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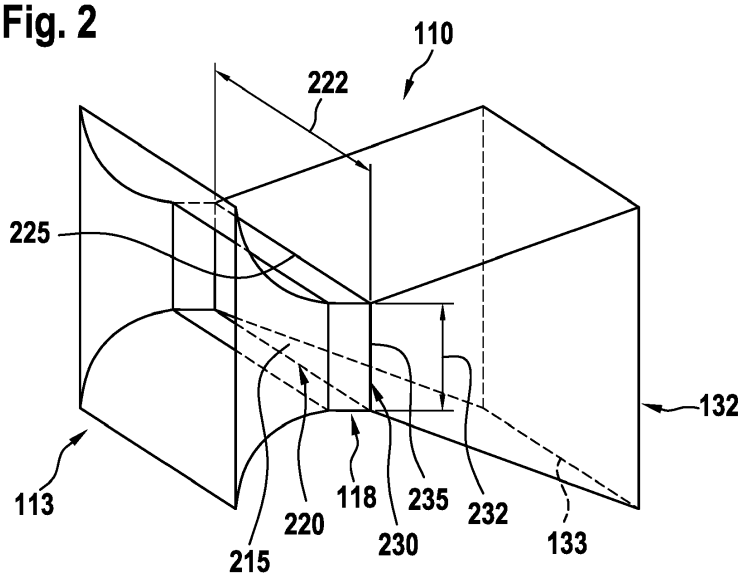
(54) **AN AIR-GAS MIXING UNIT FOR AN AIR-GAS MIXTURE BURNING APPLIANCE WITH A SLOT-SHAPED BURNING UNIT**

(57) In an air-gas mixing unit (110) for an air-gas mixture burning appliance (100) with a slot-shaped burning unit (120), the air-gas mixing unit (110) comprising an air inlet (113), a gas inlet (117) with at least one gas opening (515), an air-gas outlet (132) with a first slot-shaped cross-section (133), and an air-gas mixing section (118) for mixing air with gas to form a combustible air-gas mixture (130), the air-gas mixing section (118) having a second slot-shaped cross-section (215) upstream of the air-gas outlet (132) with a first side (220) that has a length (222) in a length direction (225) and a second side (230) that has a width (232) in a width direction (235), wherein the length (222) is at least 1.2 times the width (232), and wherein the at least one gas opening (515) is provided evenly distributed in the length direction (225) across the length (222).

Fig. 2



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Description

Background of the Invention

[0001] The present invention relates to an air-gas mixing unit for mixing of air from an air supply unit with gas from a gas supply unit to form a combustible air-gas mixture for an air-gas mixture burning appliance with a slot-shaped burning unit, wherein the air-gas mixing unit comprises an air inlet, a gas inlet, an air-gas outlet, and an air-gas mixing section for mixing the air with the gas to form the combustible air-gas mixture.

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

[0003] More specifically, known air-gas mixing units such as venturi mixers take in separate gas (fuel) and air (oxidizer) streams and provide a pre-mixed (or aerated) air-gas mixture for the burning unit at a desired concentration or ratio. A venturi mixer typically contains a converging channel in order to accelerate the air stream in order to create a decreased pressure in the throat of the mixing unit. This decreased pressure, which is sometimes also referred to as suction pressure, in the throat causes a suction effect on the gas stream, which causes the gas stream to flow into the air-gas mixing unit and mix with the air stream. The upstream side of the gas stream is usually controlled by a gas valve, which regulates the gas pressure relative to the air pressure measured at some location in the appliance. A venturi mixer usually has a circular cross-section perpendicular to the flow direction, while the cross-section of the burning unit is commonly rectangular or approximately rectangular.

[0004] In the remainder of this description, the term "gas" refers to 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. Moreover, the term "air" refers to any suitable oxidizer that may be mixed with a fuel gas to form a combustible air-gas mixture.

[0005] Document US 4,403,947 A describes a gas mixing line burner that includes an air/fuel manifold having a discharge face which causes combustion air jets to mix with fuel jets and form a main combustible mixture which is provided with a constant ignition source by virtue of stabilizing air jets interacting with the fuel jets and creating a secondary combustible mixture down the center of the main mixture.

[0006] Document JPH 09145024 A describes a flat square burner head with a vortex flow that is formed in an enclosed mixing chamber, whereby the vortex flow sufficiently mixes the fuel gas and the combustion air to perform combustion with a high load factor.

[0007] Document CN 211232873 U describes a rectangular venturi combustor structure, including nozzle and hybrid tube. However, the rectangular shape is not used for reducing the volume of combustible gas and reducing the run-up distance in the venturi mixer.

Summary of the Invention

[0008] The present invention relates to an air-gas mixing unit for mixing of air from an air supply unit with gas from a gas supply unit to form a combustible air-gas mixture for an air-gas mixture burning appliance with a slot-shaped burning unit, comprising an air inlet with at least one air opening for receiving the air from the air supply unit, a gas inlet with at least one gas opening for receiving the gas from the gas supply unit, an air-gas outlet with a first slot-shaped cross-section for providing the combustible air-gas mixture, and an air-gas mixing section for mixing the air with the gas to form the combustible air-gas mixture, wherein the air-gas mixing section has a second slot-shaped cross-section upstream of the air-gas outlet with a first side that has a length in a length direction and a second side that has a width in a width direction, wherein the length is at least 1.2 times the width, and wherein the at least one gas opening is provided evenly distributed in the length direction across the length.

