passage 116 and the top surface of the rectifying device 14 and the height difference between the top surface of the outer side wall of the second blind passage 117 and the top surface of the rectifying device 14 are denoted by H1, and the height difference between the top surface of the outer side wall of the first rich combustion flame port 118 and the top surface of the rectifying device 14 and the height difference between the top surface of the outer side wall of the second rich combustion flame port 119 and the top surface of the rectifying device 14 are denoted by H2, the maximum width of the first blind passage 116 and the maximum width of the second blind passage 117 are equal and may be denoted by W2, the maximum width of the first rich combustion flame port 118 and the maximum width of the second rich combustion flame port 119 are equal and may be denoted by W1, in which $H2\geq H1$, $W2\geq W1$, thereby facilitating control of stability of the air flow at the rich combustion flame ports and the lean combustion flame port 141, further improving the stability of the combustion flame.

[0066] The maximum width of the lean combustion flame port 141 may be denoted by W3, and the height of the rectifying device 14 may be denoted by H, in which, $W3/H=0.03\sim 0.30$, and preferably, $W3/H=0.05\sim 0.20$, thereby the structural stability of the rich combustion flame and the lean combustion flame may be further ensured.

[0067] The primary air adjusting plate 2 may be disposed in front of the rich combustion injection port 131 and the lean combustion injection port 121 of each combustion unit 1, so as to adjust the amount of injection air. Thus, the amount of air introduced from the rich combus-

tion injection port 131 and the lean combustion injection port 121 of each the combustion unit 1 may be adjusted through the primary air adjusting plate 2, thereby the proportion of the amount of air to that of fuel gas at the rich combustion injection port 131 and the proportion of the amount of air to that of fuel gas at the lean combustion injection port 121 being further controlled.

[0068] The secondary air adjusting plate 3 is disposed below the combustion unit 1 to adjust the amount of air in the combustion chamber, the primary air adjusting plate 2 extends downwardly and defines a pressure balancing chamber 21 between the primary air adjusting plate 2 and the secondary air adjusting plate 3. The air flow produced by the air blower of the gas water heater flows to the rich combustion injection port 131 and the lean combustion injection port 121 through the pressure balancing chamber 21, so that primary air entering the rich combustion injection port 131 and the lean combustion injection port 121 is more evenly, so as to improve the combustion effect.

[0069] Thus, in the combustor 100 according to embodiments of the present invention, the first rich combustion flame port 118 and the second rich combustion flame port 119 of the combustion unit 1 are located at two sides of the plurality of lean combustion flames 141, so as to form the stable flame structure having the lean combustion flame in the middle and the rich combustion flame at the both sides, reducing the flame temperature and controlling emission of the nitrogen oxides in the fume after the combustion. Moreover the sectional area S1 of the rich combustion injection port 131 and the sectional area S2 of the lean combustion injection port 121 of the combustor 100 satisfy: $S1/S2=0.20\sim 0.40$, and the sectional area S3 of the gas jet port of the rich combustion nozzle 15 and the sectional area S4 of the gas jet port of the lean combustion nozzle 16 satisfy: $S3/S4=0.25\sim 0.65$. The structure of the combustor shell 11 and the primary air ratio of the rich combustion and the lean combustion are defined, thereby achieving a good proportion of the air introduced by the rich combustion injection port 131 and the lean combustion injection port 121 to the fuel gas, further controlling the structural stability of the combustion flame and reducing the emission of nitrogen oxides.

[0070] In addition, a gas water heater having the combustor 100 according to the above embodiments is further provided by the present invention.

[0071] As the combustor 100 according to the above embodiments of the present invention has the above technical effects, hence the gas water heater according to embodiments of the present invention also has the above technical effects. That is to say, the gas water heater according to embodiments of the present invention is provided with the combustor 100 according to the above embodiments, thereby the stability of flame structure may be improved, the temperature of the flame may be reduced and the emission of nitrogen oxides in fume of the gas water heater may be reduced.

[0072] In the present invention, unless specified or limited otherwise, a structure in which a first feature is "on" or "below" a second feature may include an embodiment in which the first feature is in direct contact with the second feature, and may also include an embodiment in which the first feature and the second feature are not in direct contact with each other, but are contacted via an additional feature formed therebetween. Furthermore, a first feature "on," "above," or "on top of" a second feature may include an embodiment in which the first feature is right or obliquely "on," "above," or "on top of" the second feature, or just means that the first feature is at a height higher than that of the second feature; while a first feature "below," "under," or "on bottom of" a second feature may include an embodiment in which the first feature is right or obliquely "below," "under," or "on bottom of" the second feature, or just means that the first feature is at a height lower than that of the second feature.

[0073] Reference throughout this specification to "an embodiment," "some embodiments," "one embodiment," "another example," "an example," "a specific example," or "some examples," means that a particular feature, structure, material, or characteristic described in connection with the embodiment or example is included in at least one embodiment or example of the present invention. Thus, the appearances of the phrases such as "in some embodiments," "in one embodiment," "in an embodiment," "in another example," "in an example," "in a specific example," or "in some examples," in various places throughout this specification are not necessarily referring to the same embodiment or example of the present invention. Furthermore, the particular features, structures, materials, or characteristics may be combined in any suitable manner in one or more embodiments or examples.

[0074] Although explanatory embodiments have been shown and described, it would be appreciated by those skilled in the art that the above embodiments cannot be construed to limit the present invention, and changes, alternatives, and modifications can be made in the embodiments without departing from the scope of the present invention as defined by the appended claims.

Claims

1. A combustor (100) comprising:
at least one combustion unit (1), the combustion unit (1) comprising:

a combustor shell (11), wherein the combustor shell (11) defines a first rich combustion cavity (1111), a second rich combustion cavity (1121) and a lean combustion cavity (1141) therein, and the combustor shell (11) is provided with a rich combustion injection port (131) in communication with the first rich combustion cavity (1111) and the second rich combustion cavity (1121),

a lean combustion injection port (121) in communication with the lean combustion cavity (1141), a first rich combustion flame port (118) in communication with the first rich combustion cavity (1111), a second rich combustion flame port (119) in communication with the second rich combustion cavity (1121) and a lean combustion opening (115) in communication with the lean combustion cavity (1141) thereon;

a rectifying device (14), disposed in the lean combustion opening (115) and provided with a plurality of lean combustion flame ports (141) in communication with the lean combustion cavity (1141), wherein the first rich combustion flame port (118) and the second rich combustion flame port (119) are located at two sides of the plurality of lean combustion flame ports (141) respectively;

a primary air adjusting plate (2) disposed in front of the rich combustion injection port (131) and the lean combustion injection port (121), so as to adjust an amount of injection air; and a secondary air adjusting plate (3) disposed below the combustion unit (1), wherein the primary air adjusting plate (2) extends downwardly and defines a pressure balancing chamber (21) between the primary air adjusting plate (2) and the secondary air adjusting plate (3),

wherein a first blind passage (116) and a second blind passage (117) are defined between the rectifying device (14) and two side walls of the lean combustion opening (115) respectively, wherein the first blind passage (116) is located between the first rich combustion flame port (118) and the plurality of lean combustion flame ports (141), and the second blind passage (117) is located between the second rich combustion flame port (119) and the plurality of lean combustion flame ports (141),

characterized in that there is a height difference (H1) between the top surface of an outer side wall of the first blind passage (116) and a top surface of the rectifying device (14) and between the top surface of an outer side wall of the second blind passage (117) and the top surface of the rectifying device (14).

2. The combustor (100) according to claim 1, wherein the maximum width of the lean combustion flame port (141) is denoted by W3 and a height of the rectifying device (14) is denoted by H, wherein $W3/H=0.03\sim0.30$.
3. The combustor (100) according to claim 1, wherein a ratio of the amount of air to that of fuel gas in theory for complete combustion of fuel gas is denoted by Φ S and a mixture ratio of the amount of air to that of fuel gas at the rich combustion injection port (131)

is denoted by ΦR , wherein $\Phi R/\Phi S=0.5\sim 0.8$.

