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

(11) **EP 3 597 999 A1**

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
22.01.2020 Bulletin 2020/04

(21) Application number: **18020562.7**

(22) Date of filing: **29.10.2018**

(51) Int Cl.:
F23D 14/04 *(2006.01)* ***F23D 14/08*** *(2006.01)*
F23D 14/64 *(2006.01)* ***F23D 23/00*** *(2006.01)*

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

(30) Priority: **20.07.2018 CN 201810800675**
20.07.2018 CN 201821154328 U

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(54) GAS WATER HEATER AND BURNER THEREOF

(57) The present invention relates to the technical field of water heaters, and discloses a gas water heater and a burner thereof, the burner including an injector and a fire hole plate, wherein the injector is internally provided with at least two non-communicating parallel fuel gas-air mixing channels, one end of the injector is provided with at least two injection holes that are respectively in communication with the fuel gas-air mixing channels in one-to-one correspondence, the other end of the injector is provided with at least two jet holes that are respectively in communication with the fuel gas-air mixing channels in one-to-one correspondence, the fire hole plate is arranged covering the end of the injector that provides the jet holes, and there is provided a plurality of fire holes opened on the fire hole plate above each jet hole. As at least two non-communicating fuel gas mixing channels are provided in a single burner, increased gas utilization efficiency, low NO_X and CO emissions as well as controllable number of combustive fuel gas-air mixing channels in a single burner can be achieved, thereby effectively increasing a turndown ratio.

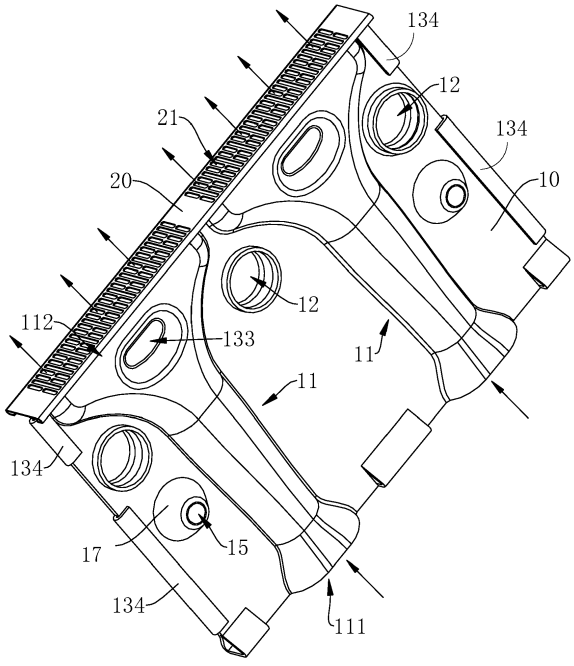

FIG. 1

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Description

FIELD OF THE PRESENT INVENTION

[0001] The present invention relates to the technical field of water heaters, and discloses a gas water heater and a burner thereof.

BACKGROUND OF THE PRESENT INVENTION

[0002] In the prior art, most water heater manufacturers adopt common atmospheric burners, in which the burner has only a single fuel gas-air mixing channel, while the NO_X emissions in the combustion products remain constantly high. It is known that NO_X is a toxic gas not only harmful to human body but also polluting the atmosphere. Facing the imminent enforcement of European EN26 standard, gas water heaters must meet the low NO_X emission requirements. However, it is difficult for common burners to meet the low NO_X demand, thus restricting the company's development in a certain degree. At the same time, the CO emission value of common burners remains relatively high, leaving zero CO emission or low CO emission requirements currently unachievable. In response to national energy conservation and emission reduction policies, it is a tendency that water heaters should achieve low pollution emissions. In addition, as the minimum input power of existing water heater has been too high, the minimum temperature rise of heated water is too high, which hardly achieves a desired bath temperature in summer, thereby significantly affecting user experience.

SUMMARY OF THE PRESENT INVENTION

[0003] The objective of the present invention is to overcome the deficiencies of the prior art and provide a gas water heater and a burner thereof, which achieves low pollution emissions by reducing NO_X and CO emissions, and also achieves "low heat combustion" by controlling the number of combustive fuel gas-air mixing channels 11 in the burner, thus effectively increasing a turndown ratio.

[0004] In order to achieve the above object, a first aspect of the present invention provides a burner comprising an injector and a fire hole plate, wherein the injector is internally provided with at least two non-communicating parallel fuel gas-air mixing channels, one end of the injector is provided with at least two injection holes that are respectively in communication with the fuel gas-air mixing channels in one-to-one correspondence, the other end of the injector is provided with at least two jet holes that are respectively in communication with the fuel gas-air mixing channels in one-to-one correspondence, the fire hole plate is arranged covering the end of the injector that provides the jet holes, and there is provided a plurality of fire holes opened on the fire hole plate above each jet hole.

[0005] Preferably, the injector is provided with a water flow channel that is disposed adjacent to the jet hole for a flow of cooling water.