[0009] Accordingly, the inventive air-gas mixing unit may align with the cross-section of the burning unit. As a result, the air-gas mixing unit may distribute the combustible air-gas mixture evenly across the burning unit. Moreover, the inventive air-gas mixing unit may reduce the volume of the combustible air-gas mixture upstream of the burning unit and thereby reduce the probability of a flame flashback event, which is an unintended ignition event upstream of the burning unit, or at least the severity of such an unintended ignition event, as the severity of such an event increases with an increased volume of combustible air-gas mixture upstream of the burning unit.

[0010] Preferably, the second slot-shaped cross-section of the air-gas mixing section has a shape of a rectangle, a stadium, a bow tie, an ellipse, or a hexagon.

[0011] Accordingly, the cross-section of the air-gas mixing section may be adapted to different shapes that the burning unit may have.

[0012] Optionally, the at least one gas opening comprises a single gas opening that extends along the entire length, and wherein the at least one air opening comprises two air openings that extend along the entire length on either side of the single gas opening.

[0013] Thus, the single gas opening and the two air openings have slot-like shapes and are suited to extrusion as a manufacturing technique, which reduces cost and complexity compared to conventional air-gas mixing units.

[0014] Optionally, the at least one air opening comprises a single air opening that extends along the entire length, and wherein the at least one gas opening comprises two gas openings that extend along the entire length on either side of the single air opening.

[0015] Thus, the single air opening and the two gas openings have slot-like shapes and are suited to extrusion as a manufacturing technique, which reduces cost and complexity compared to conventional air-gas mixing units.

[0016] Optionally, the at least one air opening comprises three air openings that extend along the entire length, and wherein the at least one gas opening comprises two gas openings that extend along the entire length, wherein the three air openings and the two gas openings are interleaved with each other.

[0017] Accordingly, the three air openings and the two gas openings have slot-like shapes and are suited to extrusion as a manufacturing technique, which reduces cost and complexity compared to conventional air-gas mixing units.

[0018] Optionally, at least one of the at least one gas opening is provided on the first side of the air-gas mixing section and arranged perpendicular to the at least one air opening such that the air-gas mixing section receives orthogonal flows of air and gas.

[0019] Thus, the orthogonal flows of air and gas provide for a precise air-gas mixture ratio.

[0020] Optionally, a single gas opening is provided on the first side of the air-gas mixing section and arranged perpendicular to the at least one air opening such that the air-gas mixing section receives orthogonal flows of air and gas.

[0021] Accordingly, the single gas opening may provide for a more homogenous gas concentration across the entire width of the air-gas mixing section.

[0022] Optionally, a plurality of gas openings is provided on the first side of the air-gas mixing section and arranged perpendicular to the at least one air opening such that the air-gas mixing section receives orthogonal flows of air and gas.

[0023] Accordingly, the plurality of gas openings may enable a more precise injection of gas into distinct portions of the airflow.

[0024] According to one embodiment, the air-gas mixing unit further comprises at least one divider that divides the air-gas mixing section into at least two sub-sections, wherein each sub-section of the at least two sub-sections is provided with an equal number of gas openings of the at least one gas opening.

[0025] Accordingly, the turbulent mixing rate between gas and air increases, and the mixing efficiency of the air-gas mixing unit increases. As a result, the air-gas mixing unit provides a more uniform combustible air-gas mixture to the burning unit.

[0026] Optionally, at least one of the at least one divider has a cross-section shape of a rectangle, an ellipse, an oval, or an air foil.

[0027] Accordingly, the cross-section shape can be selected to adjust for different requirements such as to minimize the pressure losses generated by the divider.

[0028] Optionally, the at least one divider is hollow.

[0029] Accordingly, a hollow divider provides a fluid passage from one side of the slot-shaped air-gas mixing unit to the other.

[0030] Optionally, the at least one divider extends from the air inlet to the air-gas outlet.

[0031] Thus, the divider may allow manufacturing limitations, and/or constraints, and/or tolerances to be relaxed, thereby reducing the complexity and cost of the air-gas mixing unit.

[0032] Optionally, the at least one divider extends from the air inlet to a point part-way between the air-gas mixing section and the air-gas outlet.

[0033] Accordingly, the at least one divider may enable a more homogenous mixing between divider sections.

[0034] Advantageously, the at least one divider is removable or interchangeable.

[0035] Accordingly, the air-gas mixing unit provides more flexibility and can be adjusted to different burning units.

[0036] According to one embodiment, the air inlet further comprises at least one bluff body that is arranged at least partly upstream of the air-gas mixing section. Thus, the distribution of the air across different gas openings may be fine-tuned to adjust for a more efficient suction effect on the gas.

[0037] Preferably, the at least one bluff body extends in a width direction such that the air inlet is partially divided into a plurality of sub-sections that remain fluidically connected.

[0038] Thus, a more homogenous air-gas mixture upstream of the burning unit may be achieved.