4. The combustor (100) according to claim 1, wherein the ratio of the amount of air to that of fuel gas in theory for complete combustion of fuel gas is denoted by ΦS , a mixture ratio of the amount of air to that of fuel gas at the lean combustion injection port (121) is denoted by ΦL , wherein $\Phi L/\Phi S=1.5\sim 2.0$. 5
5. The combustor (100) according to any one of claims 1-4, wherein the combustor shell (11) comprises: 10
 - a first lean combustion shell portion (113) and a second lean combustion shell portion (114), wherein the first lean combustion shell portion (113) and the second lean combustion shell portion (114) are connected together and define the lean combustion cavity (1141) and the lean combustion opening (115), and the rectifying device (14) is disposed between the first lean combustion shell portion (113) and the second lean combustion shell portion (114) and located at the lean combustion opening (115); and 15
 - a first rich combustion shell portion (111) and a second rich combustion shell portion (112), wherein the first rich combustion shell portion (111) is connected to the first lean combustion shell portion (113) and located outside of the first lean combustion shell portion, the first rich combustion shell portion (111) and the first lean combustion shell portion (113) define the first rich combustion cavity (1111) and the first rich combustion flame port (118) together, the second rich combustion shell portion (112) is connected to the second lean combustion shell portion (114) and located outside of the second lean combustion shell portion (114), the second rich combustion shell portion (112) and the second lean combustion shell portion (114) define the second rich combustion cavity (1121) and the second rich combustion flame port (119) together. 20 25 30 35 40
6. The combustor (100) according to claim 5, wherein the combustor shell (11) further comprises: 45
 - a plurality of connecting slats (17), wherein two ends of each connecting slat (17) are connected to the first rich combustion shell portion (111) and the second rich combustion shell portion (112) respectively, and the plurality of connecting slats (17) divide each of the first rich combustion flame port (118), the second rich combustion flame port (119) and the lean combustion flame port (141) into a plurality of segments. 50
7. The combustor (100) according to claim 5, wherein the combustor shell (11) further comprises: 55

a lean combustion injector (12), connected to the first lean combustion shell portion (113) and the second lean combustion shell portion (114), wherein the lean combustion injection port (121) is disposed on the lean combustion injector (12); and

a rich combustion injector (13), connected to the first rich combustion shell portion (111) and the second rich combustion shell portion (112) and in communication with the first rich combustion cavity (1111) and the second rich combustion cavity (1121), wherein the rich combustion injector is located above the lean combustion injector (12) and the rich combustion injection port (131) is disposed on the rich combustion injector (13).

8. The combustor (100) according to any one of claims 1-4, wherein the combustion unit (1) further comprises:

a rich combustion nozzle (15) configured to provide the rich combustion injection port (131) with the fuel gas and corresponding to the rich combustion injection port (131); and
a lean combustion nozzle (16) configured to provide the lean combustion injection port (121) with the fuel gas and corresponding to the lean combustion injection port (121).

9. The combustor (100) according to claim 8, wherein a sectional area $S3$ of a gas jet port of the rich combustion nozzle (15) and a sectional area $S4$ of a gas jet port of the lean combustion nozzle (16) satisfy: $S3/S4=0.25\sim 0.65$.
10. The combustor (100) according to any one of claims 1-4, wherein a plurality of combustion units (1) are provided and arranged along a width direction of the combustion unit (1).
11. A gas water heater comprising the combustor (100) according to any one of claims 1-10.

Patentansprüche

1. Brennkammer (100), umfassend:
mindestens eine Verbrennungseinheit (1), die Verbrennungseinheit (1) umfassend:

einen Brennkammermantel (11), wobei der Brennkammermantel (11) einen ersten Hohlraum fetter Verbrennung (1111), einen zweiten Hohlraum fetter Verbrennung (1121) und einen Hohlraum magerer Verbrennung (1141) darin definiert, und der Brennkammermantel (11) mit einem Einspritzanschluss fetter Verbrennung

(131) in Verbindung mit dem ersten Hohlraum fatter Verbrennung (1111) und dem zweiten Hohlraum fatter Verbrennung (1121), einem Einspritzanschluss magerer Verbrennung (121) in Verbindung mit dem Hohlraum magerer Verbrennung (1141), einem ersten Flammenanschluss fatter Verbrennung (118) in Verbindung mit dem ersten Hohlraum fatter Verbrennung (1111), einem zweiten Flammenanschluss fatter Verbrennung (119) in Verbindung mit dem zweiten Hohlraum fatter Verbrennung (1121) und einer Öffnung magerer Verbrennung (115) in Verbindung mit dem Hohlraum magerer Verbrennung (1141) darauf versehen ist; eine gleichrichtende Vorrichtung (14), die in der Öffnung magerer Verbrennung (115) angeordnet und mit einer Vielzahl von Flammenanschlüssen magerer Verbrennung (141) versehen ist, die mit dem Hohlraum magerer Verbrennung (1141) in Kommunikation sind, wobei der erste Flammenanschluss fatter Verbrennung (118) und der zweite Flammenanschluss fatter Verbrennung (119) jeweils an zwei Seiten der Vielzahl von Flammenanschlüssen magerer Verbrennung (141) angeordnet sind; eine Primärlufteinstellplatte (2), die vor dem Einspritzanschluss fatter Verbrennung (131) und dem Einspritzanschluss magerer Verbrennung (121) angeordnet ist, um eine Menge an Einspritzluft einzustellen; und eine unterhalb der Verbrennungseinheit (1) angeordnete Sekundärlufteinstellplatte (3), wobei sich die Primärlufteinstellplatte (2) nach unten erstreckt und zwischen der Primärlufteinstellplatte (2) und der Sekundärlufteinstellplatte (3) eine Druckausgleichskammer (21) definiert, wobei ein erster Blinndurchgang (116) und ein zweiter Blinndurchgang (117) jeweils zwischen der gleichrichtenden Vorrichtung (14) und zwei Seitenwänden der Öffnung magerer Verbrennung (115) definiert sind, wobei sich der erste Blinndurchgang (116) zwischen dem ersten Flammenanschluss fatter Verbrennung (118) und der Vielzahl von Flammenanschlüssen magerer Verbrennung (141) befindet, und sich der zweite Blinndurchgang (117) zwischen dem Flammenanschluss fatter Verbrennung (119) und der Vielzahl von Flammenanschlüssen magerer Verbrennung (141) befindet, **dadurch gekennzeichnet, dass** es einen Höhenunterschied (H1) zwischen der oberen Oberfläche einer äußeren Seitenwand des ersten Blinndurchgangs (116) und einer oberen Oberfläche der gleichrichtenden Vorrichtung (14) und zwischen der oberen Oberfläche einer äußeren Seitenwand des zweiten Blinndurchgangs (117) und der oberen Oberfläche der gleichrichtenden Vorrichtung (14) gibt.

2. Brennkammer (100) gemäß Anspruch 1, wobei die maximale Breite des Flammenanschlusses magerer Verbrennung (141) mit W3 und eine Höhe der Gleichrichtenden Vorrichtung (14) mit H bezeichnet wird, wobei $W3/H = 0,03-0,30$.
3. Brennkammer (100) gemäß Anspruch 1, wobei ein Verhältnis der Luftmenge zu der von Brenngas theoretisch für eine vollständige Verbrennung von Brenngas mit ΦS bezeichnet wird und ein Mischungsverhältnis der Luftmenge zu der von Brenngas an dem Einspritzanschluss fatter Verbrennung (131) mit ΦR bezeichnet wird, wobei $\Phi R/\Phi S = 0,5-0,8$.
4. Brennkammer (100) gemäß Anspruch 1, wobei das Verhältnis der Luftmenge zu der von Brenngas theoretisch für eine vollständige Verbrennung von Brenngas mit ΦS bezeichnet wird, ein Mischungsverhältnis der Luftmenge zu der von Brenngas an dem Einspritzanschluss magerer Verbrennung (121) mit ΦL bezeichnet wird, wobei $\Phi L/\Phi S = 1,5-2,0$.
5. Brennkammer (100) gemäß einem der Ansprüche 1-4, wobei der Brennkammermantel (11) Folgendes umfasst:

