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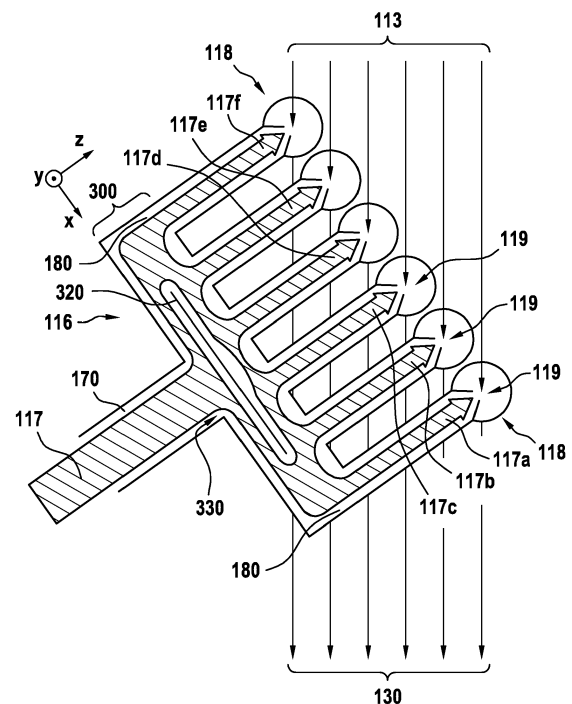
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(54) **AN AIR-GAS MIXTURE BURNING APPLIANCE WITH A GAS FLOW DISTANCE REGULATING DEVICE**

(57) In an air-gas mixture burning appliance (100) that comprises a burning unit (120), a predetermined number of air-gas mixers (118) for mixing of air (113) and gas (117), and a gas supply unit (116) that comprises a first gas flow channel (170), a plurality of second gas flow channels (180) that is arranged between the first gas flow channel (170) and the predetermined number of air-gas mixers (118), and a gas flow distance regulating device (300), the gas flow distance regulating device (300) is arranged between the first gas flow channel (170) and the plurality of second gas flow channels (180), and is adapted to regulating a relative flow distance of the gas (117) from the first gas flow channel (170) to the plurality of second gas flow channels (180) in order to adjust an arrival time of the gas (117) at the predetermined number of air-gas mixers (118).

Fig. 3



Description

Background of the Invention

[0001] The present invention relates to an air-gas mixture burning appliance that comprises a burning unit for burning a combustible air-gas mixture, an air-gas mixing unit that is arranged upstream of the burning unit and comprises a predetermined number of air-gas mixers for mixing of air and gas to form the combustible air-gas mixture, and a gas supply unit that is arranged upstream of the air-gas mixing unit, the gas supply unit comprising a first gas flow channel and a plurality of second gas flow channels that is arranged between the first gas flow channel and the predetermined number of air-gas mixers.

[0002] From the state of the art, an air-gas mixture burning appliance with an air-gas mixing unit, a burning unit, and a gas supply unit is known. In this air-gas mixture burning appliance, hydrogen may be used as gas and mixed with air to form a combustible air-gas mixture.

[0003] More specifically, such an air-gas mixture burning appliance usually mixes air and gas directly before the burning unit. During the ignition phase, the combustible air-gas mixture enters the burning unit where it is ignited at a low heat input to assist with stability and acoustics upon start up. However, sometimes the combustible air-gas mixture is not ignited immediately, which can lead to a build-up of the combustible air-gas mixture in the burning unit. A delayed ignition, which refers to igniting the built-up combustible air-gas mixture, usually leads to an explosion that may damage internal components of the air-gas mixture burning appliance and endanger the surrounding environment.

[0004] Delayed ignition is unproblematic for current natural gas burning appliances. However, delayed ignition may have severe consequences for appliances that burn a combustible air-hydrogen mixture. For example, the explosion caused by a delayed ignition of a combustible air-hydrogen mixture may not only damage internal components of the appliance, but damaged internal components may be ejected from the boiler case of the appliance. Moreover, the high sound levels that such an explosion produces, could potentially lead to hearing damage of people who are in the vicinity of such an appliance.

[0005] In the remainder of this description, the term "gas" refers as any fuel in gaseous form that, when mixed with air, forms a combustible air-gas mixture. Examples for such a gas include hydrogen, propane, butane, methane, liquefied petroleum gas, etc.

Summary of the Invention

[0006] The present invention relates to an air-gas mixture burning appliance that comprises a burning unit for burning a combustible air-gas mixture, an air-gas mixing unit that is arranged upstream of the burning unit and comprises a predetermined number of air-gas mixers for

mixing of air and gas to form the combustible air-gas mixture, and a gas supply unit that is arranged upstream of the air-gas mixing unit, the gas supply unit comprising: a first gas flow channel, a plurality of second gas flow channels that is arranged between the first gas flow channel and the predetermined number of air-gas mixers, and a gas flow distance regulating device that is arranged between the first gas flow channel and the plurality of second gas flow channels, the gas flow distance regulating device being adapted to regulating a relative flow distance of the gas from the first gas flow channel to the plurality of second gas flow channels in order to adjust an arrival time of the gas at the predetermined number of air-gas mixers.

[0007] Advantageously, the inventive air-gas mixture burning appliance may uniformly supply gas at all air-gas mixers during the ignition phase of the air-gas mixture burning appliance. Thus, the arrival time of the combustible air-gas in the burning units may be synchronized, which may prevent an initial failure to ignite the combustible air-gas mixture in the burning unit. Preventing the initial failure to ignite also prevents the build-up of a damaging concentration of the combustible air-gas mixture in the burning unit, and thereby eliminates the risks associated with a delayed ignition of such a damaging amount of the combustible air-gas mixture. More specifically, synchronizing the arrival time of the gas at the air-gas mixers before the ignition of the combustible air-gas mixture may prevent an explosion and the associated damage in the event of a delayed ignition. Moreover, adjusting the arrival time of the gas at all air-gas mixers may enable the use of gases that have a lower density than air. In fact, the volumetric flow rate of gas through a fixed geometric restriction for a given driving pressure difference is inversely related to the gas density. Thus, adjusting the arrival time of the gas at the air-gas mixers will subsequently prevent that some gas flow channels remain filled with air while other gas flow channels take a preferential share of the total flow of gas and thereby prevent the accumulation of the combustible air-gas mixture in the burning unit even for gases with a lower density than air.

[0008] According to one aspect, regulating the relative flow distance of the gas further comprises adjusting flow distances from the first gas flow channel to each one of the plurality of second gas flow channels to provide for a substantially simultaneous arrival time of the gas at the predetermined number of air-gas mixers.

[0009] Thus, the flow distance of the gas from the first gas flow channel to each one of the predetermined number of air-gas mixers may be synchronized.

[0010] According to one aspect, the gas flow distance regulating device further comprises a baffle plate that extends in longitudinal direction from a center towards two ends and that is adapted to route the gas from the first gas flow channel to at least one of the plurality of second gas flow channels.

[0011] Accordingly, the flow distance of the gas from

the first gas flow channel to at least one of the plurality of second gas flow channels may be prolonged.

[0012] According to one aspect, the first gas flow channel is mounted to the gas flow distance regulating device at a gas flow distance regulating device inlet, wherein the gas flows through the gas flow distance regulating device inlet in a predetermined gas flow direction, and wherein the baffle plate is arranged perpendicular to the predetermined gas flow direction.

[0013] Thus, the gas may be easily and efficiently routed from the first gas flow channel to the plurality of second gas flow channels.

[0014] According to one aspect, the baffle plate comprises at least one perforation.