[0039] Furthermore, the present invention relates to an air-gas mixture burning appliance comprising an air supply unit, a gas supply unit, a slot-shaped burning unit, and the air-gas mixing unit described above.

[0040] Accordingly, an air-gas mixture burning appliance with aligned slot-shaped burning unit and air-gas mixing unit may be realized.

Brief Description of the Drawings

[0041] 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 air-gas mixture burning appliance according to the present invention,

Fig. 2 shows a schematic view of an air-gas mixing unit with an air-gas mixing section that has a slot-shaped cross-section according to the present invention,

Fig. 3 shows a schematic view of the air-gas mixing

unit of Fig. 2 over a slotshaped burning unit according to the present invention,

Fig. 4A shows a schematic view of the air-gas mixing unit of Fig. 2 with a rectangular-shaped cross-section according to the present invention,

Fig. 4B shows a schematic view of the air-gas mixing unit of Fig. 2 with a stadium-shaped cross-section according to the present invention,

Fig. 4C shows a schematic view of the air-gas mixing unit of Fig. 2 with a hexagon-shaped cross-section according to the present invention,

Fig. 4D shows a schematic view of the air-gas mixing unit of Fig. 2 with a bow tie-shaped cross-section according to the present invention,

Fig. 5A shows a schematic view of a length-wise cross-section of an air-gas mixing unit with two air openings and one gas opening according to the present invention,

Fig. 5B shows a schematic view of a length-wise cross-section of an air-gas mixing unit with one air opening and one gas opening according to the present invention,

Fig. 5C shows a schematic view of a length-wise cross-section of an air-gas mixing unit with one air opening and two gas openings according to the present invention,

Fig. 5D shows a schematic view of a length-wise cross-section of an air-gas mixing unit with three air openings and two gas openings according to the present invention,

Fig. 6A shows a schematic view of a length-wise cross-section of an air-gas mixing unit with one air opening and one orthogonal gas opening according to the present invention,

Fig. 6B shows a schematic view of a length-wise cross-section of an air-gas mixing unit with one air opening and four orthogonal gas openings according to the present invention,

Fig. 6C shows a schematic view of a length-wise cross-section of an air-gas mixing unit with one air opening and two bluff bodies and four orthogonal gas openings according to the present invention,

Fig. 7A shows a schematic top view of an air-gas mixing unit without a divider according to the present invention,

Fig. 7B shows a schematic top view of an air-gas mixing unit with a divider according to the present invention,

Fig. 8A shows a schematic top view and cross-section of an air-gas mixing unit with a divider that has a rectangular cross-section shape according to the present invention,

Fig. 8B shows a schematic top view and cross-section of an air-gas mixing unit with a divider that has a cross-section shape of an air foil according to the present invention,

Fig. 8C shows a schematic top view and cross-section of an air-gas mixing unit with a divider that has an elliptical cross-section shape according to the present invention, and

Fig. 8D shows a schematic top view and cross-section of an air-gas mixing unit with a hollow divider that has a rectangular cross-section shape according to the present invention.

Detailed Description

[0042] Fig. 1 shows an exemplary air-gas mixture burning appliance 100 with an air-gas mixing unit 110 and a burning unit 120. 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.

[0043] Illustratively, the air-gas mixture burning appliance 100 may include an air supply unit 112 and a gas supply unit 116. If desired, the air supply unit 112 may include a fan 114 that may be operated with an adaptable fan speed and/or within predetermined ranges of fan speeds to provide air to the air-gas mixing unit 110.

[0044] 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.

[0045] By way of example, the air-gas mixing unit 110 includes an air inlet 113 that receives air from the air supply unit 112 and a gas inlet 117 that receives gas from the gas supply unit 116. The air inlet 113 has at least one air opening 115.

[0046] The air supply unit 112 and the gas supply unit 116 may be interconnected via an air-gas mixing section 118. Preferably, the combustible air-gas mixture 130 is formed in the air-gas mixing section 118 from where the combustible air-gas mixture 130 is provided via the air-gas outlet 132 to the burning unit 120. The air-gas outlet 132 may have a slot-shaped cross-section 133.

[0047] 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 in the air-gas mixing section 118 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. By way of example, the burner surface 124 is illustrated with a flame 122 that is stabilised against the burner surface 124.

[0048] Fig. 2 shows a schematic view of an air-gas mixing unit 110 with an air-gas mixing section 118 that has a slot-shaped cross-section 215. The air-gas mixing unit 110 may include an air inlet 113 for receiving air, a gas inlet for receiving gas, an air-gas outlet 132 with a first slot-shaped cross-section 133 for providing a combustible air-gas mixture, and an air-gas mixing section 118 for mixing the air with the gas to form the combustible air-gas mixture.

[0049] Illustratively, the air-gas mixing section 118 has a second slot-shaped cross-section 215 upstream of the air-gas outlet 132. The slot-shaped cross-section 215 has a first side 220 that has a length 222 in a length direction 225 and a second side 230 that has a width 232 in a width direction 235. The length 222 is at least 1.2 times the width 232 (i.e., the length 222 is greater than or equal to 1.2 times the width 232). If desired, the length 222 is smaller than or equal to 4 times the width 232. Preferably, the length 222 is greater than or equal to 2.5 times the width 232 and smaller than or equal to 3.5 times the width 232. If desired, the gas inlet may include at least one gas opening that is provided evenly distributed in the length direction 225 across the length 222.