[0006] Preferably, the fuel gas-air mixing channel is T-shaped in general, and the fuel gas-air mixing channel includes a converging section, a mixing section, and a diverging section which are sequentially communicated along a fuel gas-air flow direction, wherein the converging section has a tapered shape that gradually tapers in the fuel gas-air flow direction, a cross-sectional area of an inlet of the converging section is 3-6 times a cross-sectional area of an outlet of the converging section; a cross-sectional area of the mixing section along the fuel gas-air flow direction gradually increases, and a cross-sectional area of an outlet of the mixing section is 2-5 times a cross-sectional area of an inlet of the mixing section; and the diverging section is triangular-shaped in general along the fuel-gas air flow direction, a cross-sectional area of an inlet of the diverging section is smaller than a cross-sectional area of an outlet of the diverging section, and an intermediate section of the diverging section is provided with a constricted opening.

[0007] Preferably, the cross-sectional area of the inlet of the converging section is four times the cross-sectional area of the outlet of the converging section, and the cross-sectional area of the outlet of the mixing section is three times the cross-sectional area of the inlet of the mixing section.

[0008] Preferably, lengths of the converging section, the mixing section, and the diverging section along the fuel gas-air flow direction are respectively set to A, B and C, wherein B>C>A, B is 3-6 times of A, and B is 1.5-3.5 times of C.

[0009] Preferably, a surface of the fire hole plate is provided with a catalyst.

[0010] Preferably, the injector is formed by folding and connecting a structurally symmetrical first casing towards opposite sides along a center line thereof, wherein the first casing is provided with at least two first pressing grooves on one side besides the center line, and is provided with at least two second pressing grooves which are in one-to-one correspondence with the first pressing grooves on the other side besides the center line; and after the first casing is folded towards opposite sides, the first pressing groove (131) and the second pressing groove facing each other form the fuel gas-air mixing channel.

[0011] Preferably, the injector is formed by assembling a second casing and a third casing having a same structure, wherein the second casing is provided with at least two third pressing grooves, the third casing is provided with at least two fourth pressing grooves which are in one-to-one correspondence with the third pressing grooves, and the third pressing groove and the fourth pressing groove facing each other form the fuel gas-air mixing channel.

[0012] Preferably, the end of the injector adjacent to the jet holes is provided with an outwardly extending

flange, an engagement groove is disposed at an edge of the fire hole plate, and the flange is inserted into the engagement groove to connect the fire hole plate and the injector.

[0013] For a similar objective, a second aspect of the present invention provides a gas water heater comprising the burner of any of the above.

[0014] The present invention provides a burner and a gas water heater comprising the same, where the burner is provided with at least two non-communicating fuel gas-air mixing channels with at least two corresponding independent injection holes. In this way, more air can be introduced by the fuel gas, so that the fuel gas combustion is more sufficient, thereby reducing the emission of NO_X and CO in the combustion process. At the same time, the number of combustive fuel gas-air mixing channels in the burner is controllable, which can effectively increase a turndown ratio and achieve low heat combustion, thereby ultimately meeting various requirements of the customers for bath temperature.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015]

FIG. 1 is a schematic perspective view of a burner in an embodiment of the present invention;

FIG. 2 is a front elevational view of Figure 1;

FIG. 3 is a cross-sectional view taken along line A-A of Figure 2;

FIG. 4 is a schematic view showing the structure of an injector after being disassembled and unfolded, according to an embodiment of the present invention.

List of reference numerals:

[0016]

10. injector

11. fuel gas-air mixing channel

111. injection hole

112. jet hole

113. converging section

1131. inlet of converging section

1132. outlet of converging section

114. mixing section

1141. inlet of mixing section

1142. outlet of mixing section

115. diverging section

1151. inlet of diverging section

1152. outlet of diverging section

115a. constricted opening

12. water flow channel

13. first casing

131. first pressing groove

132. second pressing groove

133. fifth pressing groove

134. folding rim

14. flange

15. mounting hole

16. threaded hole

17. positioning boss

18. center line

20. fire hole plate;

21. fire hole

22. engagement groove

DETAILED DESCRIPTION OF ILLUSTRATED EMBODIMENTS

[0017] Implementations of the present invention are further described in detail below in conjunction with the drawings and embodiments. The following examples are intended to illustrate the present invention, but not to limit the scope of the present invention.

[0018] In the description of the present invention, it is to be understood that the designated orientation or positional relationship of the terms "upper", "lower", "left", "right", "top", "bottom" and the like is based on the drawings, which is merely for the purpose of describing the present invention and simplifying the description, and is not intended to indicate or imply that the device or element to be referred to has a particular orientation or is constructed and operated in a particular orientation, and thus is not to be construed as limiting the present inven-

tion. It should be understood that the terms "first", "second", and the like are used in the present invention to describe various information that should not be limited thereto, and these terms are only used to distinguish the same type of information from each other. For example, "first" information may also be referred to as "second" information, and similarly, "second" information may also be referred to as "first" information, without departing from the scope of the present invention.