[0015] Accordingly, the gas flow from the first gas flow channel to the plurality of second gas flow channels may be fine-tuned.

[0016] According to one aspect, the baffle plate comprises a first plurality of perforations that is arranged between first and second distances from the center and a second plurality of perforations that is arranged between third and fourth distances from the center, wherein each perforation of the first and second plurality of perforations has a cross-sectional area, wherein a sum of the cross-sectional areas of all perforations of the first plurality of perforations is smaller than a sum of the cross-sectional areas of all perforations of the second plurality of perforations, and wherein the greater one of the first and second distances is smaller than or equal to the smaller one of the third and fourth distances.

[0017] Thus, the gas flow from the first gas flow channel to the gas flow channels of the plurality of second gas flow channels that are further away from the center of the baffle plate is less restricted than the gas flow from the first gas flow channel to the gas flow channels of the plurality of second gas flow channels that are closer to the center of the baffle plate.

[0018] According to one aspect, the first plurality of perforations is greater than the second plurality of perforations.

[0019] Accordingly, the first plurality of perforations may include a comparatively large number of small perforations and the second plurality of perforations a comparatively smaller number of larger perforations.

[0020] According to one aspect, the first plurality of perforations is smaller than or equal to the second plurality of perforations.

[0021] Accordingly, the first plurality of perforations may include a comparatively small number of perforations of approximately the same size or smaller than the second plurality of perforations.

[0022] According to one aspect, the gas flow distance regulating device further comprises at least one additional baffle plate that is arranged parallel to the baffle plate.

[0023] Thus, the gas flow distance regulating device may provide for a staggered arrangement of a plurality of baffle plates that may be adapted to fine-tune the flow distance between the first gas flow channel and the in-

dividual channels of the plurality of second gas flow channels.

[0024] Preferably, the gas has a density that is smaller than half the density of the air.

5 **[0025]** Thus, the air-gas mixture burning appliance may be adapted to burn a combustible air-gas mixture with a gas that has less than half the density of air.

[0026] Preferably, the gas is hydrogen.

10 **[0027]** Accordingly, the air-gas mixture burning appliance may burn a combustible air-hydrogen mixture.

Brief Description of the Drawings

[0028] Exemplary embodiments of the present invention are described in detail hereinafter with reference to the attached drawings. In these attached drawings, identical or identically functioning components and elements are labelled with identical reference signs and they are generally only described once in the following description.

Fig. 1 shows a schematic view of an illustrative air-gas mixture burning appliance according to the present invention, during the ignition phase,

Fig. 2 shows a schematic view of a gas supply unit that is arranged upstream of a plurality of air-gas mixers and that comprises an illustrative gas flow distance regulating device,

Fig. 3 shows a schematic view of the gas supply unit of Fig. 2 with a gas flow distance regulating device that comprises a baffle plate to regulate the relative flow distance of gas from a first gas flow channel to a plurality of second gas flow channels according to the present invention,

40 Fig. 4A shows a schematic view of an illustrative baffle plate,

Fig. 4B shows a schematic view of an illustrative baffle plate with perforations,

45 Fig. 4C shows a schematic view of an illustrative baffle plate with perforations having a small cross-sectional area in the center of the baffle plate and perforations having a comparatively larger cross-sectional area further away from the center of the baffle plate,

Fig. 4D shows a schematic view of an illustrative baffle plate with a first number of perforations having a small cross-sectional area in the center of the baffle plate and a second comparatively greater number of perforations of substantially the same cross-sectional area

further away from the center of the baffle plate, and

Fig. 5 shows a schematic view of a gas supply unit with an illustrative gas flow distance regulating device that comprises staggered baffle plates.

Detailed Description

[0029] Fig. 1 shows an exemplary air-gas mixture burning appliance 100 with an air-gas mixing unit 110, a burning unit 120, and a flame detector 150. By way of example, the air-gas mixture burning appliance 100 may be used in a boiler or, more generally, in a building heating system. Preferably, the gas used is hydrogen such that the air-gas mixture burning appliance 100 forms an air-hydrogen mixture burning appliance.

[0030] The air-gas mixing unit 110 is preferably adapted for mixing of air and gas to form a combustible air-gas mixture 130. Preferentially, the combustible air-gas mixture 130 is a homogenous mixture of the air and the gas.

[0031] By way of example, the air-gas mixing unit 110 includes an air supply unit 112 and a gas supply unit 116. Illustratively, the air supply unit 112 includes a fan 114 that may be operated with an adaptable fan speed and/or within predetermined ranges of fan speeds to draw air into the air-gas mixing unit 110.

[0032] The air supply unit 112 and the gas supply unit 116 may be interconnected via a predetermined number of air-gas mixers 118 which forms a corresponding predetermined number of discrete points of mixing 119. Preferably, the combustible air-gas mixture 130 is formed at the predetermined number of discrete points of mixing 119 and guided via the predetermined number of air-gas mixers 118 to the burning unit 120.

[0033] By way of example, at least a first and a second air-gas mixer 118 of the predetermined number of air-gas mixers 118 may be identical. For example, all air-gas mixers 118 of the predetermined number of air-gas mixers 118 may be identical. If desired, at least a first and a second air-gas mixer 118 of the predetermined number of air-gas mixers 118 may be different. By way of example, at least one of the predetermined number of air-gas mixers 118 may be a venturi air-gas mixer.

[0034] Illustratively, the burning unit 120 is provided with a burner surface 124 that is arranged downstream of the air-gas mixing unit 110 such that the combustible air-gas mixture 130 that is formed at the predetermined number of discrete points of mixing 119 flows towards the burner surface 124. The combustible air-gas mixture 130 is burned by the burning unit 120 and, more specifically, at the burner surface 124.

[0035] By way of example, the burner surface 124 is illustrated with a comparatively small flame 122 which occurs e.g. during an ignition phase of the air-gas mixture burning appliance 100. As an example, during such an ignition phase, the air-gas mixing unit 110 may have a

low firing rate, i.e. a comparatively low rate at which feed of the combustible air-gas mixture 130 from the air-gas mixing unit 110 to the burning unit 120 occurs, in terms of volume, heat units, or weight per unit time. As another example, during such an ignition phase, the gas supply unit 116 may regulate a relative flow distance of the gas in order to adjust an arrival time of the gas at the different air-gas mixers 118 of the predetermined number of air-gas mixers 118 such that a uniform small flame 122 may occur simultaneously upon ignition at the entire burner surface 124.

[0036] According to one aspect, the flame detector 150 is provided for sensing presence of a flame 122 in the burning unit 120. By way of example, the flame detector 150 detects a flame signal 160 in the burning unit 120. Thus, the flame detector 150 is suitable for determining whether a flame 122 is present in the burning unit 120, or not. However, it should be noted that suitable flame detection techniques that may be used with the flame detector 150 are well-known to the person skilled in the art and are, therefore, not described in more detail, for brevity and conciseness. For instance, the flame detector 150 may use any suitable sensing element for sensing presence of the flame 122 in the burning unit 120.

[0037] Illustratively, the flame detector 150 is connected to a controller 140. Preferably, the controller 140 is adapted to control supply of gas to the air-gas mixing unit 110, in particular to control the gas supply unit 116, on the basis of a detection signal 142 provided by the flame detector 150.

[0038] The detection signal 142 may be created and/or provided by the flame detector 150, or alternatively by the controller 140, by comparing the detected flame signal 160 with a predetermined flame detection threshold. Thus, the controller 140 may create a control signal 182 on the basis of the detection signal 142.