[0050] Fig. 3 shows a schematic view of the air-gas mixing unit 110 of Fig. 2 over a slot-shaped burning unit 120. If desired, the slot-shaped cross-section 133 of the air-gas outlet 132 may be selected to have the same dimensions as the slot-shaped cross-section of the burning unit 120. Thus, the air-gas outlet 132 of the air-gas mixing unit 110 may be aligned with the burning unit 120 such that the combustible air-gas mixture is provided evenly distributed across the burner surface of the burning unit 120.

[0051] Illustratively, the slot-shaped cross-section 215 of the air-gas mixing section 118 may be selected to have the same shape as the slot-shaped cross-section 133 of the air-gas outlet 132, albeit with smaller dimensions. For example, the slot-shaped cross-section 215 of the air-gas mixing section 118 may have the shape of a rectangle, a stadium, a bow tie, an ellipse, or a hexagon.

[0052] Fig. 4A shows a schematic view of the air-gas mixing unit 110 of Fig. 2 with an air-gas mixing section 118 that has a rectangular-shaped cross-section 215.

[0053] Fig. 4B shows a schematic view of the air-gas mixing unit 110 of Fig. 2 with an air-gas mixing section 118 that has a stadium-shaped cross-section 215. Illustratively, the overall length of the stadium shape may define the length 222 in length direction 225 and the height of the stadium shape the width 232 in width direction 235 of the stadium-shaped cross-section 215.

[0054] Fig. 4C shows a schematic view of the air-gas mixing unit 110 of Fig. 2 with an air-gas mixing section 118 that has a hexagon-shaped cross-section 215. Exemplarily, the hexagon shape may be made of two isosceles trapezoids that are mirrored on the long edge. The long edge and the short edge may differ by less than 40%. Preferably, the long edge and the short edge differ by less than 20%. Illustratively, the long edge may define the width 232 in width direction 235 of the hexagon-shaped cross-section 215.

[0055] Fig. 4D shows a schematic view of the air-gas mixing unit 110 of Fig. 2 with an air-gas mixing section 118 that has a bow tie-shaped cross-section 215. Exemplarily, the bow tie shape may be made of two isosceles trapezoids that are mirrored on the short edge. The long edge and the short edge may differ by less than 40%. Preferably, the long edge and the short edge differ by less than 20%. Illustratively, the long edge may define the width 232 in width direction 235 of the bow tie-shaped cross-section 215.

[0056] Illustratively, the air-gas mixing unit 110 may include an air inlet with at least one air opening and a gas inlet with at least one gas openings that are both slot-shaped. Fig. 5A to 5D show examples of air-gas mixing units 110 with slot-shaped air and gas openings.

[0057] Fig. 5A shows a schematic view of a lengthwise cross-section of an air-gas mixing unit 110 comprising an air inlet 113 with at least one air opening 115 and a gas inlet 117 with at least one gas opening 515. As shown in Fig. 5A, the air inlet 113 includes two air openings 115 and the gas inlet 117 comprises a single gas opening 515. The single gas opening 515 and the two air openings 115 may extend along the entire length of the slot-shaped cross-section, whereby the two air openings 115 may be arranged on either side of the single gas opening 515.

[0058] Fig. 5B shows a schematic view of a lengthwise cross-section of an air-gas mixing unit 110, in which the air inlet 113 with the at least one air opening 115 includes one air opening 115 and the gas inlet 117 with the at least one gas opening 515 includes one gas opening 515. The gas opening 515 and the air opening 115 may extend along the entire length of the slot-shaped cross-section.

[0059] Fig. 5C shows a schematic view of a lengthwise cross-section of an air-gas mixing unit 110, in which the air inlet 113 with the at least one air opening 115 includes a single air opening 115 and the gas inlet 117 with the at least one gas opening 515 includes two gas openings 515. The single air opening 115 and the two gas openings 515 may extend along the entire length of the slot-shaped cross-section, whereby the two gas openings 515 may be arranged on either side of the single air opening 115.

[0060] Fig. 5D shows a schematic view of a lengthwise cross-section of an air-gas mixing unit 110, in which the air inlet 113 with the at least one air opening 115 includes three air openings 115 and the gas inlet 117

with the at least one gas opening 515 includes two gas openings 515. The three air openings 115 and the two gas openings 515 may extend along the entire length of the slot-shaped cross-section, whereby the three air openings 115 and the two gas openings 515 may be interleaved with each other.

[0061] If desired, a different number of air openings 115 and/or gas openings 515 may be selected. For example, the number of gas openings may be greater than two and/or the number of air openings may be greater than three. Preferably, the number of gas openings may be selected to be smaller than the air openings as manufacturing tolerances are more relevant for the gas openings.

[0062] Illustratively, the at least one gas opening 515 may be provided on the length side of the air-gas mixing section 118 and arranged perpendicular to the at least one air opening 115 such that the air-gas mixing section 118 receives orthogonal flows of air and gas.