einen ersten Mantelabschnitt magerer Verbrennung (113) und einen zweiten Mantelabschnitt magerer Verbrennung (114), wobei der erste Mantelabschnitt magerer Verbrennung (113) und der zweite Mantelabschnitt magerer Verbrennung (114) miteinander verbunden sind und den Hohlraum magerer Verbrennung (1141) und die Öffnung magerer Verbrennung (115) definieren, und die gleichrichtende Vorrichtung (14) zwischen dem ersten Mantelabschnitt magerer Verbrennung (113) und dem zweiten Mantelabschnitt magerer Verbrennung (114) angeordnet ist und sich an der Öffnung magerer Verbrennung (115) befindet; und einen ersten Mantelabschnitt fatter Verbrennung (111) und einen zweiten Mantelabschnitt fatter Verbrennung (112), wobei der erste Mantelabschnitt fatter Verbrennung (111) mit dem ersten Mantelabschnitt magerer Verbrennung (113) verbunden ist und sich außerhalb des ersten Mantelabschnitts fatter Verbrennung befindet, der erste Mantelabschnitt fatter Verbrennung (111) und der erste Mantelabschnitt magerer Verbrennung (113) zusammen den ersten Hohlraum fatter Verbrennung (1111) und den ersten Flammenanschluss fatter Verbrennung (118) definieren, der zweite Mantelabschnitt fatter Verbrennung (112) mit dem zweiten Mantelabschnitt magerer Verbrennung (114) verbunden ist und sich außerhalb des zweiten Mantel-

abschnitts magerer Verbrennung (114) befindet, der zweite Mantelabschnitt fetter Verbrennung (112) und der zweite Mantelabschnitt magerer Verbrennung (114) zusammen den zweiten Hohlraum fetter Verbrennung (1121) und den zweiten Flammenanschluss fetter Verbrennung (119) definieren.

6. Brennkammer (100) gemäß Anspruch 5, wobei der Brennkammermantel (11) ferner Folgendes umfasst:

1. eine Vielzahl von Verbindungslamellen (17), wobei zwei Enden von jeder Verbindungslamelle (17) mit dem ersten Mantelabschnitt fetter Verbrennung (111) bzw. dem zweiten Mantelabschnitt fetter Verbrennung (112) verbunden sind, und die Vielzahl von Verbindungslamellen (17) jeden von dem ersten Flammenanschluss fetter Verbrennung (118), dem zweiten Flammenanschluss fetter Verbrennung (119) und dem Flammenanschluss magerer Verbrennung (141) in eine Vielzahl von Segmenten unterteilt.

7. Brennkammer (100) gemäß Anspruch 5, wobei der Brennkammermantel (11) ferner Folgendes umfasst:

einen Injektor magerer Verbrennung (12), der mit dem ersten Mantelabschnitt magerer Verbrennung (113) und dem zweiten Mantelabschnitt magerer Verbrennung (114) verbunden ist, wobei der Einspritzanschluss magerer Verbrennung (121) an dem Injektor magerer Verbrennung (12) angeordnet ist; und einen Injektor fetter Verbrennung (13), der mit dem ersten Mantelabschnitt fetter Verbrennung (111) und dem zweiten Mantelabschnitt fetter Verbrennung (112) verbunden ist und mit dem ersten Hohlraum fetter Verbrennung (1111) und dem zweiten Hohlraum fetter Verbrennung (1121) in Verbindung ist, wobei sich der Injektor fetter Verbrennung (13) oberhalb des Injektors magerer Verbrennung (12) befindet und der Einspritzanschluss fetter Verbrennung (131) an dem Injektor fetter Verbrennung (13) angeordnet ist.

8. Brennkammer (100) gemäß einem der Ansprüche 1-4, wobei die Verbrennungseinheit ferner Folgendes umfasst:

eine Düse fetter Verbrennung (15), die konfiguriert ist, um dem Einspritzanschluss fetter Verbrennung (131) das Brenngas bereitzustellen und dem Einspritzanschluss fetter Verbrennung (131) zu entsprechen; und eine Düse magerer Verbrennung (16), die kon-

figuriert ist, um dem Einspritzanschluss magerer Verbrennung (121) das Brenngas bereitzustellen und dem Einspritzanschluss magerer Verbrennung (121) zu entsprechen.

9. Brennkammer (100) gemäß Anspruch 8, wobei eine Querschnittsfläche S3 eines Gasstrahlanschlusses der Düse fetter Verbrennung (15) und eine Querschnittsfläche S4 einer Gasstrahlöffnung der Düse magerer Verbrennung (16) Folgendes erfüllen: $S3/S4 = 0,25 \sim 0,65$.

10. Brennkammer (100) gemäß einem der Ansprüche 1 bis 4, wobei eine Vielzahl von Verbrennungseinheiten (1) bereitgestellt und entlang einer Breitenrichtung der Verbrennungseinheit (1) angeordnet ist.

11. Gas-Wassererhitzer, umfassend die Brennkammer (100) gemäß einem der Ansprüche 1-10.

Revendications

1. Une chambre de combustion (100) comprenant :
au moins une unité de combustion (1), l'unité de combustion (1) comprenant :

une enveloppe de chambre de combustion (11), dans laquelle l'enveloppe de chambre de combustion (11) définit une première cavité de combustion riche (1111), une deuxième cavité de combustion riche (1121) et une cavité de combustion pauvre (1141) à l'intérieur, et l'enveloppe de chambre de combustion (11) est pourvue d'un orifice d'injection de combustion riche (131) en communication avec la première cavité de combustion riche (1111) et la deuxième cavité de combustion riche (1121), un orifice d'injection de combustion pauvre (121) en communication avec la cavité de combustion pauvre (1141), un premier orifice de flamme de combustion riche (118) en communication avec la première cavité de combustion riche (1111), un deuxième orifice de flamme de combustion riche (119) en communication avec la deuxième cavité de combustion riche (1121) et une ouverture de combustion pauvre (115) en communication avec la cavité de combustion pauvre (1141) sur celle-ci ;
un dispositif de redressement (14), disposé dans l'ouverture de combustion pauvre (115) et pourvu d'une pluralité d'orifices de flamme de combustion pauvre (141) en communication avec la cavité de combustion pauvre (1141), dans laquelle le premier orifice de flamme de combustion riche (118) et le deuxième orifice de flamme de combustion riche (119) sont situés respectivement sur deux côtés de la pluralité d'orifices de flamme de combustion pauvre

- (141) ;
 une plaque de réglage d'air primaire (2) disposée devant l'orifice d'injection de combustion riche (131) et l'orifice d'injection de combustion pauvre (121), de manière à régler une quantité d'air d'injection ; et
 une plaque de réglage d'air secondaire (3) disposée sous l'unité de combustion (1), dans laquelle la plaque de réglage d'air primaire (2) s'étend vers le bas et définit une chambre d'équilibrage de pression (21) entre la plaque de réglage d'air primaire (2) et plaque de réglage d'air secondaire (3),
 dans laquelle un premier passage borgne (116) et un deuxième passage borgne (117) sont définis entre le dispositif de redressement (14) et deux parois latérales de l'ouverture de combustion pauvre (115) respectivement, dans laquelle le premier passage borgne (116) est situé entre le premier orifice de flamme de combustion riche (118) et la pluralité d'orifices de flamme de combustion pauvre (141), et le deuxième passage borgne (117) est situé entre le deuxième orifice de flamme de combustion riche (119) et la pluralité d'orifices de flamme de combustion pauvre (141),
caractérisé en ce qu'il y a une différence de hauteur (H1) entre la surface supérieure d'une paroi latérale extérieure du premier passage borgne (116) et une surface supérieure du dispositif de redressement (14) et entre la surface supérieure d'une paroi latérale extérieure du deuxième passage borgne (117) et la surface supérieure du dispositif de redressement (14).
2. La chambre de combustion (100) selon la revendication 1, dans laquelle la largeur maximale de l'orifice de flamme de combustion pauvre (141) est désignée par W3 et une hauteur du dispositif de redressement (14) est désignée par H, où $W3/H = 0,03 \sim 0,30$.
 3. La chambre de combustion (100) selon la revendication 1, dans laquelle un rapport de la quantité d'air à celle du gaz combustible en théorie pour une combustion complète du gaz combustible est désigné par ΦS et un rapport de mélange de la quantité d'air à celle du gaz combustible à l'orifice d'injection de combustion riche (131) est désigné par ΦR , où $\Phi R/\Phi S = 0,5 \sim 0,8$.
 4. La chambre de combustion (100) selon la revendication 1, dans laquelle le rapport de la quantité d'air à celle du gaz combustible en théorie pour une combustion complète du gaz combustible est désigné par ΦS , un rapport de mélange de la quantité d'air à celle du gaz combustible à l'orifice d'injection de combustion pauvre (121) est désigné par ΦL , où Φ