[0039] Fig. 2 shows an illustrative gas supply unit 116 of an air-gas mixture burning appliance (e.g., air-gas mixture burning appliance 100 of Fig. 1). If desired, gas supply unit 116 may be arranged upstream of an air-gas mixing unit (e.g., air-gas mixing unit 110 of Fig. 1).

[0040] The air-gas mixing unit may be arranged upstream of a burning unit (e.g., burning unit 120 of Fig. 1) for burning a combustible air-gas mixture 130. Illustratively, the air-gas mixing unit may include a predetermined number of air-gas mixers 118 for mixing of air 113 and gas 117 to form the combustible air-gas mixture 130. The air 113 may be mixed with the gas 117 at discrete points of mixing 119 in the air-gas mixers 118.

[0041] Illustratively, the gas 117 may have a density that is smaller than 80% the density of the air 113. If desired, the gas 117 may have a density that is smaller than half the density of the air 113. As an example, the gas 117 may be hydrogen.

[0042] By way of example, at least a first and a second air-gas mixer 118 of the predetermined number of air-gas mixers 118 may be identical. For example, all air-gas mixers 118 of the predetermined number of air-gas

mixers 118 may be identical. If desired, at least a first and a second air-gas mixer 118 of the predetermined number of air-gas mixers 118 may be different. By way of example, at least one of the predetermined number of air-gas mixers 118 may be a venturi air-gas mixer.

[0043] Illustratively, gas supply unit 116 may be adapted to regulating the flow of gas 117 to the air-gas mixers 118. If desired, the gas supply unit 116 may include a first gas flow channel 170 and a plurality of second gas flow channels 180. The plurality of second gas flow channels 180 may be arranged between the first gas flow channel 170 and the predetermined number of air-gas mixers 118. Illustratively, gas supply unit 116 may include a gas flow distance regulating device 300. The gas flow distance regulating device 300 may be arranged between the first gas flow channel 170 and the plurality of second gas flow channels 180.

[0044] Illustratively, the gas flow distance regulating device 300 may be adapted to regulating a relative flow distance of the gas 117 from the first gas flow channel 170 to the plurality of second gas flow channels 180. For example, the gas flow distance regulating device 300 may regulate the relative flow distance of the gas 117 from the first gas flow channel 170 to the plurality of second gas flow channels 180 in order to adjust an arrival time of the gas 117a, 117b, 117c, 117d, 117e, 117f at the predetermined number of air-gas mixers 118.

[0045] By way of example, the gas flow distance regulating device 300 may adjust flow distances from the first gas flow channel 170 to each one of the plurality of second gas flow channels 180 to provide for a substantially simultaneous arrival time of the gas 117a, 117b, 117c, 117d, 117e, 117f at the predetermined number of air-gas mixers 118.

[0046] If desired, the gas flow distance regulating device 300 may be adapted to regulating the relative flow distance of the gas 117 from the first gas flow channel 170 to the plurality of second gas flow channels 180 such that the same concentration of the gas 117a, 117b, 117c, 117d, 117e, 117d arrives at the predetermined number of air-gas mixers 118, preferably at the same time.

[0047] Illustratively, the gas flow distance regulating device 300 may include a baffle plate 320. The baffle plate 320 may be adapted to route the gas 117 from the first gas flow channel 170 to at least one of the plurality of second gas flow channels 180.

[0048] If desired, the baffle plate 320 may be adapted to route the gas 117 from the first gas flow channel 170 to more than one of the plurality of second gas flow channels 180. For example, the baffle plate 320 may be adapted to route the gas 117 from the first gas flow channel 170 to all gas flow channels of the plurality of second gas flow channels 180.

[0049] As shown in Figure 2, the first gas flow channel 170 may be mounted to the gas flow distance regulating device 300 at a gas flow distance regulating device inlet 330. The gas 170 may flow through the gas flow distance regulating device inlet 330 in a predetermined gas flow

direction 340. For example, the predetermined gas flow direction 340 may be parallel to a z-axis.

[0050] The baffle plate 320 may have a length extension parallel to an x-axis, a height extension parallel to a y-axis, and a thickness parallel to the z-axis. As shown in Fig. 2, the x-axis, the y-axis, and the z-axis may form a Cartesian coordinate system, and the baffle plate 320 may have a uniform thickness.

[0051] If desired, the baffle plate 320 may be arranged relative to the predetermined gas flow direction 340 at an angle that is between 45° and 90°. Illustratively, the baffle plate 320 may be arranged perpendicular to the predetermined gas flow direction 340. In other words, the length and height extensions of the baffle plate 320 may form a plane that is parallel to the x-y-plane.

[0052] Illustratively, the gas flow distance regulating device 300 may include a plurality of baffle plates 320 that are arranged at predetermined angles relative to each other and to the predetermined gas flow direction.

[0053] Fig. 3 shows a schematic view of the gas supply unit 116 of Fig. 2 with gas flow distance regulating device 300. The gas flow distance regulating device 300 may regulate the relative flow distance of gas 117 from the first gas flow channel 170 to the plurality of second gas flow channels 180. For example, the gas flow distance regulating device 300 may regulate the relative flow distance of the gas 117 from the first gas flow channel 170 to the plurality of second gas flow channels 180 to provide for a substantially simultaneous arrival time of the gas 117a, 117b, 117c, 117d, 117e, 117f at the predetermined number of air-gas mixers 118.

[0054] As shown in Fig. 3, the gas flow distance regulating device 300 may include a baffle plate 320. The baffle plate 320 may regulate the relative flow distance of the gas 117.

[0055] As an example, consider the scenario in which the gas supply unit 116 is filled with air before the initial supply of gas 117 that enter the gas flow distance regulating device 300 at the gas flow distance regulating device inlet 330 in a direction that is substantially parallel to a z-axis. Consider further that the gas flow distance regulating device 300 includes baffle plate 320 that is arranged parallel to the x-y-plane of the Cartesian coordinate system as shown in Fig. 3, such that the gas 117 has to flow around the baffle plate 320, and that the baffle plate 320 completely shuts off the direct path from the gas flow distance device inlet 330 to the gas flow channels 180 that route gas flows 117c and 117d.

[0056] In this scenario, the gas flows 117a, 117c, 117d, and 117f flow substantially the same distance from the gas flow distance device inlet 330 to the respective gas flow channels 180 of the plurality of second gas flow channels 180, while the gas flows 117b and 117e flow comparatively over a smaller distance from the gas flow distance device inlet 330 to the respective gas flow channels 180.

[0057] Thus, the baffle plate 320 may regulate the relative flow distance of the gas 117 from the first gas flow

channel 170 to each one of the plurality of second gas flow channels 180. Thereby, the gas flow distance regulating device 300 provides for a substantially simultaneous arrival time of the gas 117a, 117b, 117c, 117d, 117e, 117f at the predetermined number of air-gas mixers 118.

[0058] As a result, the air-gas mixers 118 that mix air 113 with the gas 117a, 117b, 117c, 117d, 117e, 117f to form the combustible air-gas mixture 130 may provide a uniform distribution of the combustible air-gas mixture 130 at a burning unit (e.g., burning unit 120 of Fig. 1) that may be arranged downstream of the air-gas mixers 118. Thereby, a failure to ignite the combustible air-gas mixture 130 combined with an accumulation of substantial quantities of the combustible air-gas mixture 130 in the burning unit (e.g., in a combustion chamber) may be prevented and the associated damages caused by a delayed ignition may be avoided.

[0059] Fig. 4A shows a schematic view of an illustrative baffle plate 320. The baffle plate 320 may have a length extension parallel to an x-axis, a height extension parallel to a y-axis, and a thickness parallel to a z-axis. The x-, y-, and z-axes may form a Cartesian coordinate system.