[0063] Fig. 6A shows a schematic view of a lengthwise cross-section of an air-gas mixing unit 110 with one air opening 115 and one orthogonal gas opening 515. As shown in Fig. 6A, the gas opening 515 may be a single gas opening 515. The single gas opening 515 may be provided on the length side of the air-gas mixing section 118 and arranged perpendicular to the air opening 115. Thus, the air-gas mixing section 118 may receive orthogonal flows of air and gas. If desired, the single gas opening 515 may be slot-shaped.

[0064] Fig. 6B shows a schematic view of a lengthwise cross-section of an air-gas mixing unit 110 with one air opening 115 and a plurality of orthogonal gas opening 515. As shown in Fig. 6A, the plurality of gas openings 515 may include four gas openings 515. The plurality of gas openings 515 may include a different number of gas openings 515. For example, the plurality of gas openings 515 may include two, three, five, six, seven, eight, etc. gas openings.

[0065] The four gas openings 515 may be provided evenly distributed on the length side of the air-gas mixing section 118 and arranged perpendicular to the air opening 115. Thus, the air-gas mixing section 118 may receive orthogonal flows of air and gas. If desired, the four gas openings 515 may be punctiform-shaped.

[0066] Illustratively, the air inlet 113 may include at least one bluff body that is arranged at least partly upstream of the air-gas mixing section 118. Fig. 6C shows a schematic view of the air-gas mixing unit 110 of Fig. 6B with two bluff bodies 610 that are arranged upstream of the air-gas mixing section 118.

[0067] As shown in Figure 6C, the bluff bodies 610 extend partially in width direction of the air inlet 113 upstream of the slot-shaped air-gas mixing section 118. If desired, the at least one of the bluff bodies 610 may extend in width direction such that the air inlet 113 is partially divided into a plurality of sub-sections that remain fluidically connected.

[0068] Fig. 7A shows a schematic top view of an air-gas mixing unit 110 with an air-gas mixing section 118 with a stadium-shaped cross-section in which the overall length of the stadium shape may define the length 222 and the height of the stadium shape the width 232 of the stadium-shaped cross-section. If desired, at least one divider may divide the air-gas mixing section 118 into at least two sub-sections.

[0069] Fig. 7B shows a schematic top view of an air-gas mixing unit 110 with an air-gas mixing section 118 with a divider 750 that divides the air-gas mixing section 118 into two sub-sections 720. Preferably, the divider 750 divides the air-gas mixing section 118 into equal sized sub-sections 720. For example, the divider 750 may be located in the middle of the length dimension of the air-gas mixing unit 110.

[0070] Illustratively, each sub-section 720 of the at least two sub-sections 720 is provided with an equal number of gas openings 515. If desired, the divider 750 may be removable or interchangeable.

[0071] The divider 750 may allow for an increase of the width 232 of the air-gas mixing section 118 while maintaining the same cross-sectional area. As a result, manufacturing limitations, constraints, and/or tolerances may be relaxed, which may reduce the cost of manufacturing of the air-gas mixing unit 110. Moreover, the hydraulic diameter of each sub-section 720 increases with respect to the slot-shaped cross-section without divider 750 shown in Fig. 7A. As a result, the Reynolds number increases, the turbulent mixing rate between the gas and the air increases, and the mixing efficiency of the air-gas mixing unit 110 increases. As a result, the air-gas mixing unit 110 provides a more uniform combustible air-gas mixture to the burning unit. Alternatively, the streamwise depth of the air-gas mixing unit 110 may be reduced.

[0072] The at least one divider 750 may have different cross-section shapes. For example, the at least one divider 750 may have a cross-section shape of a rectangle, an ellipse, an oval, or an air foil.

[0073] Fig. 8A shows a schematic top view and cross-section of an air-gas mixing unit 110 with a divider 750 that has a cross-section shape of a rectangle 752. As shown in Figure 8A, the divider 750 divides the air-gas mixing section 118 into two sub-sections 720, each of which is provided with two gas openings 515.

[0074] Thus, each sub-section 720 of the two sub-sections 720 is provided with an equal number of gas openings 515.

[0075] Fig. 8B shows a schematic top view and cross-section of an air-gas mixing unit 110 with a divider 750 that has a cross-section shape of an air foil 754. As shown in Figure 8B, the divider 750 divides the air-gas mixing section 118 into two sub-sections 720, each of which is provided with two gas openings 515.

[0076] Illustratively, the dividers 750 of Fig. 8A and Fig. 8B extend from the air inlet to the air-gas outlet. If desired, the divider 750 may extend from the air inlet to a point part-way between the air-gas mixing section 118 and the air-gas outlet.

[0077] Fig. 8C shows a schematic top view and cross-section of an air-gas mixing unit 110 with a divider that has a cross-section shape of an ellipse 756. As shown in Figure 8C, the divider 750 divides the air-gas mixing section 118 into two sub-sections 720, each of which is provided with two gas openings 515. Illustratively, the divider 750 may extend from the air inlet to a point part-way between the air-gas mixing section 118 and the air-gas outlet.