[0019] As shown in FIG. 1 to FIG. 4, an embodiment of the first aspect of the present invention provides a burner including an injector 10 and a fire hole plate 20, where the injector 10 is internally provided with at least two non-communicating parallel fuel gas-air mixing channels 11. One end of the injector 10 is provided with at least two injection holes 111 that are respectively in communication with the fuel gas-air mixing channels 11 in one-to-one correspondence, the other end of the injector 10 is provided with at least two jet holes 112 that are respectively in communication with the fuel gas-air mixing channels 11 in one-to-one correspondence. The fire hole plate 20 is arranged covering the end of the injector 10 that provides the jet holes 112. Above each jet hole 112, there is provided a plurality of fire holes 21 opened on the fire hole plate 20. Illustratively, referring to FIG. 1, the injector 10 of the present embodiment is internally provided with two non-communicating fuel gas-air mixing channels 11, each of which is provided with the injection hole 111 and the jet hole 112. In operation, fuel gas enters the fuel gas-air mixing channel 11 from the injection hole 111; based on a Venturi principle, the fuel gas introduces air from the injection hole 111 into the fuel gas-air mixing channel 11. The fuel gas and air are uniformly mixed in the fuel gas-air mixing channel 11 and then jet out from the jet hole 112 to be stably and uniformly burned above the fire holes 21.

[0020] The injector 10 of the present invention is provided with at least two non-communicating and independent fuel gas-air mixing channels 11, and each fuel gas-air mixing channel 11 is provided with the injection hole 111 and the jet hole 112. On the one hand, due to that the injector 10 is provided with an increased number of the injection holes 111 as compared with existing injectors, more air can be introduced so that the fuel gas is able to be fully burned, in this way, the fuel gas utilization rate is improved, thereby reducing NO_X and CO emissions. On the other hand, by controlling the number of combustive fuel gas-air mixing channels 11 in the burner of a burner assembly of a water heater, it is possible to realize "low heat combustion" and increase a turndown ratio of the burner assembly, thereby meeting the user's requirements for lower bath water temperatures in summer. Provided that each burner has a rated input power of 2 KW and municipal natural gas is used as the fuel gas source, a common burner having a single fuel gas-air mixing channel has a turndown ratio of 2:1, while the burner of an embodiment of the present invention having two fuel gas-air mixing channels has a turndown ratio of 4:1 due to a selectable number of combustive fuel gas-air mixing channels. Therefore, under the same input power conditions, the burner of the present invention having two fuel gas-air mixing channels can halve the minimum temperature rise of the water heated by the water heater, thereby effectively improving the user's bath comfort.

[0021] Based on the above technical solution, a burner is provided in the present embodiment. Referring to FIG. 1, the injector 10 is provided with a water flow channel 12 which is disposed adjacent to the jet hole 112 for a flow of cooling water. By providing the water flow channel 12 adjacent to the jet hole 112, a large amount of heat generated by the combustion in the injector 10 can be absorbed to effectively reduce the temperature of combustion zone of the fire holes 21, thereby further reducing the amount of generated NO_X. It should be understood that the cooling water is also referred to water to be heated by the burner, the water absorbs the heat of a surface of the injector 10 prior to passing through the water flow channel 12, thereby effectively improving the energy conversion efficiency and effectively achieving energy saving and emission reduction. Illustratively, a water pipe is inserted in the water flow channel 12 by pipe expansion techniques. The water pipe should be properly installed for the cooling water to pass through, thereby ensuring heat transfer and absorption. Illustratively, the water flow channels 12 are opened on both sides of each of the fuel gas-air mixing channel 11.

[0022] Specifically, in the present embodiment, the fuel gas-air mixing channel 11 is T-shaped in general, which enables a sufficient mixing of the fuel gas and air.

[0023] In this embodiment, the fuel gas-air mixing channel 11 includes a converging section 113, a mixing section 114, and a diverging section 115 which are sequentially communicated along a fuel gas-air flow direction. The converging section 113 has a tapered shape that gradually tapers along the fuel gas-air flow direction, a cross-sectional area of an inlet 1131 of the converging section 113 is 3-6 times a cross-sectional area of an outlet 1132 of the converging section 113. By adopting the design of the tapered-shaped cross section, the frictional losses of induced air are reduced. Meanwhile, under the advantageous Venturi principle, induced fuel gas creates a negative pressure at the outlet 1132 of the converging section 113, which can increase air intake from the inlet 1131 of the converging section 113. In order to evenly distribute the velocity field, the concentration field and the temperature field of the fuel gas-air mixture before it enters the diverging section 115, a cross-sectional area of the mixing section 114 along the fuel gas-air flow direction gradually increases. A cross-sectional area of an outlet 1142 of the mixing section 114 is 2-5 times a cross-sectional area of an inlet 1141 of the mixing section 114. Referring to FIG. 1 and FIG. 2, the diverging section 115 is triangular-shaped in general along the fuel gas-air flow direction, a cross-sectional area of an inlet 1151 of the diverging section 115 is smaller than a cross-sectional

area of an outlet 1152 of the diverging section 115. Referring to FIG. 3, an intermediate section of the diverging section 115 is provided with a constricted opening 115a. In this way, the fuel gas and air can be mix further uniformly; and at the same time, a part of dynamic pressure becomes a static pressure to increase the pressure of the fuel gas-air mixture to uniformly mix the fuel gas and air. In addition, the constricted opening 115a provides a uniform distribution of the fuel gas-air velocity in the fuel gas-air mixing channel 11.

[0024] Preferably, in the present embodiment, in order to better mix the fuel gas and air mixture uniformly, the cross-sectional area of the inlet 1131 of the converging section 113 is four times the cross-sectional area of the outlet 1132 of the converging section 113.

[0025] For the same purpose, in the present embodiment, preferably, the cross-sectional area of the outlet 1142 of the mixing section 114 is three times the cross-sectional area of the inlet 1141 of the mixing section 114.