[0060] Illustratively, the baffle plate 320 may have a uniform thickness. In other words, the thickness may be the same along the entire length and height extensions of the baffle plate 320.

[0061] If desired, the thickness of the baffle plate 320 may be non-uniform. For example, the baffle plate 320 may have the greatest thickness at the center 321 of the baffle plate 320. The thickness may decrease towards the ends 323, 324 of the of the baffle plate 320, e.g. to provide for a more streamlined baffle plate 320.

[0062] Consider the scenario in which the baffle plate 320 has a uniform thickness. In this scenario, the baffle plate 320 may be straight such that the length and height extensions of the baffle plate 320 form a plane such that every point on the surface of the baffle plate 320 has the same coordinate on the z-axis (e.g., such as the baffle plate 320 shown in Fig. 2 and Fig. 3).

[0063] Alternatively, the baffle plate 320 may have a different shape such that at least two points on the surface of the baffle plate 320 that are at different height and/or different length extensions have a different coordinate on the z-axis. As an example, the baffle plate 320 may be curved.

[0064] A straight baffle plate 320 may cause turbulences to the gas flow in gas flow distance regulating device 300. In some scenarios, turbulences in the gas flow may affect the arrival time of the gas flows (e.g., gas flow 117a compared to gas flow 117c of Fig. 3) at the respective air-gas mixers, even though the distances from the gas flow distance regulating device inlet to the respective air-gas mixers are the same.

[0065] If desired, the baffle plate 320 may include perforations 310. Fig. 4B shows a schematic view of an illustrative baffle plate 320 with perforations 310. The perforations 310 may mitigate at least a portion of the neg-

ative effect of turbulences on the arrival time of the different gas flows at the air-gas mixers.

[0066] Illustratively, the baffle plate 320 may include perforations 310 that have a uniform cross-sectional area. If desired, at least two perforations 310 may have a different cross-sectional area.

[0067] The perforations 310 may have any cross-sectional shape. For example, the perforations 310 may be round, oval, elliptical, triangular, rectangular, etc. Preferably, the perforations 310 are round.

[0068] By way of example, the perforations 310 may be distributed uniformly across the baffle plate 320. As shown in Fig. 4B, the perforations 310 may be distributed non-uniformly across the baffle plate 320. If desired, the perforations 310 may be distributed uniformly in some sections of the baffle plate 320.

[0069] Fig. 4C and Fig. 4D show schematic views of illustrative baffle plates 320 with perforations 310 that are distributed uniformly in some sections of the respective baffle plate 320.

[0070] For example, an illustrative baffle plate 320 may include a first plurality of perforations 311 that is arranged between first and second distances 326, 327 from the center 321 of the baffle plate 320 and a second plurality of perforations 312 that is arranged between third and fourth distances 328, 329 from the center 321 of the baffle plate.

[0071] Illustratively, each perforation 310 of the first and second plurality of perforations 311, 312 may have a cross-sectional area (i.e., an area in the x-y plane). A sum of the cross-sectional areas of all perforations 310 of the first plurality of perforations 311 may be smaller than a sum of the cross-sectional areas of all perforations 310 of the second plurality of perforations 312, and the greater one of the first and second distances 326, 327 may be smaller than or equal to the smaller one of the third and fourth distances 328, 329. Fig. 4C and Fig. 4D show such illustrative baffle plates 320.

[0072] Fig. 4C shows a schematic view of a baffle plate 320 with perforations 310 that are distributed uniformly in some sections of the baffle plate 320. As shown in Fig. 4C, at least two perforations 310 may have a different cross-sectional area.

[0073] Illustratively, baffle plate 320 may have a first plurality of perforations 311 with a first cross-sectional area, which is the sum of all perforations 310 of the first plurality of perforations 311, in the center 321 of the baffle plate 320 and a second plurality of perforations 312 with a second cross-sectional area, which is the sum of all perforations 310 of the second plurality of perforations 312 towards the end 324 in length direction of the baffle plate 320.

[0074] As shown in Fig. 4C, the second cross-sectional area of the second plurality of perforations 312 may be comparatively larger than the first cross-sectional area of the first plurality of perforations 311. Nevertheless, the first plurality of perforations 311 has nine perforations and is therefore greater in number than the second plu-

rality of perforations 312, which has four perforations.

[0075] The first plurality of perforations 311 may be arranged between first and second distances 326, 327 from the center 321 of the baffle plate 320, and the second plurality of perforations 312 may be arranged between third and fourth distances 328, 329 from the center 321 of the baffle plate. Illustratively, the greater of the first and second distances 326, 327 may be smaller than the smaller one of the third and fourth distances 328, 329. If desired, the baffle plate 320 may be arranged in the gas flow distance regulating device 300 such that the first plurality of perforations 311 is closer to the center of the gas flow distance regulating device inlet (e.g., gas flow distance regulating device inlet 330 of Fig. 2 or Fig. 3) than the second plurality of perforations 312.

[0076] Baffle plate 320 of Fig. 4C is shown with perforations that increase in cross-sectional area from the center 321 of the baffle plate 320 towards the ends 323, 324 of the baffle plate 320. However, some sections may have fewer perforations 310 that each have comparatively greater cross-sectional areas than the neighboring section that is closer to the center 321 of the baffle plate 320, while other sections may have more perforations 310 that each have comparatively smaller cross-sectional areas than the neighboring section that is closer to the center 321 of the baffle plate 320.

[0077] Fig. 4D shows a schematic view of a baffle plate 320 with perforations 310 that are distributed uniformly in some sections of the baffle plate 320. As shown in Fig. 4D, all perforations 310 may have substantially the same cross-sectional area. If desired, some perforations 310 may have a different cross-sectional area.

[0078] Illustratively, baffle plate 320 may have a first plurality of perforations 311 with a first cross-sectional area, which is the sum of all perforations 310 of the first plurality of perforations 311, in the center of the baffle plate 320 and a second plurality of perforations 312 with a second cross-sectional area, which is the sum of all perforations 310 of the second plurality of perforations 312 towards the end 323, 324 of the baffle plate 320.

[0079] As shown in Fig. 4D, the second cross-sectional area of the second plurality of perforations 312 may be comparatively larger than the first cross-sectional area of the first plurality of perforations 311. Illustratively, the first plurality of perforations 311 has three perforations and is therefore smaller than the second plurality of perforations 312, which has 16 perforations.

[0080] The first plurality of perforations 311 may be arranged between first and second distances 326, 327 from the center 321 of the baffle plate 320, and the second plurality of perforations 312 may be arranged between third and fourth distances 328, 329 from the center 321 of the baffle plate 320. Illustratively, the greater of the first and second distances 326, 327 may be smaller than the smaller one of the third and fourth distances 328, 329. If desired, the baffle plate 320 may be arranged in the gas flow distance regulating device 300 such that the first plurality of perforations 311 is closer to the center of

the gas flow distance regulating device inlet than the second plurality of perforations 312.

[0081] The gas flow distance regulating device 300 of Fig. 2 or Fig. 3 is shown to include a single baffle plate 320. However, the gas flow distance regulating device 300 may include more than one baffle plate, if desired. For example, the gas flow distance regulating device 300 may include three or more baffle plates, for example to fine tune the arrival time of the gas 117a, 117b, 117c, 117d, 117e, 117f at the different air-gas mixers 118.