[0078] Fig. 8D shows a schematic top view and cross-section of an air-gas mixing unit 110 with a hollow divider 758 that has a rectangular cross-section shape 752. Illustratively, the hollow divider 758 may provide a fluid passage from one side of the slot-shaped air-gas mixing unit 110 to the other.

[0079] It should be noted that the shape and extensions of the dividers 750 of the air-gas mixing units 110 of Fig. 8A to Fig. 8D are only cited by way of example, and not for limiting the invention accordingly. Instead, combining different cross-section shapes with different extensions and/or hollow structures are likewise contemplated, such as e.g. combining a hollow divider with the cross-section shape of an air foil and an extension from the air inlet to a point part-way between the air-gas mixing section 118 and the air-gas outlet.

Claims

1. An air-gas mixing unit (110) for mixing of air from an air supply unit (112) with gas from a gas supply unit (116) to form a combustible air-gas mixture (130) for an air-gas mixture burning appliance (100) with a slot-shaped burning unit (120), comprising:

   an air inlet (113) with at least one air opening (115) for receiving the air from the air supply unit (112);
   a gas inlet (117) with at least one gas opening (515) for receiving the gas from the gas supply unit (116);
   an air-gas outlet (132) with a first slot-shaped cross-section (133) for providing the combustible air-gas mixture (130); and
   an air-gas mixing section (118) for mixing the air with the gas to form the combustible air-gas mixture (130), wherein the air-gas mixing section (118) has a second slot-shaped cross-section (215) upstream of the air-gas outlet (132) with a first side (220) that has a length (222) in a length direction (225) and a second side (230) that has a width (232) in a width direction (235), wherein the length (222) is at least 1.2 times the width (232), and wherein the at least one gas opening (515) is provided evenly distributed in the length direction (225) across the length (222).

2. The air-gas mixing unit of claim 1, wherein the second slot-shaped cross-section (215) of the air-gas mixing section (118) has a shape of a rectangle, a stadium, a bow tie, an ellipse, or a hexagon.

3. The air-gas mixing unit of claim 1 or 2, wherein the at least one gas opening (515) comprises a single gas opening (515) that extends along the entire length (222), and wherein the at least one air opening (115) comprises two air openings (115) that extend along the entire length (222) on either side of the single gas opening (515).

4. The air-gas mixing unit of claim 1 or 2, wherein the at least one air opening (115) comprises a single air opening (115) that extends along the entire length (222), and wherein the at least one gas opening (515) comprises two gas openings (515) that extend along the entire length (222) on either side of the single air opening (115).

5. The air-gas mixing unit of claim 1 or 2, wherein the at least one air opening (115) comprises three air openings (115) that extend along the entire length (222), and wherein the at least one gas opening (515) comprises two gas openings (515) that extend along the entire length (222), wherein the three air openings (115) and the two gas openings (515) are interleaved with each other.

6. The air-gas mixing unit of claim 1 or 2, wherein at least one of the at least one gas opening (515) is provided on the first side (220) of the air-gas mixing section (118) and arranged perpendicular to the at least one air opening (115) such that the air-gas mixing section (118) receives orthogonal flows of air and gas.

7. The air-gas mixing unit of claim 6, further comprising: at least one divider (750) that divides the air-gas mixing section (118) into at least two sub-sections (720), wherein each sub-section (720) of the at least two sub-sections (720) is provided with an equal number of gas openings (515) of the at least one gas opening (515).

8. The air-gas mixing unit of claim 7, wherein at least one of the at least one divider (750) has a cross-section shape of a rectangle (752), an ellipse (756), an oval, or an air foil (754).

9. The air-gas mixing unit of claim 7 or 8, wherein the at least one divider (750) is hollow (758).

10. The air-gas mixing unit of any one of the preceding claims, wherein the air inlet (113) further comprises: at least one bluff body (610) that is arranged at least partly upstream of the air-gas mixing section (118).

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

an air supply unit (112);
a gas supply unit (116);
a slot-shaped burning unit (120); and
the air-gas mixing unit (110) of any one of the preceding claims.