[0026] Further, in order to uniformly mix the fuel gas and air in the fuel gas-air mixing channel 11, lengths of the converging section 113, the mixing section 114 and the diverging section 115 along the fuel gas-air flow direction are respectively set to A, B and C, wherein B>C>A, B is 3-6 times of A, and B is 1.5-3.5 times of C.

[0027] Preferably, in the burner, the length B of the mixing section 114 is four times the length A of the converging section 113, and the length B the mixing section 114 is twice the length C of the diverging section 115.

[0028] In this embodiment, in order to achieve a stable combustion, the fire holes 21 are uniformly opened on the fire hole plate 20, and the fire hole 21 has a diameter ranging from 0.5 to 1.5 mm. The fuel gas-air mixture jetted from the jet hole 112 can be evenly distributed into the fire holes 21 for stable and complete combustion.

[0029] Specifically, in the present embodiment, a surface of the fire hole plate 20 is provided with a catalyst, the catalyst being a noble metal, a transition metal hydride or a transition metal oxide. The catalyst can effectively reduce the activation energy of the fuel gas-air mixture, and at the same time enrich the molecules of the mixture on the surface of the fire hole plate 20, thereby increasing the reaction speed and accelerating the burning rate. Organic exhaust gas generated from incomplete combustion can be flamelessly burned under a low ignition temperature by using the catalyst, and then can be oxidized and decomposed into CO_2 and H_2O, which achieves low CO and even zero CO emissions and releases a large amount of heat, thereby achieving the goal of energy saving and emission reduction.

[0030] FIG. 4 is a schematic view showing the structure of an injector after being disassembled and unfolded, according to an embodiment of the present invention. Specifically, in this embodiment, referring specifically to FIG. 4, the injector 10 is formed by folding and connecting a structurally symmetrical first casing 13 towards opposite sides along a center line 18 thereof, wherein the first casing 13 is provided with at least two first pressing grooves 131 on one side besides the center line 18, and is provided with at least two second pressing grooves 132 which are in one-to-one correspondence with the first pressing grooves 131 on the other side besides the center line 18. After the first casing 13 is folded towards opposite sides, the first pressing groove 131 and the second pressing groove 132 form the fuel gas-air mixing channel 11. By integrally forming the injector 10, the manufacture of the injector 10 can be simplified. Illustratively, referring to FIG. 1 and FIG. 4 , two opposite edges of the first casing 13 that are perpendicular to the center line 18 are provided with folding rims 134 for performing a snap connection between the two structurally symmetrical parts of the first casing 13 after the first casing 13 is folded.

[0031] As an alternative, the injector 10 can be formed by assembling a second casing and a third casing having a same structure (not shown in the drawings), wherein the second casing is provided with at least two third pressing grooves (not shown in the drawings), the third casing is provided with at least two fourth pressing grooves (not shown in the drawings) which are in one-to-one correspondence with the third pressing grooves. The third pressing groove and the fourth pressing groove facing each other form the fuel gas-air mixing channel 11. Similarly, the second casing and the third casing are assembled together though folding rims 134 that are arranged on two opposite edges of the second casing or the third casing.

[0032] Illustratively, the injector 10 is fabricated from a material selected from at least one of aluminum, copper, stainless steel and other alloy.

[0033] Illustratively, in the present embodiment, referring to FIG. 3 and FIG. 4, two opposite fifth pressing grooves 133 are respectively depressed from two opposite surfaces of the diverging section 115 of the injector 10 to form the constricted opening 115a in the fuel gas-air mixing channel 11.

[0034] The fire hole plate 20 is arranged covering the end of the injector 10 that provides the jet holes 112. In this embodiment, referring to FIG. 3, in order to mount the fire hole plate 20 on the end of the injector 10 that provides the jet holes 112 in a sealed manner, the end of the injector 10 that provides the jet holes 112 is provided with an outwardly extending flange 14, an engagement groove 22 is disposed at an edge of the fire hole plate 20, and the flange 14 is inserted into the engagement groove 22 to connect the fire hole plate 20 and the injector 10. Illustratively, the injector 10 is snapped into the fire hole plate 20, then fixedly connected by riveting or spot welding or other processes. Illustratively, an edge of the fire hole plate 20 is provided with a bent edge to form the engagement groove 22.

[0035] Illustratively, in the present embodiment, an angle between a central axis of the injection hole 111 and an end surface of the jet hole 112 is preferably 90 degrees. Meanwhile, when the burner of the present invention is applied to a type of water heater with a fan for supplying air, the angle between the central axis of the

injection hole 111 and the end surface of the jet hole 112 ranges from 0 to 90 degrees.

[0036] Referring to FIG. 1, in the present embodiment, a front side and a back side of the injector 10 are each provided with a positioning boss 17, which is used for stacking and assembling a plurality of the burners to form a burner assembly. During the assembly process, two adjacent burners are initially positioned by abutting the corresponding two positioning bosses 17, so that the distance between adjacent burners can be kept consistent. Further, in order to facilitate the assembly, the injector 10 is provided with a mounting hole 15 at the positioning boss 17. During assembling, a connecting member passes through the mounting holes 15 of adjacent two injectors 10, so as to assemble a plurality of the burners to form a burner assembly. Referring to FIG. 4, an end surface of the injector 10 that provides the injection holes 111 is provided with mounting portions for mounting windshields. Each of the injection holes 111 is provided with windshields at both sides. Illustratively, the mounting portions are threaded holes 16 opened on both sides of the injection hole 111.