$$L/\Phi S = 1,5 \sim 2,0.$$

5. La chambre de combustion (100) selon l'une quelconque des revendications 1 à 4, dans laquelle l'enveloppe de chambre de combustion (11) comprend :
 une première partie d'enveloppe de combustion pauvre (113) et une deuxième partie d'enveloppe de combustion pauvre (114), dans laquelle la première partie d'enveloppe de combustion pauvre (113) et la deuxième partie d'enveloppe de combustion pauvre (114) sont connectées ensemble et définissent la cavité de combustion pauvre (1141) et l'ouverture de combustion pauvre (115), et le dispositif de redressement (14) est disposé entre la première partie d'enveloppe de combustion pauvre (113) et la deuxième partie d'enveloppe de combustion pauvre (114) et situé au niveau de l'ouverture de combustion pauvre (115) ; et
 une première partie d'enveloppe de combustion riche (111) et une deuxième partie d'enveloppe de combustion riche (112), dans laquelle la première partie d'enveloppe de combustion riche (111) est connectée à la première partie d'enveloppe de combustion pauvre (113) et située à l'extérieur de la première partie d'enveloppe de combustion pauvre, la première partie d'enveloppe de combustion riche (111) et la première partie d'enveloppe de combustion pauvre (113) définissent ensemble la première cavité de combustion riche (1111) et le premier orifice de flamme de combustion riche (118), la deuxième partie d'enveloppe de combustion riche (112) est connectée à la deuxième partie d'enveloppe de combustion pauvre (114) et située à l'extérieur de la deuxième partie d'enveloppe de combustion pauvre (114), la deuxième partie d'enveloppe de combustion riche (112) et la deuxième partie d'enveloppe de combustion pauvre (114) définissent ensemble la deuxième cavité de combustion riche (1121) et le deuxième orifice de flamme de combustion riche (119).
6. La chambre de combustion (100) selon la revendication 5, dans laquelle l'enveloppe de chambre de combustion (11) comprend en outre :
 une pluralité de lattes de connexion (17), dans laquelle deux extrémités de chaque latte de connexion (17) sont connectées respectivement à la première partie d'enveloppe de combustion riche (111) et à la deuxième partie d'enveloppe de combustion riche (112), et la pluralité de lattes de connexion (17) divise chacun du premier orifice de flamme de combustion riche (118), du deuxième orifice de flamme de combustion riche (119) et de l'orifice de flamme de combustion pauvre (141) en une pluralité de segments.

7. La chambre de combustion (100) selon la revendication 5, dans laquelle l'enveloppe de chambre de combustion (11) comprend en outre :

un injecteur de combustion pauvre (12), connecté à la première partie d'enveloppe de combustion pauvre (113) et à la deuxième partie d'enveloppe de combustion pauvre (114), dans laquelle l'orifice d'injection de combustion pauvre (121) est disposé sur l'injecteur de combustion pauvre (12) ; et
 un injecteur de combustion riche (13), connecté à la première partie d'enveloppe de combustion riche (111) et à la deuxième partie d'enveloppe de combustion riche (112) et en communication avec la première cavité de combustion riche (1111) et la deuxième cavité de combustion riche (1121), dans laquelle l'injecteur de combustion riche est situé au-dessus de l'injecteur de combustion pauvre (12) et l'orifice d'injection de combustion riche (131) est disposé sur l'injecteur de combustion riche (13).

8. La chambre de combustion (100) selon l'une quelconque des revendications 1 à 4, dans laquelle l'unité de combustion (1) comprend en outre :

une buse de combustion riche (15) configurée pour fournir l'orifice d'injection de combustion riche (131) avec le gaz combustible et correspondant à l'orifice d'injection de combustion riche (131) ; et
 une buse de combustion pauvre (16) configurée pour fournir l'orifice d'injection de combustion pauvre (121) avec le gaz combustible et correspondant à l'orifice d'injection de combustion pauvre (121).

9. La chambre de combustion (100) selon la revendication 8, dans laquelle une zone de section S3 d'un orifice de jet de gaz de la buse de combustion riche (15) et une zone de section S4 d'un orifice de jet de gaz de la buse de combustion pauvre (16) satisfont :

$$S3/S4 = 0,25 \sim 0,65.$$

10. La chambre de combustion (100) selon l'une quelconque des revendications 1 à 4, dans laquelle une pluralité d'unités de combustion (1) sont prévues et disposées le long d'une direction de largeur de l'unité de combustion.