Fig. 1

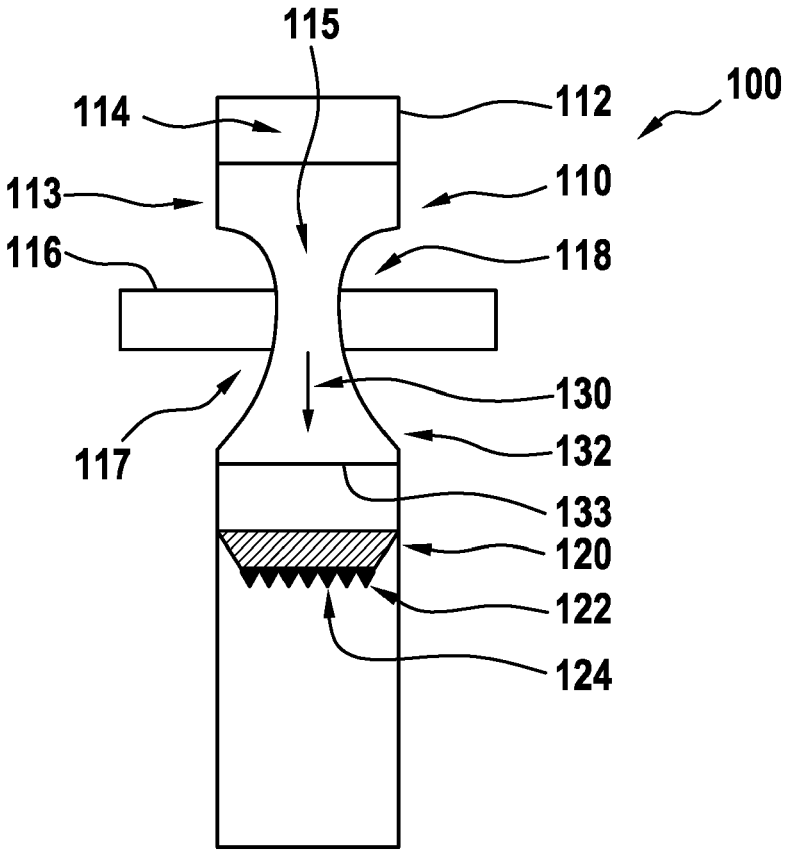

Fig. 2

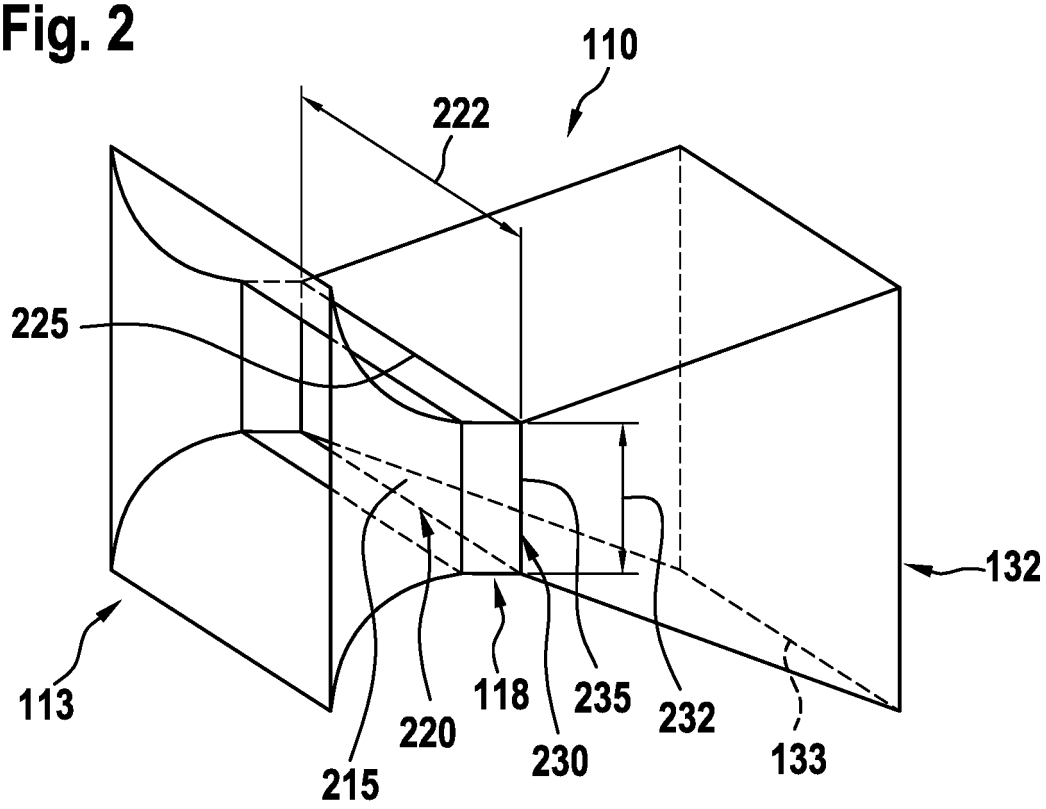
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Fig. 3

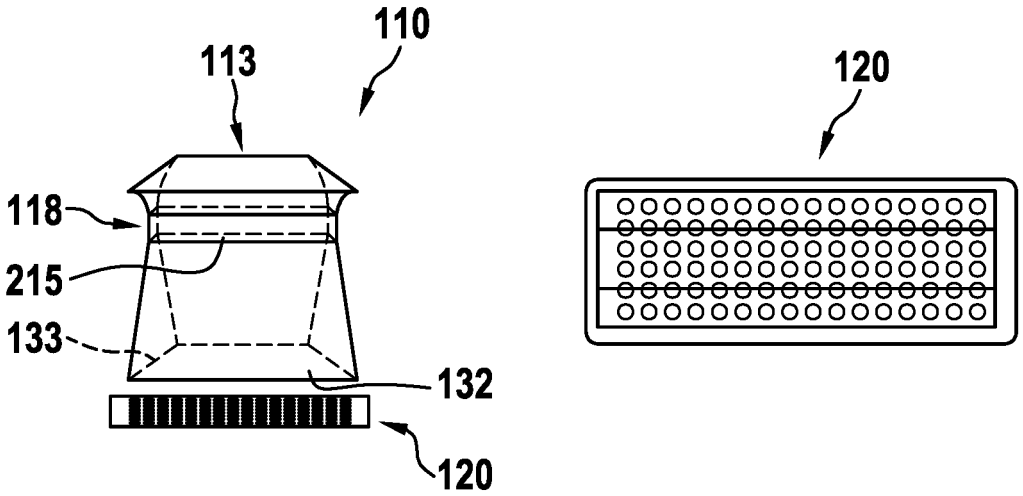
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Fig. 4A