[0037] An embodiment of the second aspect of the present invention provides a gas water heater including the burner according to any of the above. Since the gas water heater provided by the present invention comprises the burner according to the first aspect, the gas water heater has the all the benefits of the burner stated above; the present embodiment will not be stated in detail here.

[0038] In summary, the embodiments of the present invention provide a gas water heater and a burner thereof, where the burner comprises an injector that is provided with at least two non-communicating fuel gas-air mixing channels and at least two corresponding independent jet holes. In this way, more air can be introduced by the fuel gas, so that the fuel gas combustion is more sufficient, thereby reducing the emission of NO_X and CO in the combustion process. At the same time, the number of combustive fuel gas-air mixing channels in the burner is controllable, which can effectively increase a turndown ratio and achieve low heat combustion, thereby ultimately meeting various requirements of the customers for bath temperature.

[0039] The embodiments stated above are only preferred embodiments of the present invention, and it is noted that those skilled in the art can make various improvements and substitutions without departing from the technical principles of the present invention, and the improvements and substitutions fall within the scope of the present invention.

Claims

1. A burner, comprising an injector (10) and a fire hole plate (20), wherein:

   the injector (10) is internally provided with at least two non-communicating parallel fuel gas-air mixing channels (11), one end of the injector (10) is provided with at least two injection holes (111) that are respectively in communication with the fuel gas-air mixing channels (11) in one-to-one correspondence, the other end of the injector (10) is provided with at least two jet holes (112) that are respectively in communication with the fuel gas-air mixing channels (11) in one-to-one correspondence, the fire hole plate (20) is arranged covering the end of the injector (10) that provides the jet holes (112), and there is provided a plurality of fire holes (21) opened on the fire hole plate (20) above each jet hole (112).

2. The burner according to claim 1, wherein the injector (10) is provided with a water flow channel (12) that is disposed adjacent to the jet hole (112) for a flow of cooling water.

3. The burner according to claim 2, wherein the fuel gas-air mixing channel (11) is T-shaped in general, and the fuel gas-air mixing channel (11) comprises a converging section (113), a mixing section (114), and a diverging section (115) which are sequentially communicated along a fuel gas-air flow direction, wherein:

   the converging section (113) has a tapered shape that gradually tapers in the fuel gas-air flow direction, a cross-sectional area of an inlet (1131) of the converging section (113) is 3-6 times a cross-sectional area of an outlet (1132) of the converging section (113); a cross-sectional area of the mixing section (114) along the fuel gas-air flow direction gradually increases, and a cross-sectional area of an outlet (1142) of the mixing section (114) is 2-5 times a cross-sectional area of an inlet (1141) of the mixing section; and the diverging section (115) is triangular-shaped in general along the fuel-gas air flow direction, a cross-sectional area of an inlet (1151) of the diverging section (115) is smaller than a cross-sectional area of an outlet (1152) of the diverging section (115), and an intermediate section of the diverging section (115) is provided with a constricted opening (115a).

4. The burner according to claim 3, wherein the cross-sectional area of the inlet (1131) of the converging section (113) is four times the cross-sectional area of the outlet (1132) of the converging section (113), and the cross-sectional area of the outlet (1142) of the mixing section (114) is three times the cross-sectional area of the inlet (1141) of the mixing section (114).

5. The burner according to claim 3, wherein lengths of

the converging section (113), the mixing section (114), and the diverging section (115) along the fuel gas-air flow direction are respectively set to A, B and C, wherein:

B>C>A, B is 3-6 times of A, and B is 1.5-3.5 times of C.

6. The burner according to any one of claims 1 to 5, wherein a surface of the fire hole plate (20) is provided with a catalyst.

7. The burner according to claim 6, wherein the injector (10) is formed by folding and connecting a structurally symmetrical first casing (13) towards opposite sides along a center line (18) thereof, wherein the first casing (13) is provided with at least two first pressing grooves (131) on one side besides the center line (18), and is provided with at least two second pressing grooves (132) which are in one-to-one correspondence with the first pressing grooves (131) on the other side besides the center line (18); and after the first casing (13) is folded towards opposite sides, the first pressing groove (131) and the second pressing groove (132) facing each other form the fuel gas-air mixing channel (11).

8. The burner according to claim 6, wherein the injector (10) is formed by assembling a second casing and a third casing having a same structure, wherein the second casing is provided with at least two third pressing grooves, the third casing is provided with at least two fourth pressing grooves which are in one-to-one correspondence with the third pressing grooves, and the third pressing groove and the fourth pressing groove facing each other form the fuel gas-air mixing channel (11).

9. The burner according to claim 6, wherein the end of the injector (10) that provides the jet holes (112) is provided with an outwardly extending flange (14), an engagement groove (22) is disposed at an edge of the fire hole plate (20), and the flange (14) is inserted into the engagement groove (22) to connect the fire hole plate (20) and the injector (10).