11. Un chauffe-eau à gaz comprenant la chambre de combustion (100) selon l'une quelconque des revendications 1 à 10.

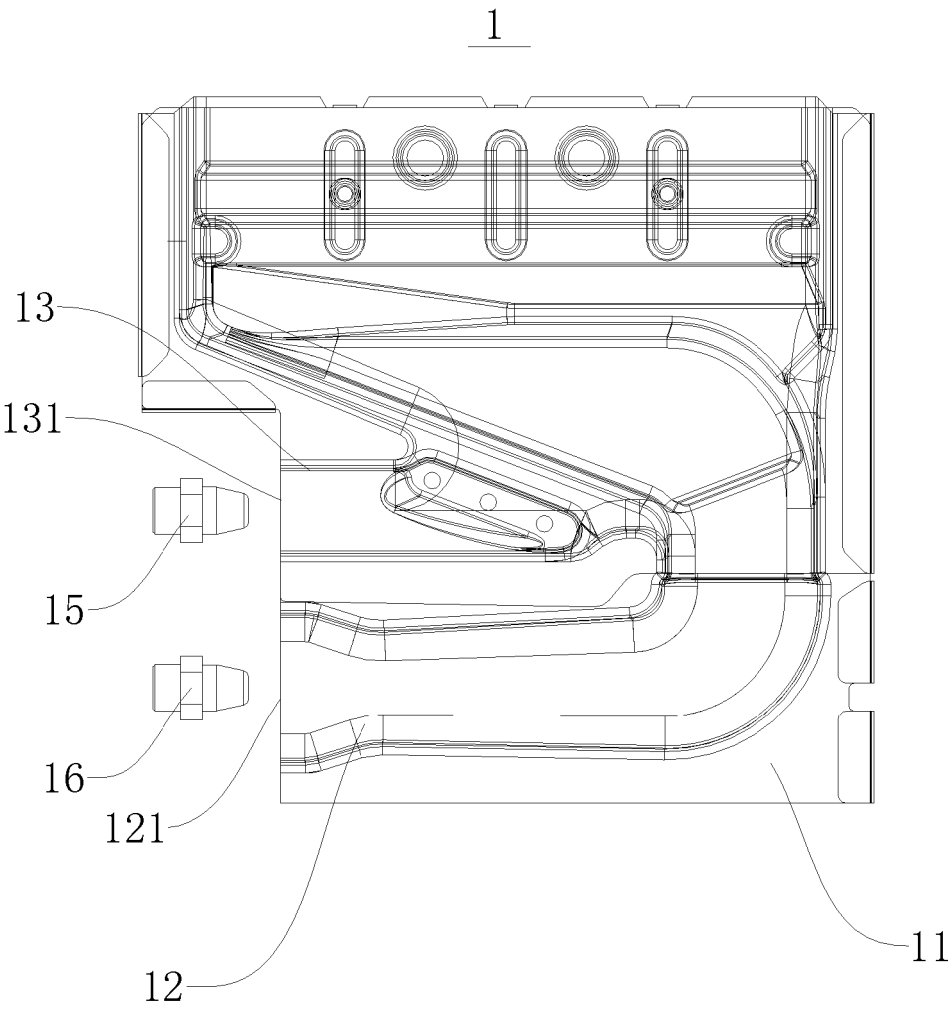


Fig. 1

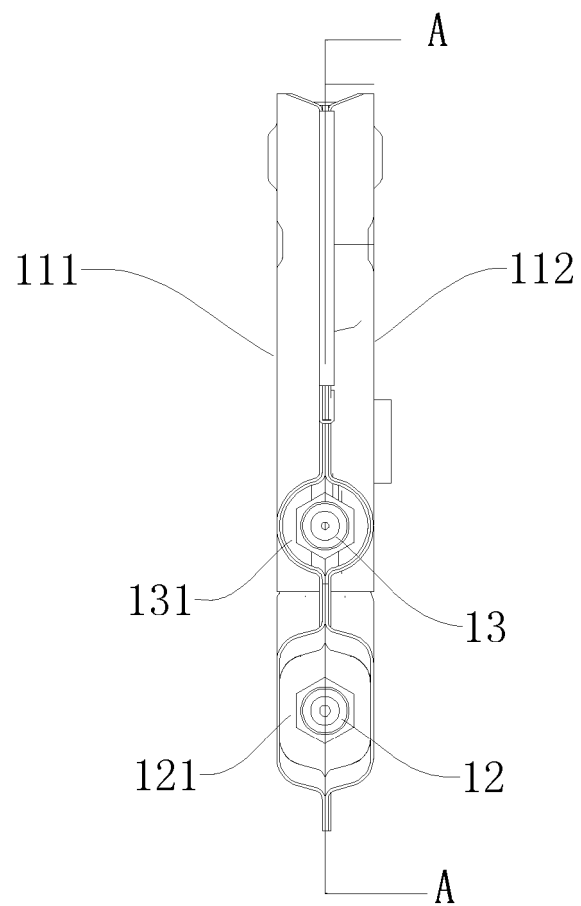