[0082] Fig. 5 shows a schematic view of a gas supply unit 116 with a gas flow distance regulating device 300 that comprises more than one baffle plate 320. The baffle plates 320 may be adapted to route the gas 117 from the first gas flow channel 170 to at least one of the plurality of second gas flow channels 180. If desired, the baffle plates 320 may be adapted to route the gas 117 from the first gas flow channel 170 to each one of the plurality of second gas flow channels 180 to provide for a substantially simultaneous arrival time of the gas 117a, 117b, 117c, 117d, 117e, 117f at the predetermined number of air-gas mixers 118.

[0083] Illustratively, the first gas flow channel 170 is mounted to the gas flow distance regulating device 300 at a gas flow distance regulating device inlet 330. The gas 170 flows through the gas flow distance regulating device inlet 330 in a predetermined gas flow direction that may be parallel to the z-axis.

[0084] As shown in Fig. 5, the gas flow distance regulating device 300 may include seven baffle plates 320. Preferably, the baffle plate 320 that is closest to the gas flow distance regulating device inlet 330 may be arranged perpendicular to the predetermined gas flow direction (i.e., parallel to the x-y-axis plane).

[0085] Illustratively, all baffle plates 320 may be arranged parallel to each other and to the x-y-axis plane. If desired, at least two baffle plates 320 may be arranged non-parallel to each other and/or non-parallel to the x-y-axis plane. For example, at least two baffle plates 320 may be arranged relative to each other at an angle that is between 5 degrees and 45 degrees.

[0086] As shown in Fig. 5, the number of aligned baffle plates 320 may double in direction of the z-axis. For example, alignment 350 that is closest to the gas flow distance regulating device inlet 330 may include a single baffle plate 320. Alignment 360 that is in direction of the z-axis further away from the gas flow distance regulating device inlet 330 may include two aligned baffle plates 320. The two aligned baffle plates 320 of alignment 360 may be arranged parallel to the single baffle plate 320 of alignment 350. Alignment 370 that is even further away from the gas flow distance regulating device inlet 330 in direction of the z-axis may include four aligned baffle plates 320.

[0087] Thus, as shown in Fig. 5, gas flow distance regulating device 300 may include three parallel alignments 350, 360, 370 of baffle plates 320. If desired, gas flow distance regulating device 300 may include more or less

than three parallel alignments of baffle plates 320. For example, gas flow distance regulating device 300 may include two, four, five, six, etc. parallel alignments of baffle plates 320.

[0088] Illustratively, the number of aligned baffle plates 320 at each alignment 350, 360, 370 and/or the number of alignments and/or the arrangements of the individual baffle plates 320 may be selected based on the number of parallel gas flow channels in the plurality of second gas flow channels 180.

[0089] By way of example, all baffle plates 320 in an alignment 350, 360, 370 may have the same dimensions. If desired, at least two baffle plates 320 in the same alignment 350, 360, 370 may have different dimensions.

[0090] As shown in Fig. 5, two baffle plates 320 that are in different parallel alignments 350, 360, 370 may have different dimensions. If desired, at least two baffle plates 320 that are in different parallel alignments 350, 360, 370 may have the same dimensions.

[0091] If desired, at least one baffle plate 320 may include at least one perforation (e.g., one of perforations 310 of Fig. 4B, 4C, or 4D). In some embodiments, all baffle plates 320 may include at least one perforation.

[0092] Gas supply unit 116 of Fig. 2 and Fig. 3 is shown with a single first gas flow channel 170. However, it should be noted that the first gas flow channel 170 of the gas supply unit 116 of Fig. 2 and Fig. 3 is only cited by way of example, and not for limiting the invention accordingly. Instead, gas supply units 116 with more than one first gas flow channel are likewise contemplated. For example, the gas supply unit 116 may have two or more gas flow channels that supply gas to the plurality of second gas flow channels 180.

[0093] Similarly, gas supply unit 116 of Fig. 2 and Fig. 3 is shown with six second gas flow channels 180. However, it should be noted that the plurality of second gas flow channels 180 of the gas supply unit 116 of Fig. 2 and Fig. 3 is only cited by way of example, and not for limiting the invention accordingly. Instead, gas supply units 116 with a plurality of second gas flow channels having more or less than six gas flow channels are likewise contemplated.

Claims

1. An air-gas mixture burning appliance (100), comprising:

a burning unit (120) for burning a combustible air-gas mixture (130),
an air-gas mixing unit (110) that is arranged upstream of the burning unit (120) and comprises a predetermined number of air-gas mixers (118) for mixing of air (113) and gas (117) to form the combustible air-gas mixture (130), and
a gas supply unit (116) that is arranged upstream of the air-gas mixing unit (110), the gas

supply unit (116) comprising:

a first gas flow channel (170),
a plurality of second gas flow channels (180) that is arranged between the first gas flow channel (170) and the predetermined number of air-gas mixers (118), and
a gas flow distance regulating device (300) that is arranged between the first gas flow channel (170) and the plurality of second gas flow channels (180), the gas flow distance regulating device (300) being adapted to regulating a relative flow distance of the gas (117) from the first gas flow channel (170) to the plurality of second gas flow channels (180) in order to adjust an arrival time of the gas (117) at the predetermined number of air-gas mixers (118).

2. The air-gas mixture burning appliance of claim 1, wherein regulating the relative flow distance of the gas (117) further comprises adjusting flow distances from the first gas flow channel (170) to each one of the plurality of second gas flow channels (180) to provide for a substantially simultaneous arrival time of the gas (117a, 117b, 117c, 117d, 117e, 117f) at the predetermined number of air-gas mixers (118).

3. The air-gas mixture burning appliance of claim 1 or 2, wherein the gas flow distance regulating device (300) further comprises:

a baffle plate (320) that extends in longitudinal direction from a center (321) towards two ends (323, 324) and that is adapted to route the gas (117) from the first gas flow channel (170) to at least one of the plurality of second gas flow channels (180).

4. The air-gas mixture burning appliance of claim 3, wherein the first gas flow channel (170) is mounted to the gas flow distance regulating device (300) at a gas flow distance regulating device inlet (330), wherein the gas (170) flows through the gas flow distance regulating device inlet (330) in a predetermined gas flow direction (340), and wherein the baffle plate (320) is arranged perpendicular to the predetermined gas flow direction (340).

5. The air-gas mixture burning appliance of claim 3 or 4, wherein the baffle plate (320) comprises at least one perforation (310).

6. The air-gas mixture burning appliance of claim 4, wherein the baffle plate (320) comprises a first plurality of perforations (311) that is arranged between first and second distances (326, 327) from the center (321) and a second plurality of perforations (312)

that is arranged between third and fourth distances (328, 329) from the center (321), wherein each perforation (310) of the first and second plurality of perforations (311, 312) has a cross-sectional area, wherein a sum of the cross-sectional areas of all perforations (310) of the first plurality of perforations (311) is smaller than a sum of the cross-sectional areas of all perforations (310) of the second plurality of perforations (312), and wherein the greater one of the first and second distances (326, 327) is smaller than or equal to the smaller one of the third and fourth distances (328, 329).

7. The air-gas mixture burning appliance of claim 6, wherein the first plurality of perforations (311) is greater than the second plurality of perforations (312).
8. The air-gas mixture burning appliance of claim 6, wherein the first plurality of perforations (311) is smaller than or equal to the second plurality of perforations (312).
9. The air-gas mixture burning appliance of any one of claims 3 to 5, wherein the gas flow distance regulating device (300) further comprises:
at least one additional baffle plate (320) that is arranged parallel to the baffle plate (320).
10. The air-gas mixture burning appliance of any one of the preceding claims, wherein the gas (117) has a density that is smaller than half the density of the air (113).
11. The air-gas mixture burning appliance of any one of the preceding claims, wherein the gas (117) is hydrogen.