10. A gas water heater, comprising the burner according to any one of claims 1-9.

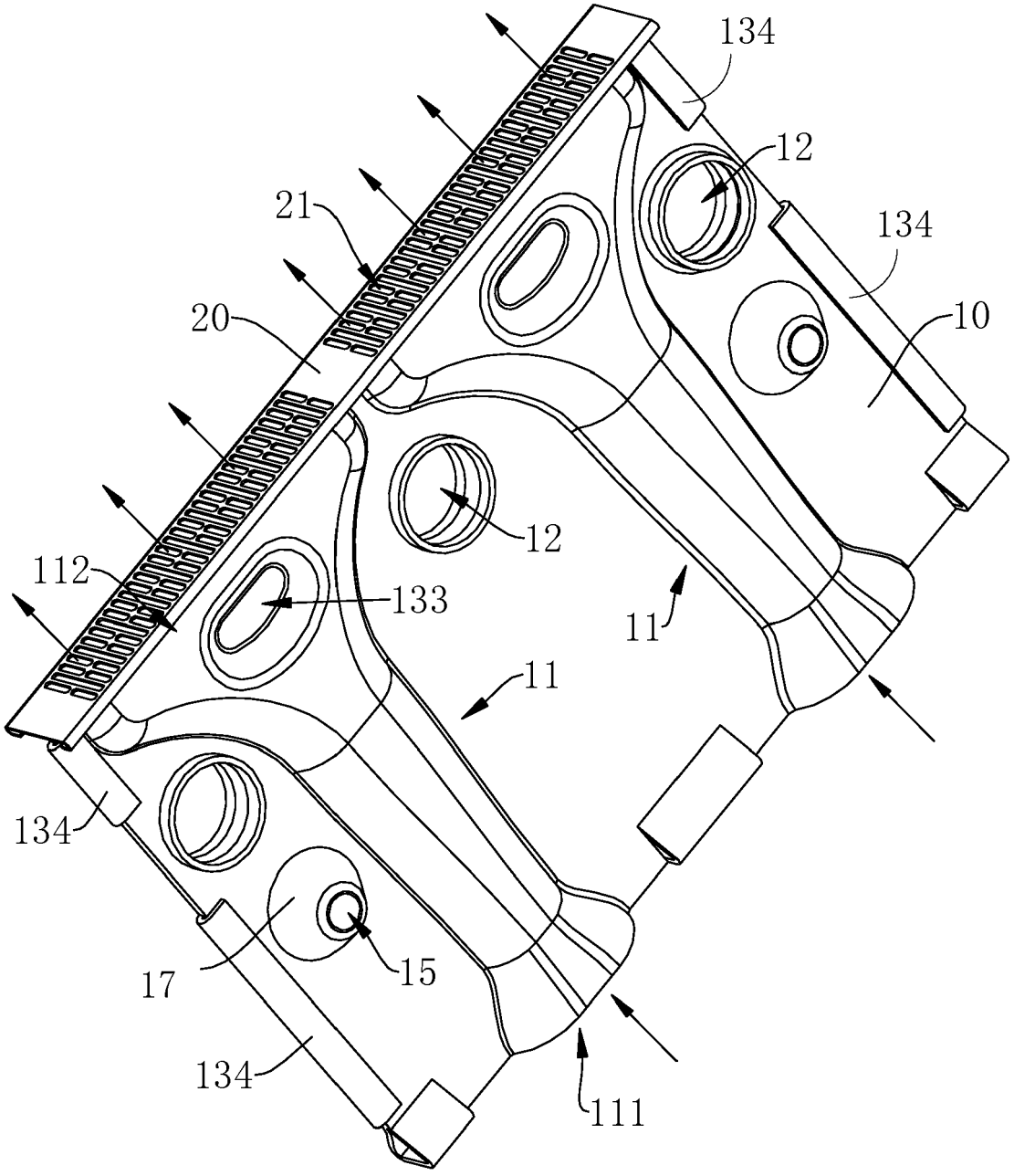

FIG. 1