Fig. 2

A-A

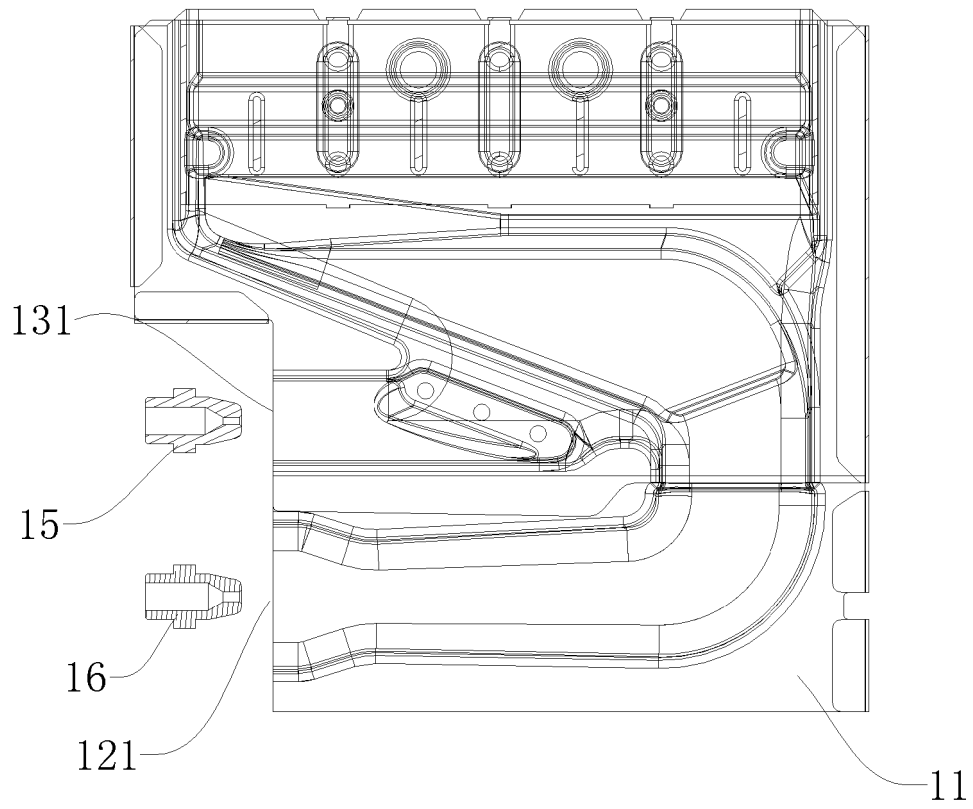


Fig. 3

1

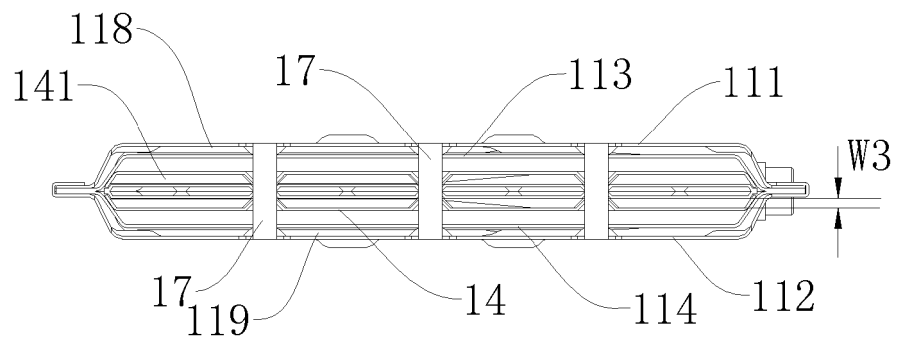


Fig. 4

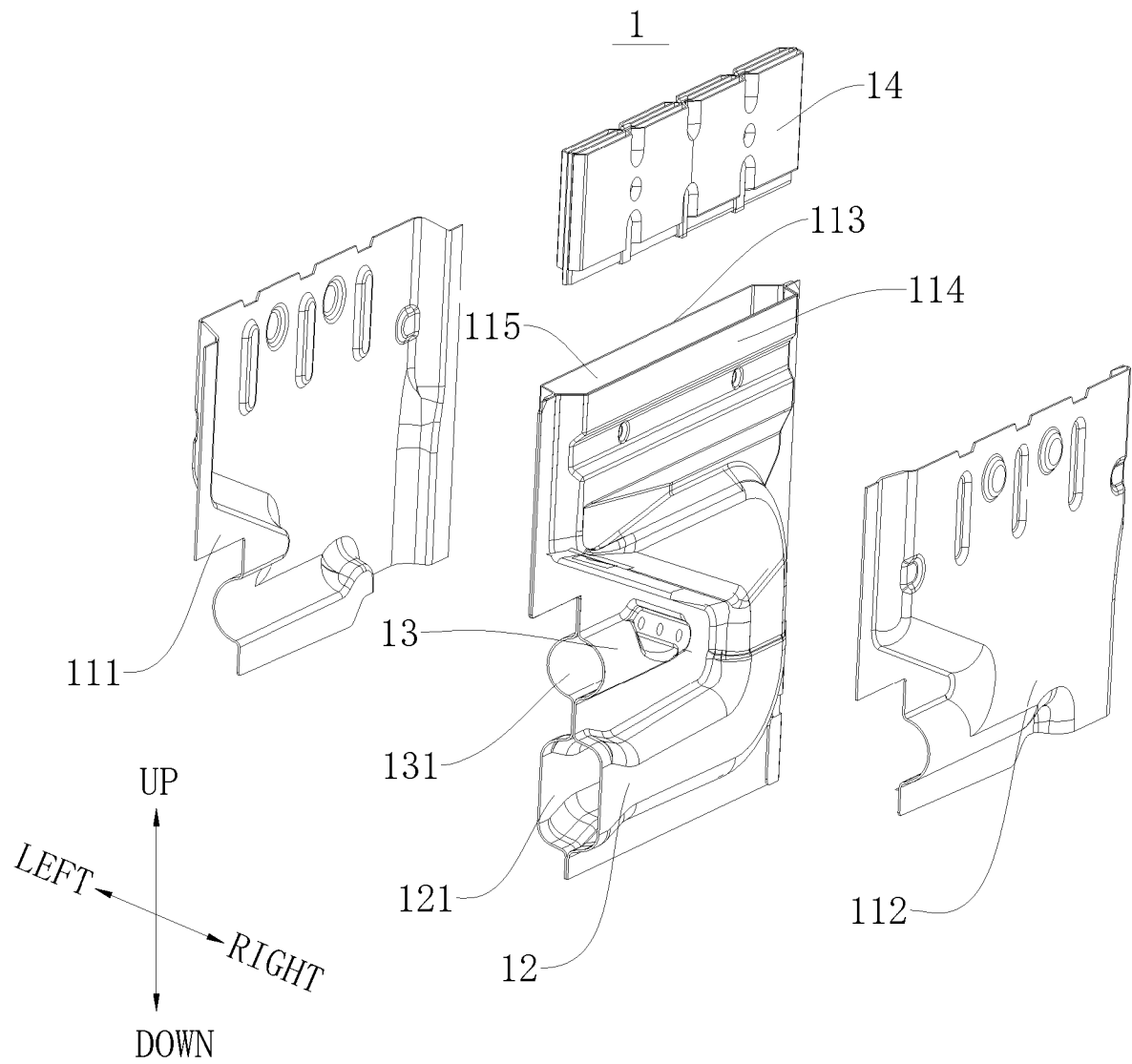


Fig. 5

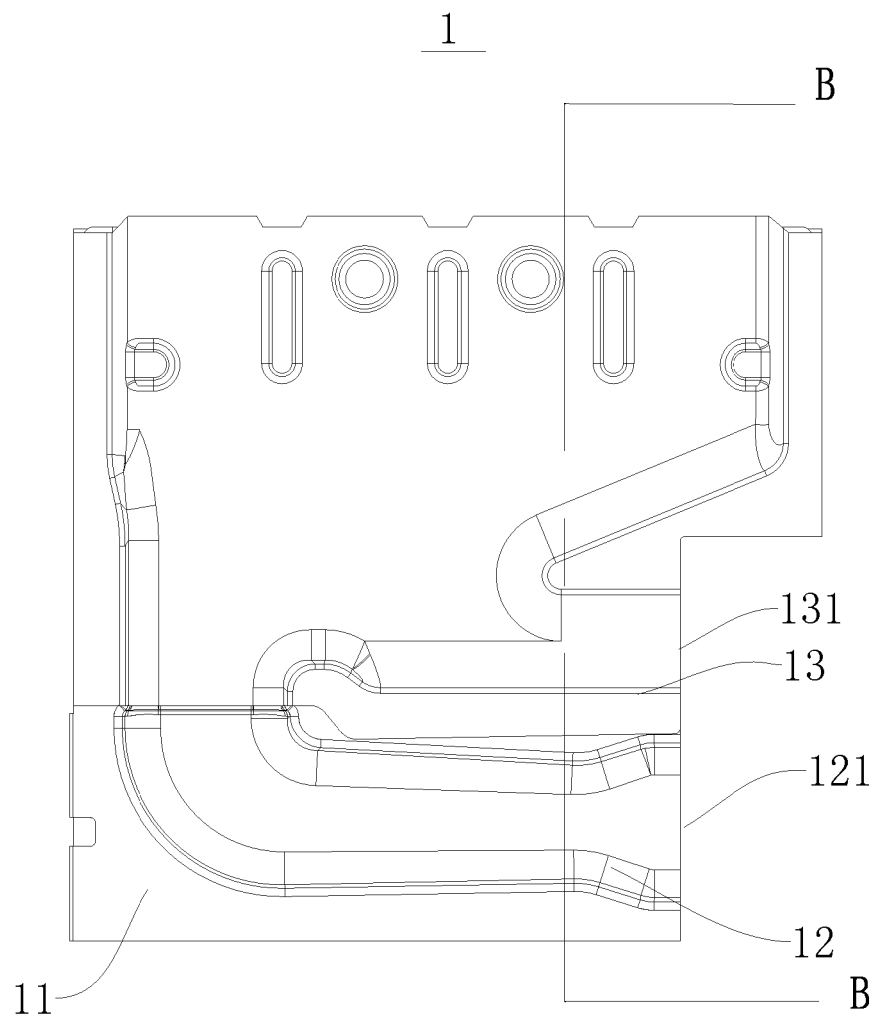