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Fig. 1

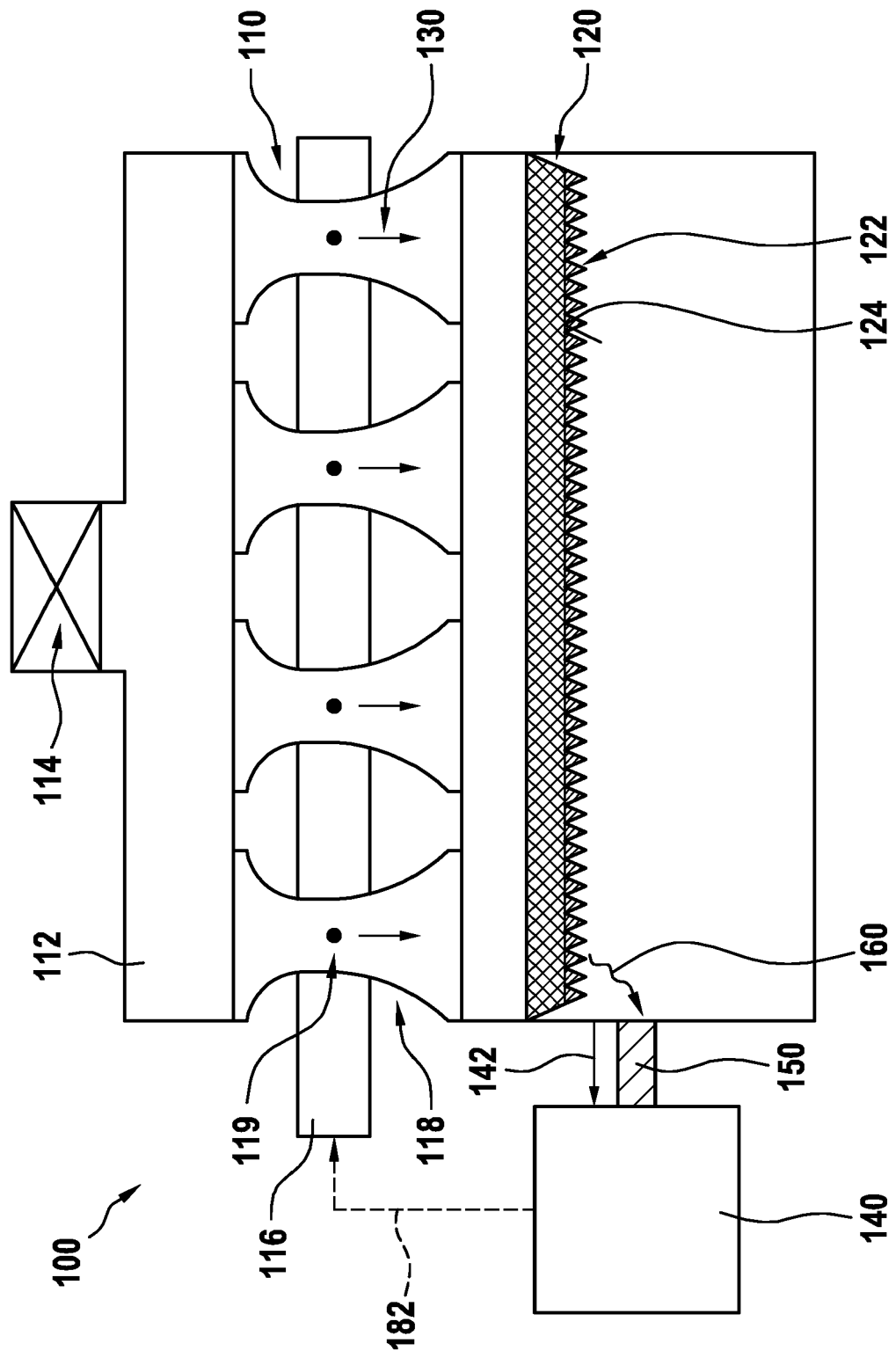


Fig. 2

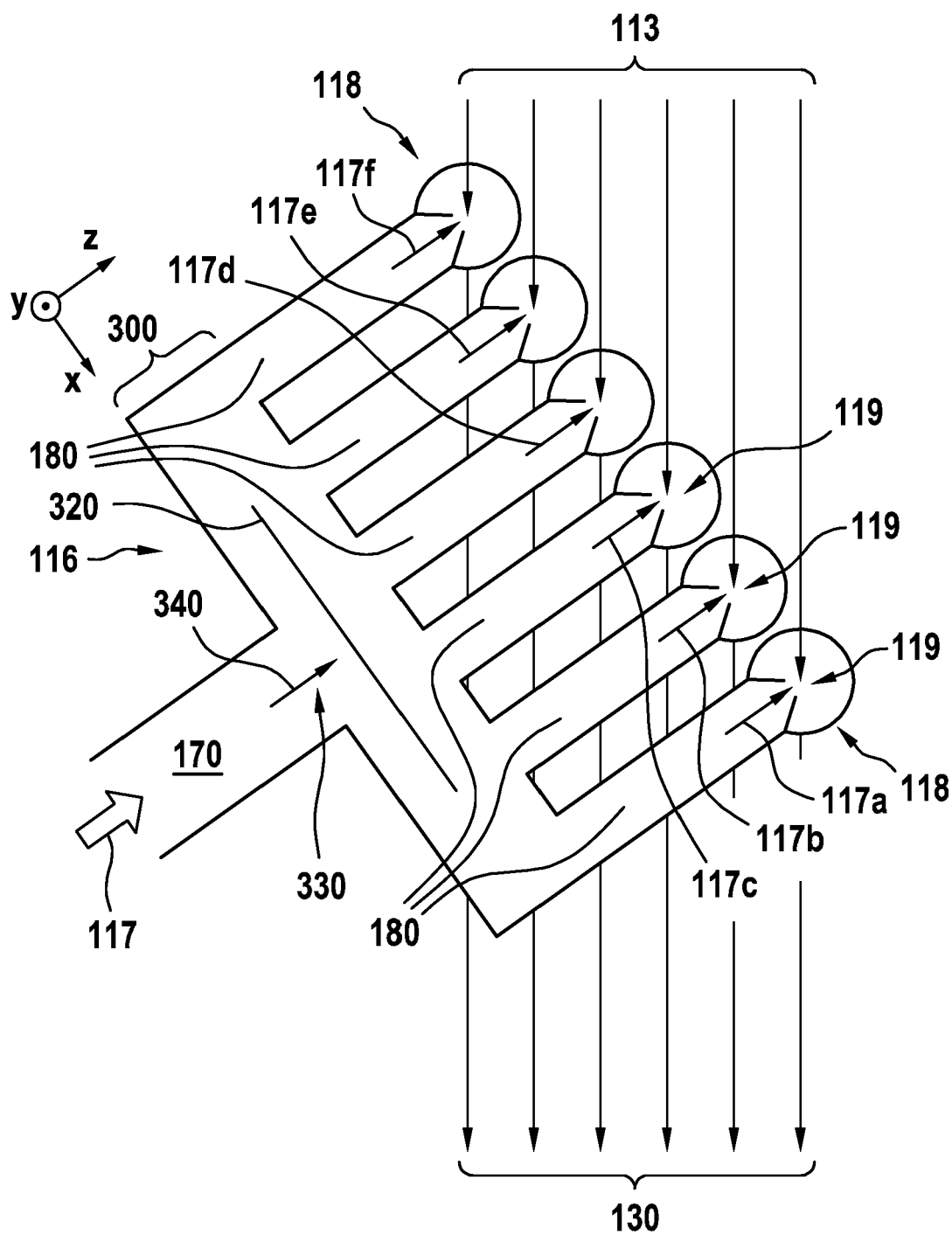


Fig. 3