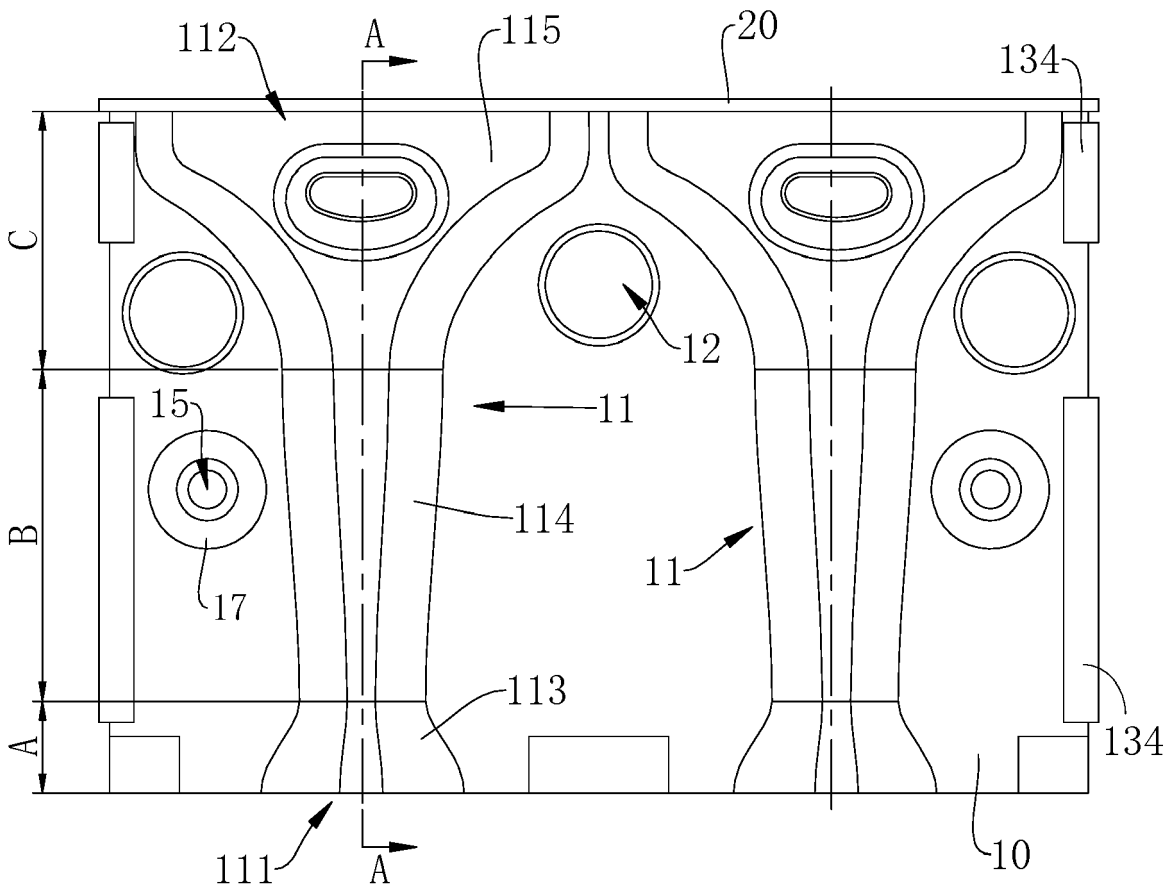

FIG. 2

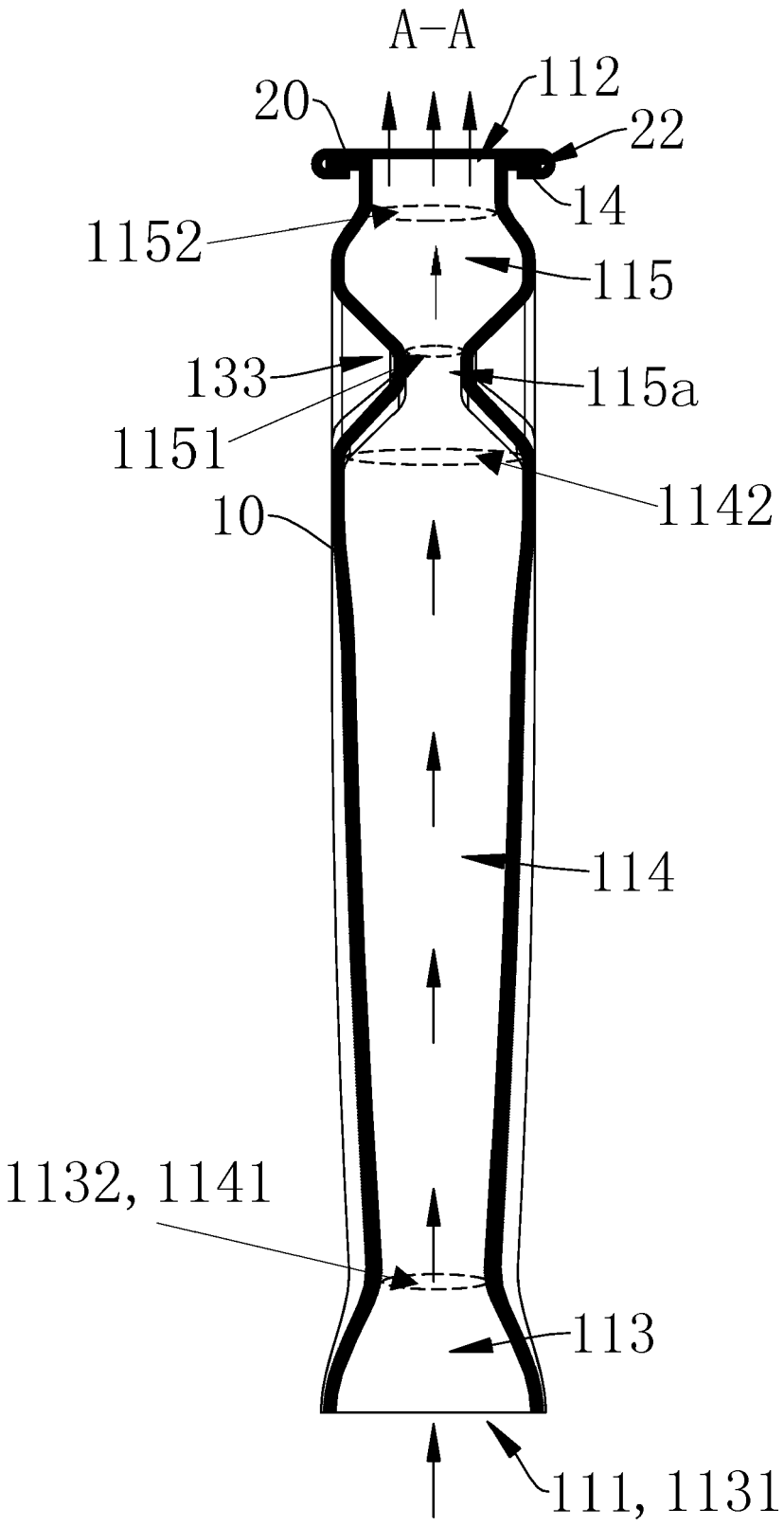
A–A
20
112
22
14
1152
115
133
115a
1151
1142
10
114
1132, 1141
113
111, 1131