Fig. 6

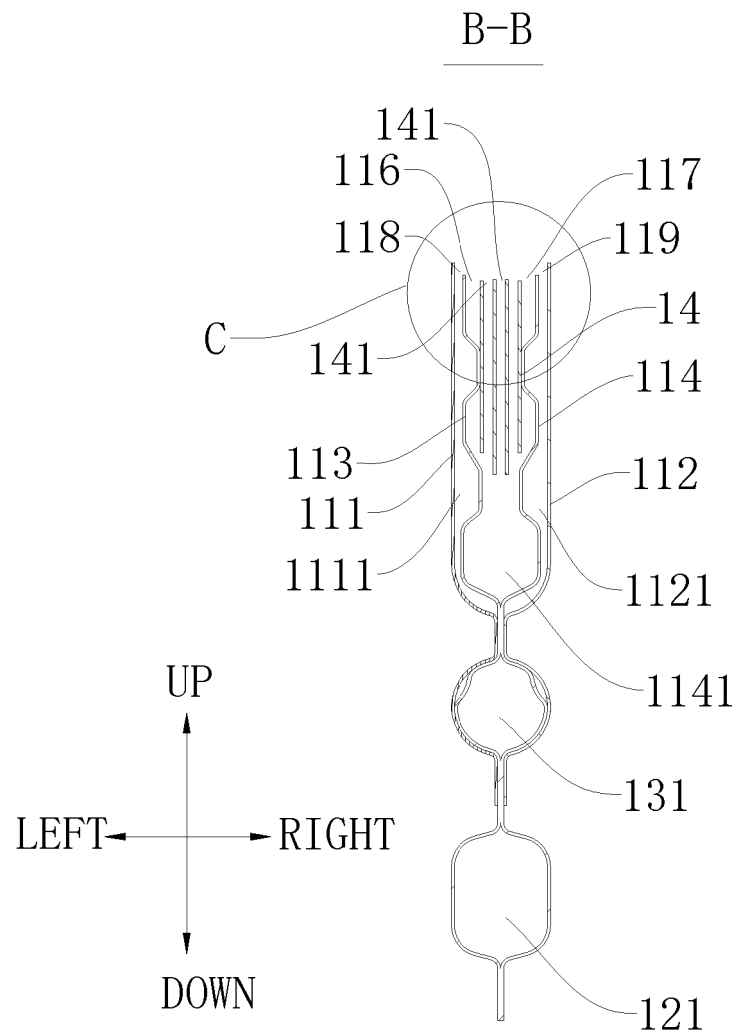


Fig. 7

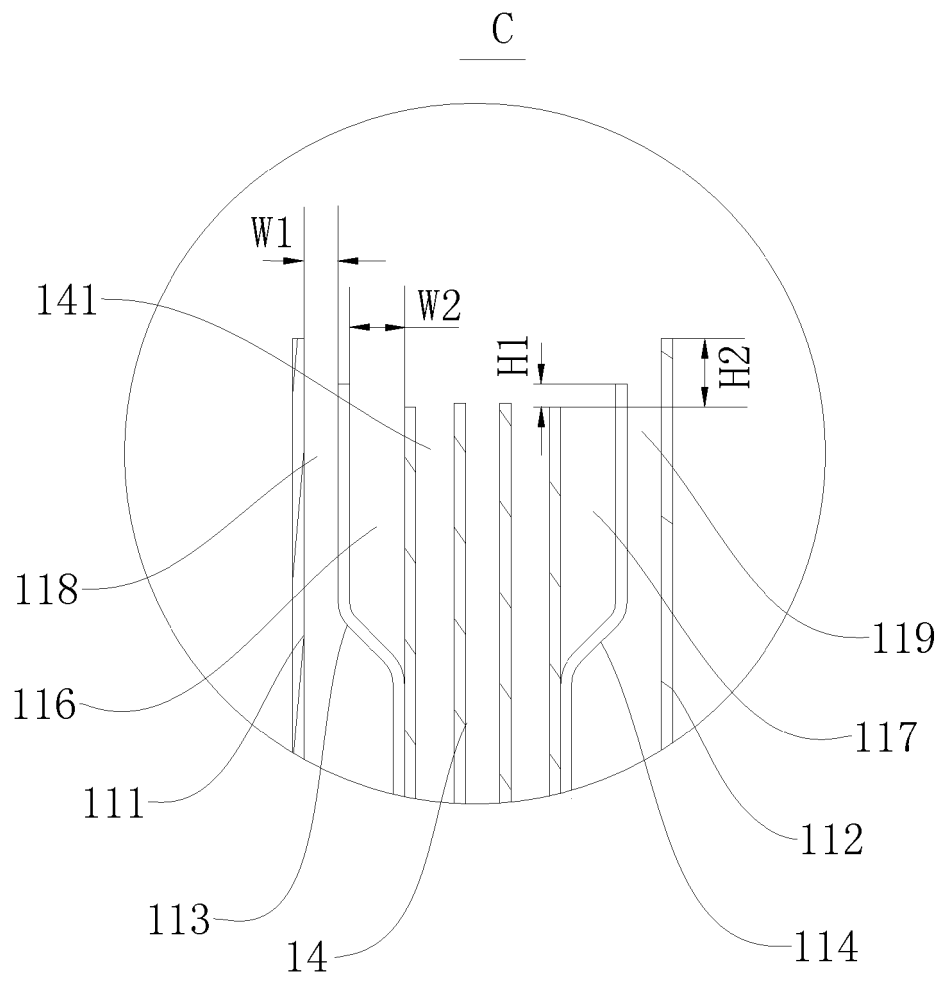


Fig. 8

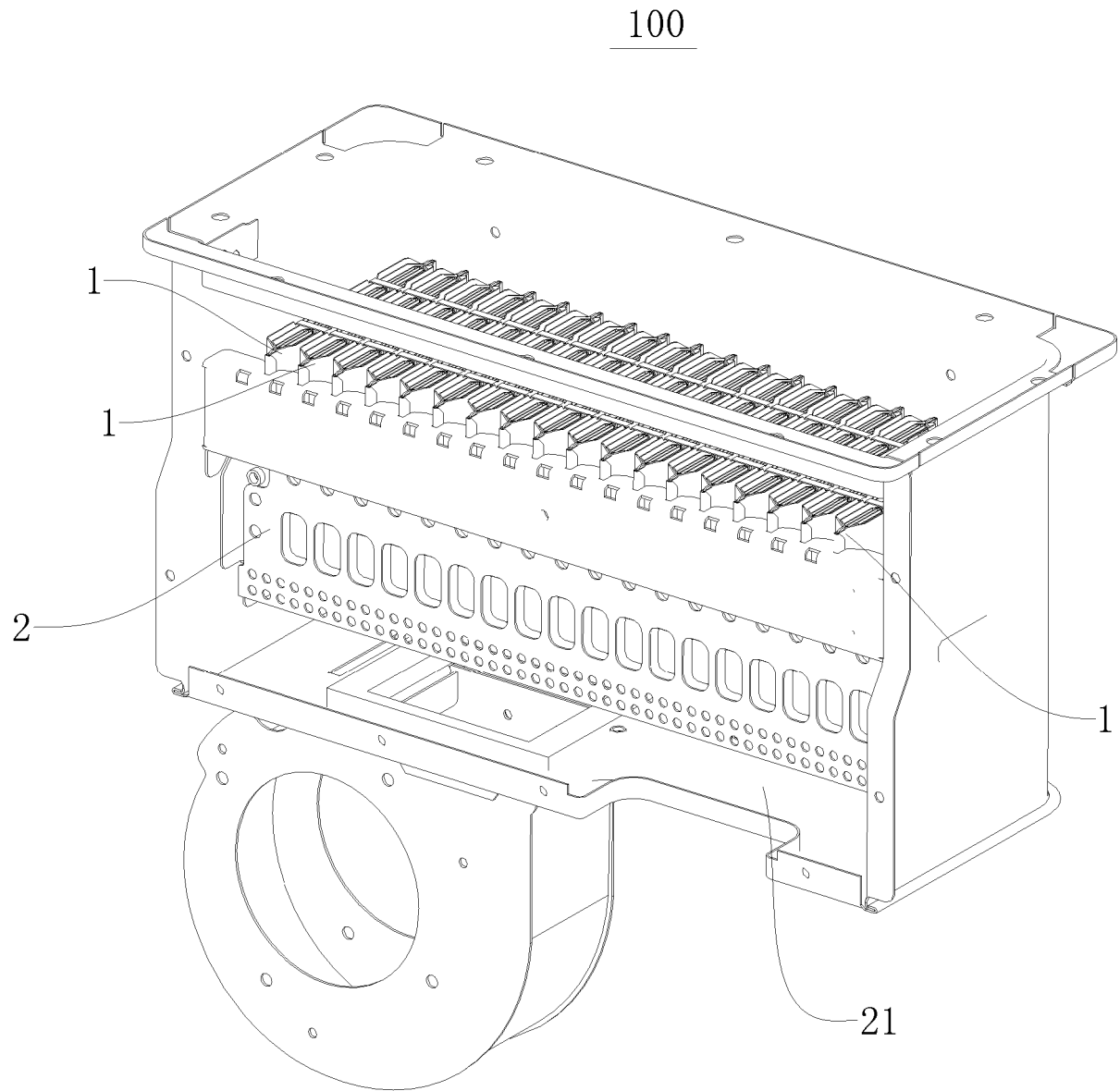


Fig. 9

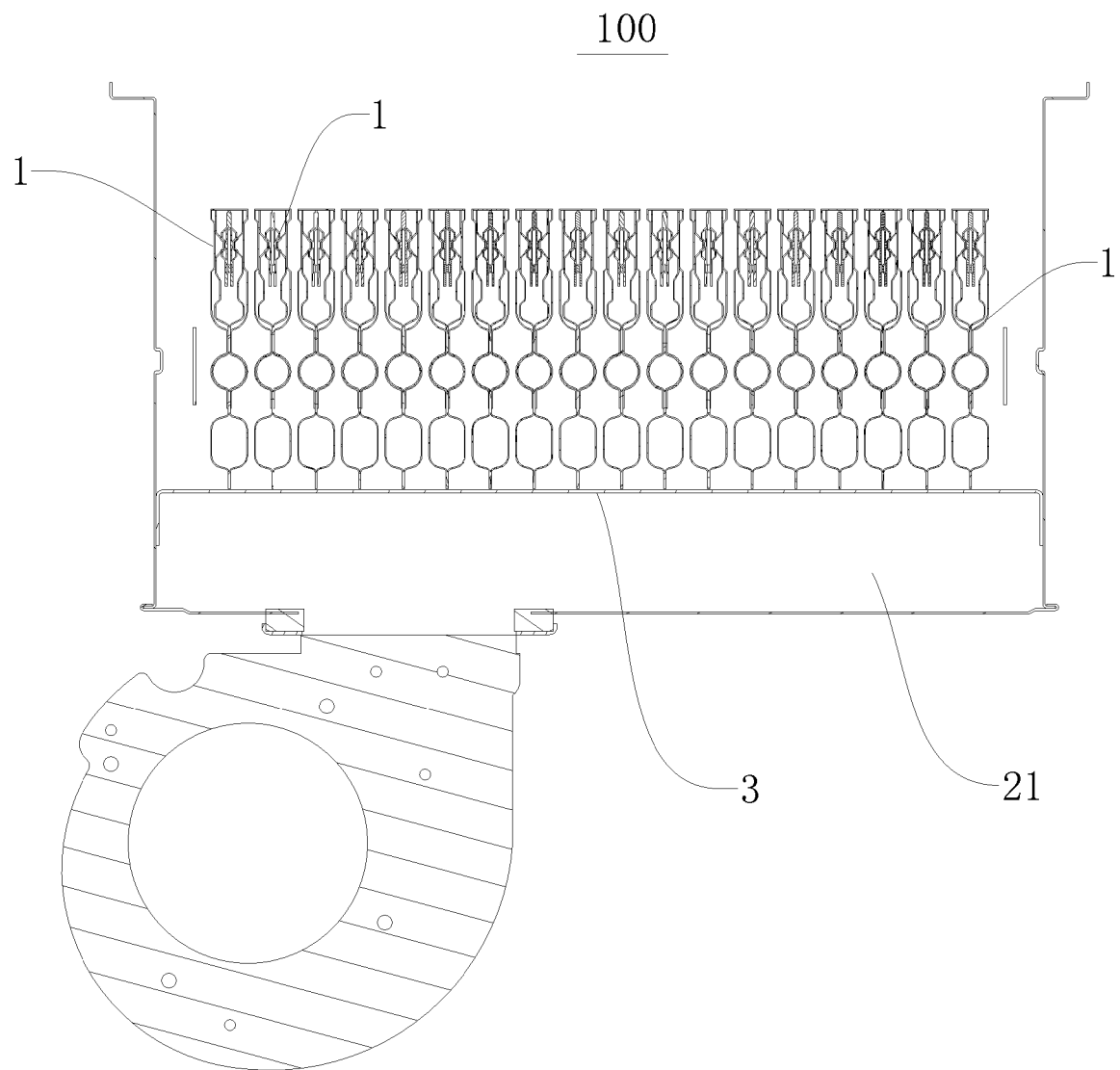