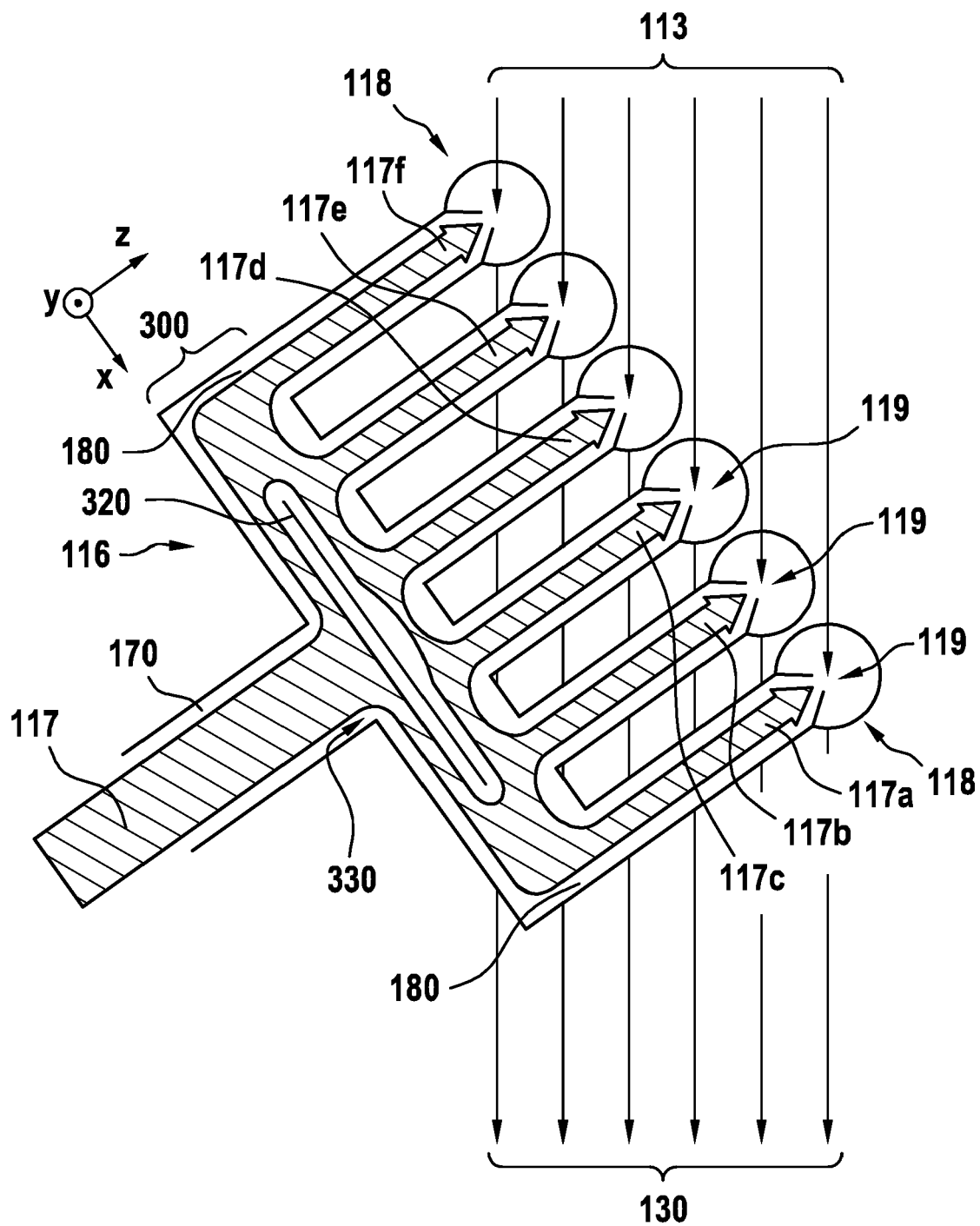


Fig. 4A

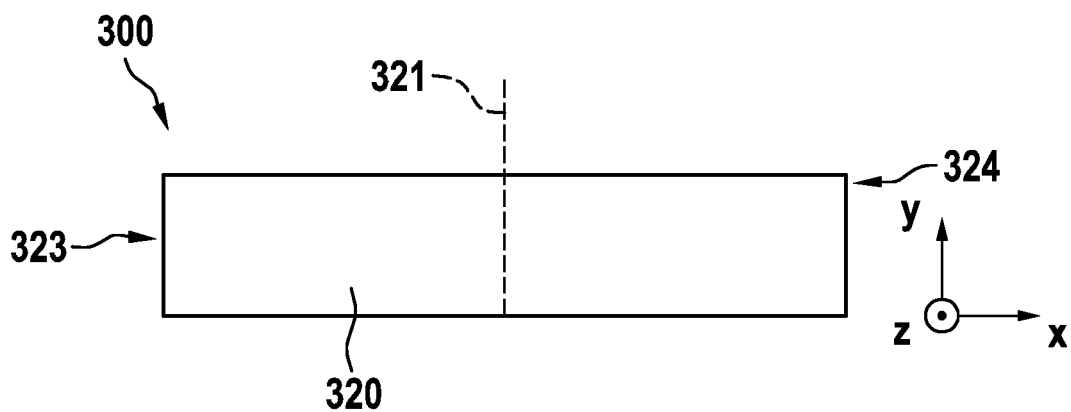


Fig. 4B

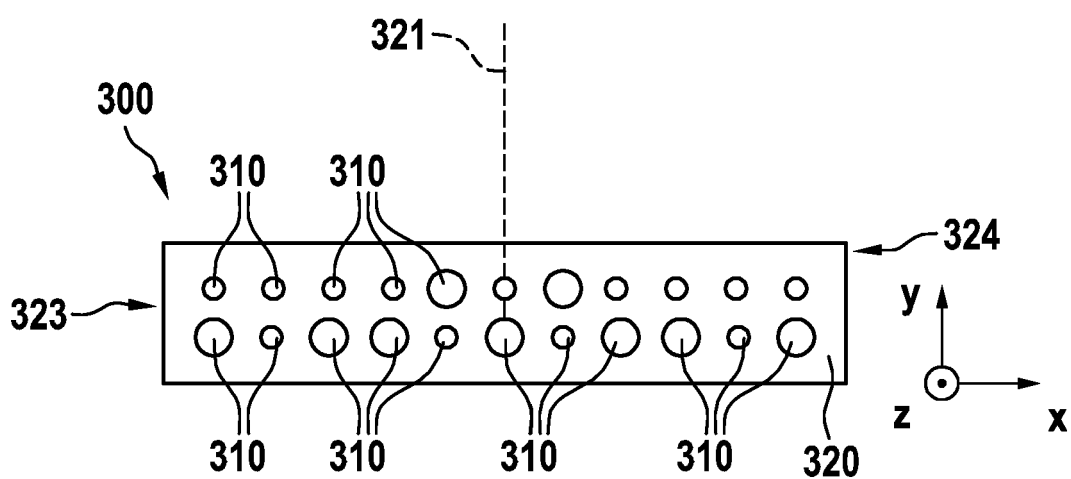


Fig. 4C

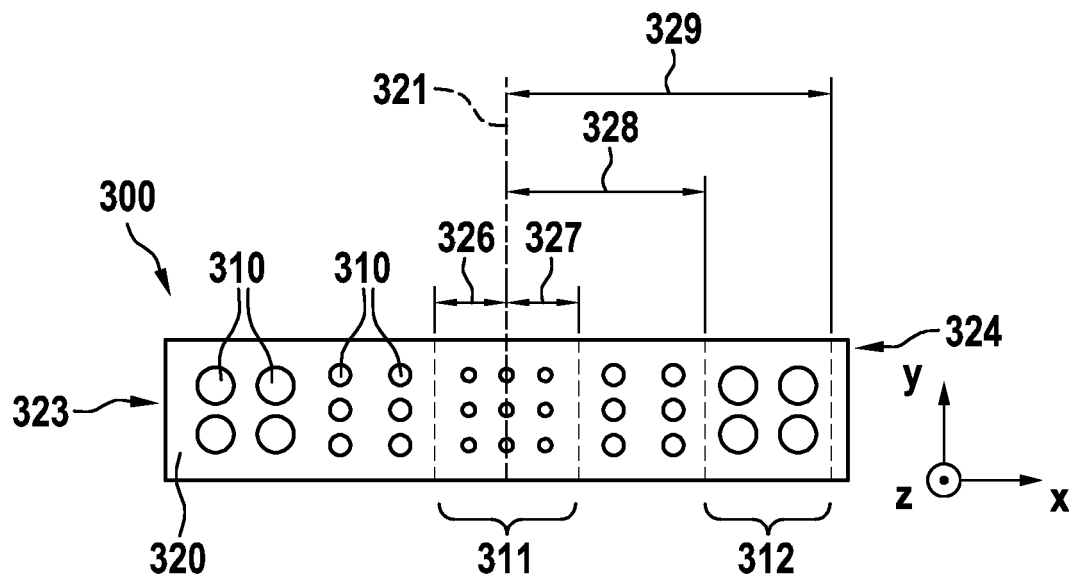