FIG. 3

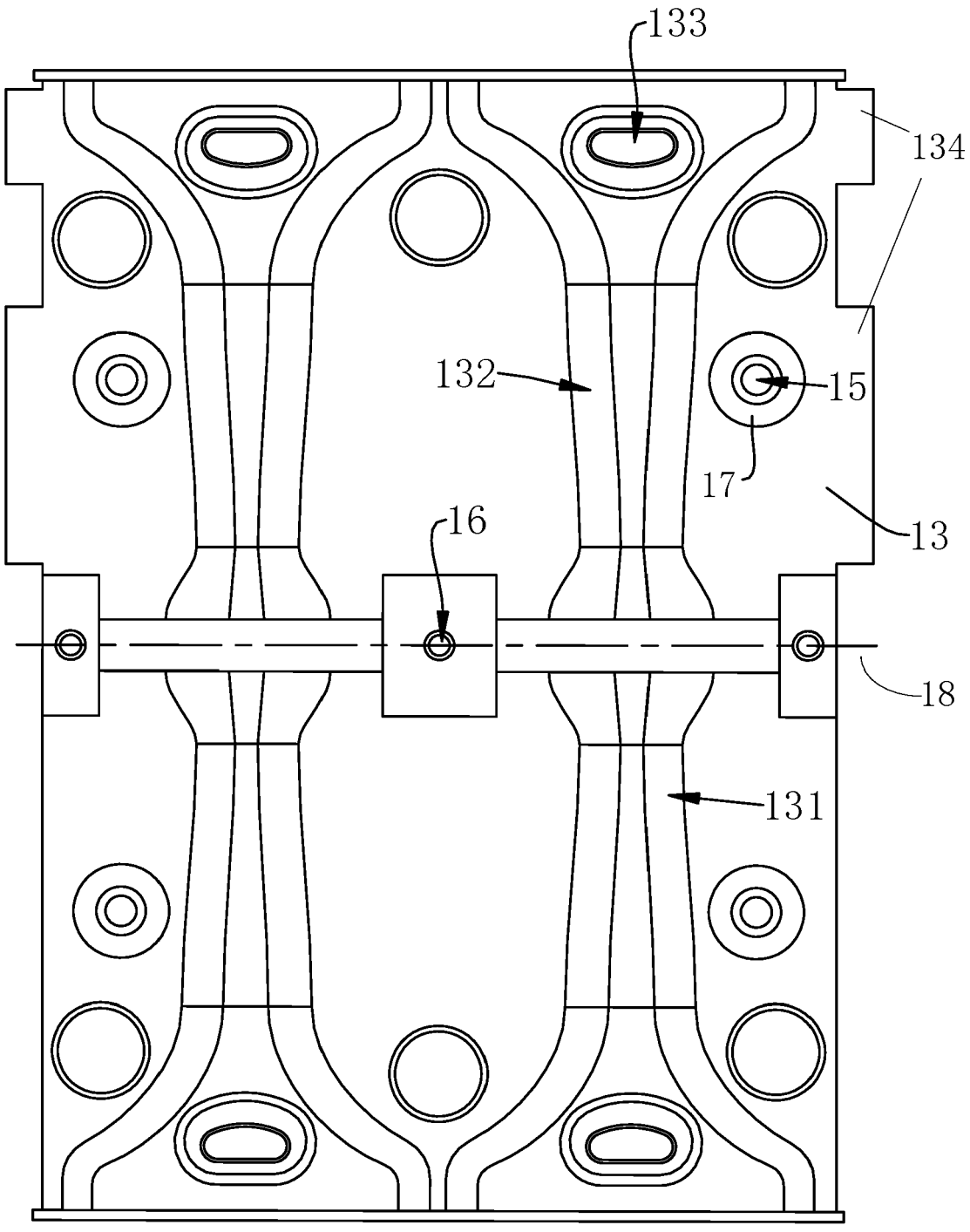

FIG. 4

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 18 02 0562

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 197 24 812 A1 (VAILLANT JOH GMBH & CO [DE]) 11 December 1997 (1997-12-11) * column 2, line 37 - column 3, line 44 * * figures 1-3 *	1,2,6,10	INV. F23D14/04 F23D14/08 F23D14/64 F23D23/00
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X	DE 297 10 274 U1 (VAILLANT JOH GMBH & CO [DE]) 14 August 1997 (1997-08-14) * page 3, paragraph 7 - page 4, paragraph 4 * * figures 1,2 *	1,2,10	
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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	16 May 2019	Gavriliu, Costin

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Application Number
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