Fig. 10

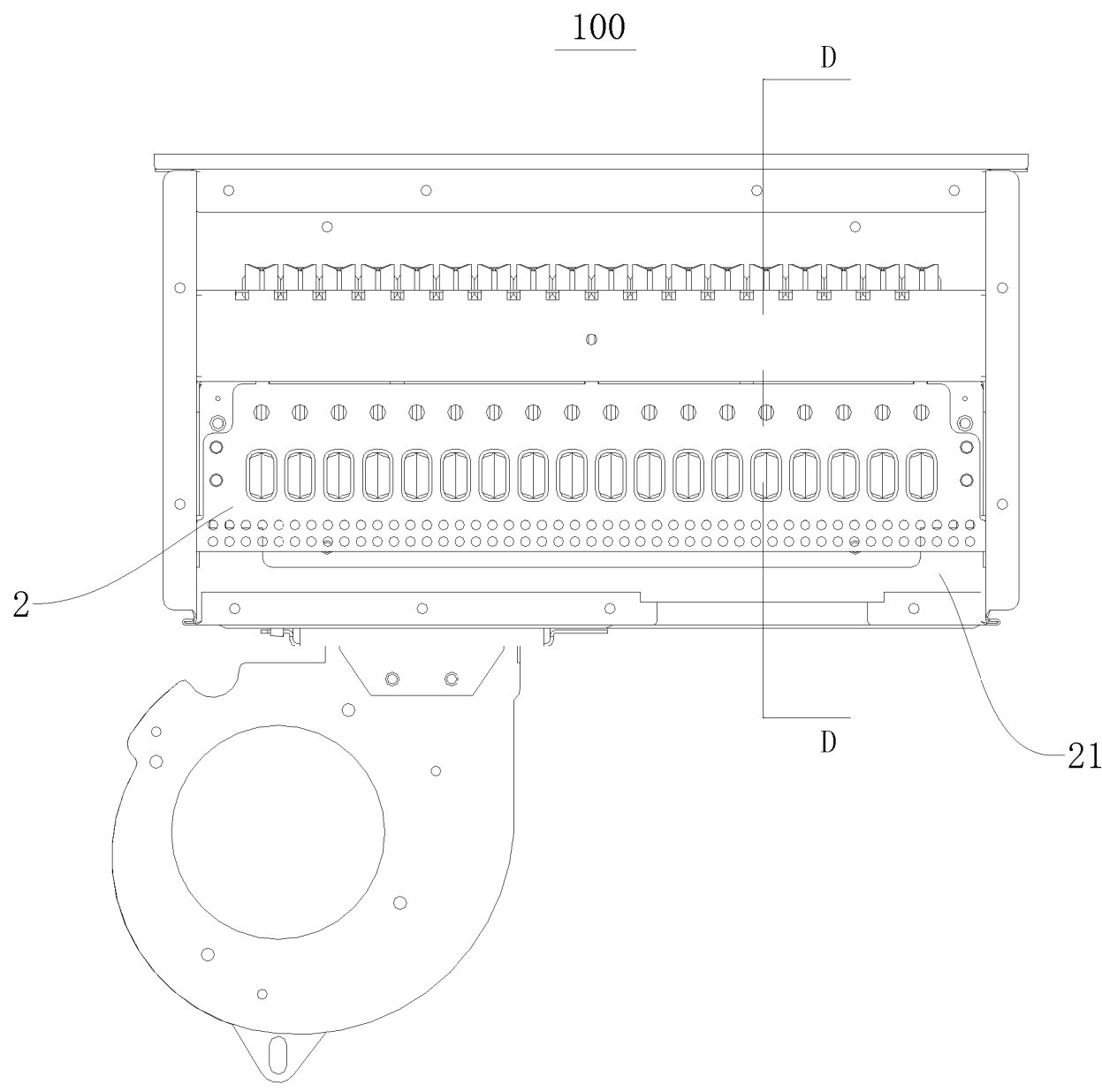


Fig. 11

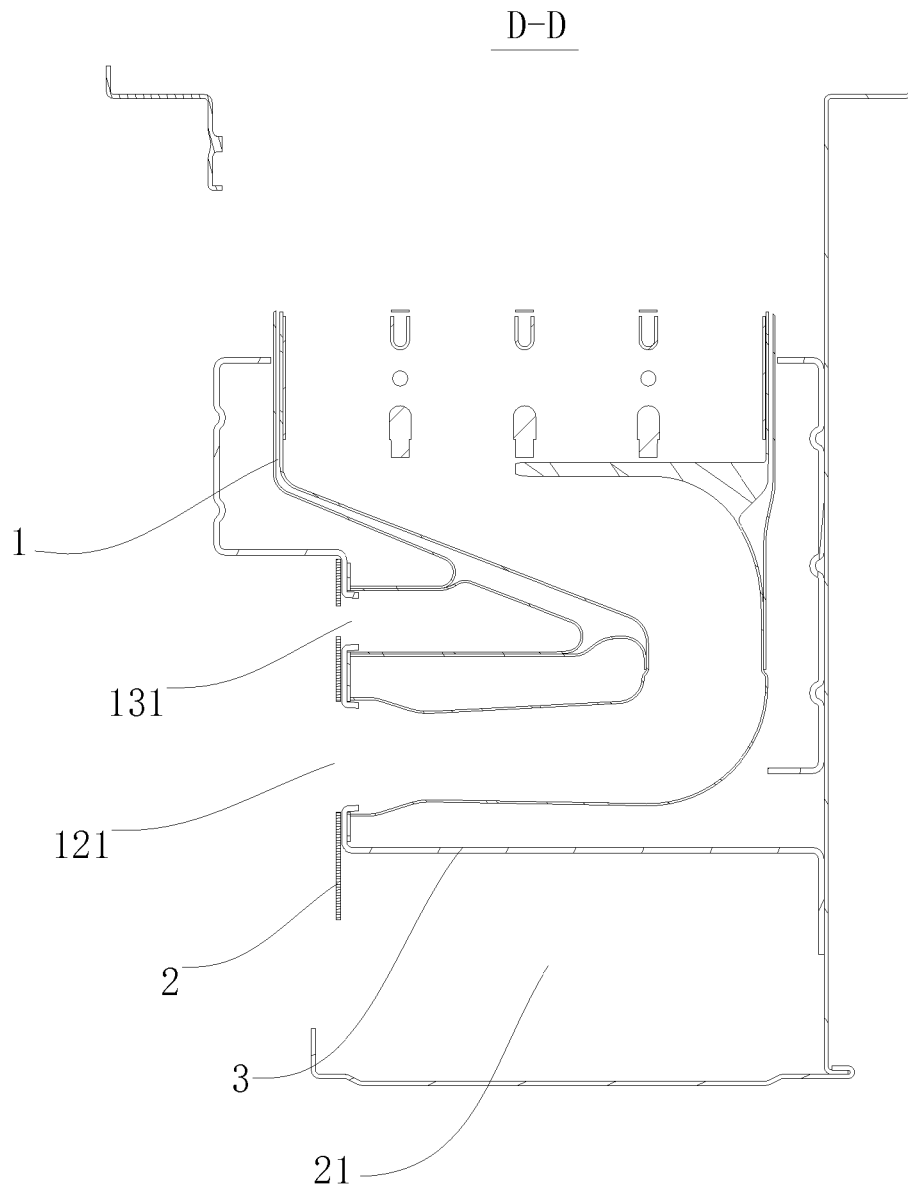


Fig. 12

REFERENCES CITED IN THE DESCRIPTION

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