Fig. 4D

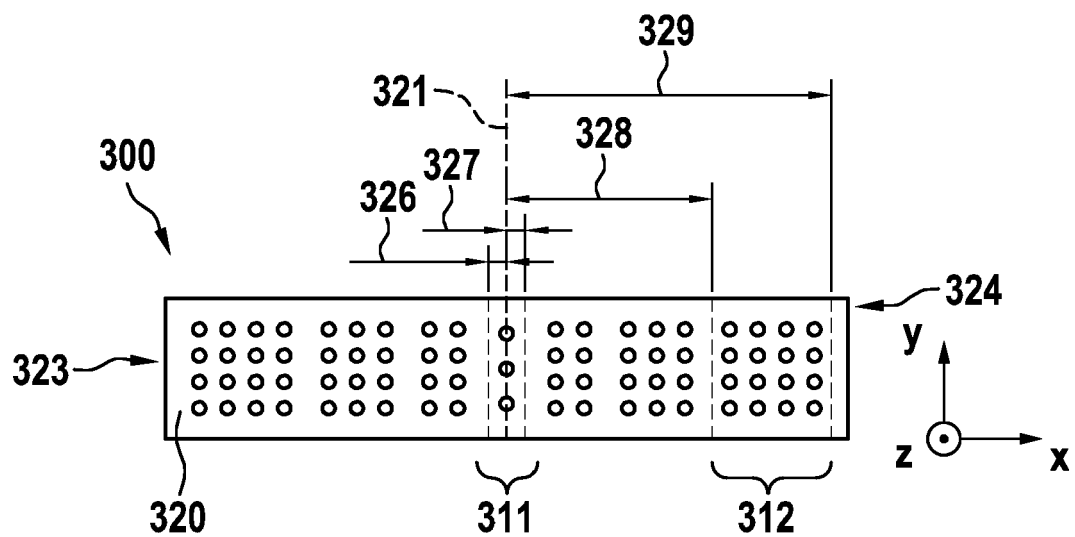
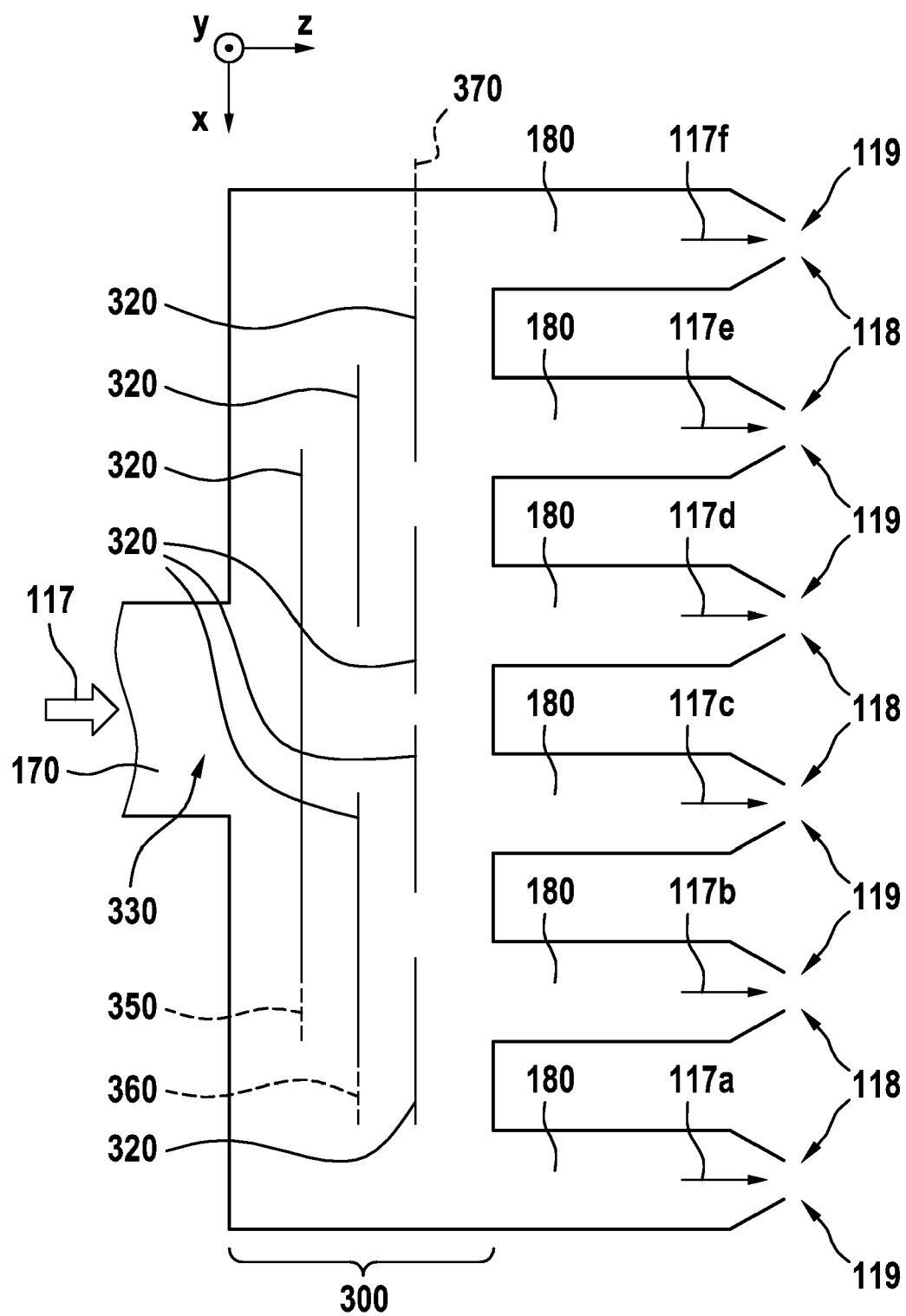


Fig. 5





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