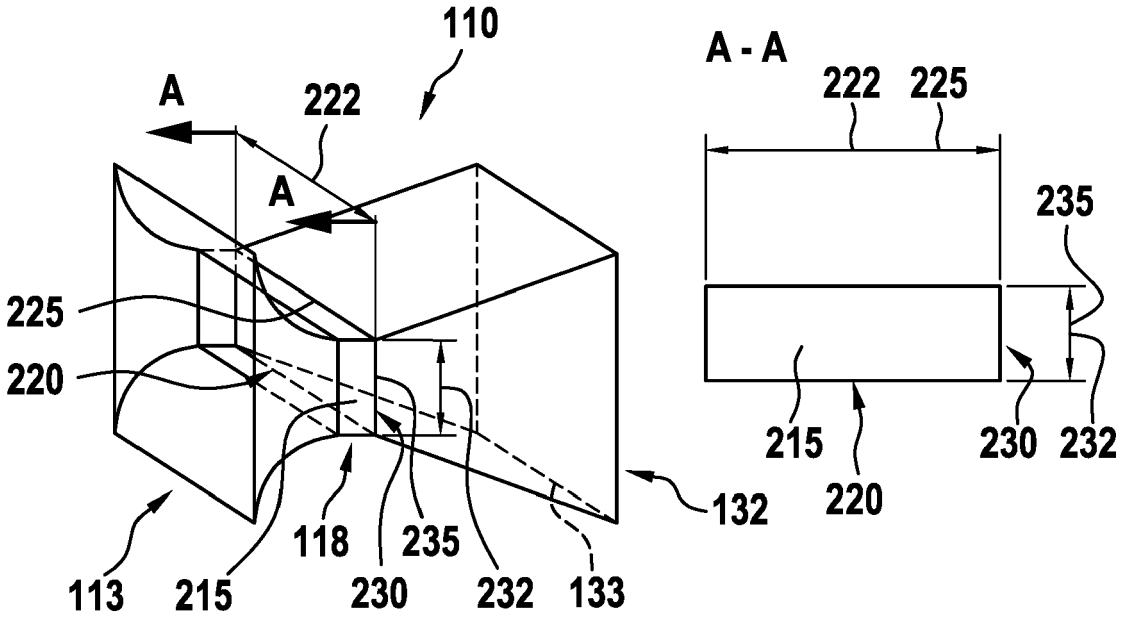
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Fig. 4B

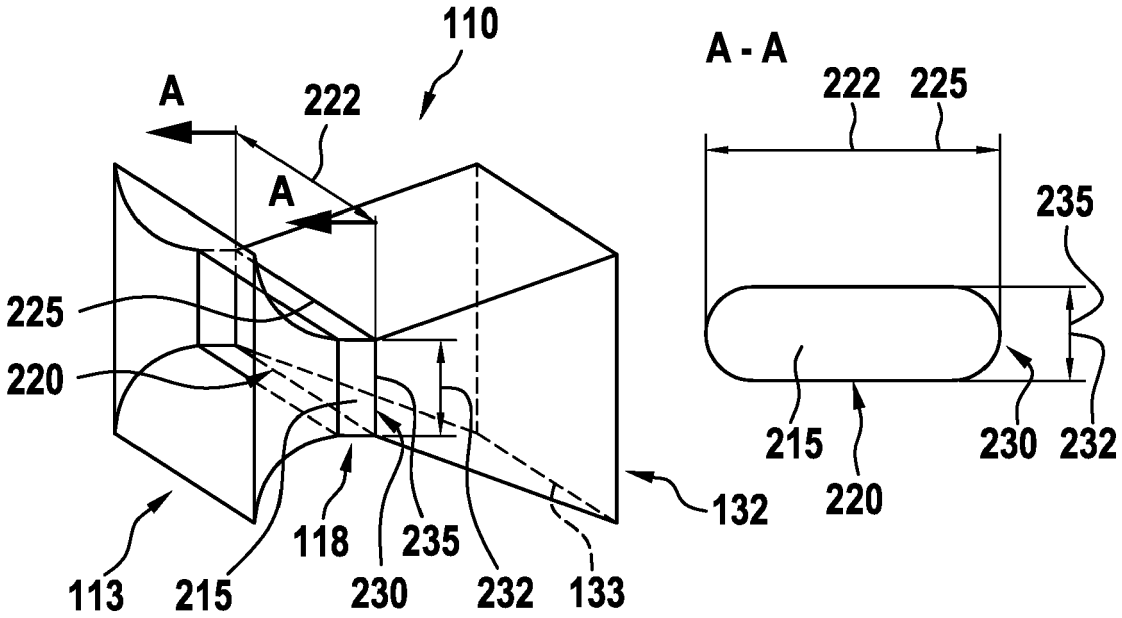
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Fig. 4C

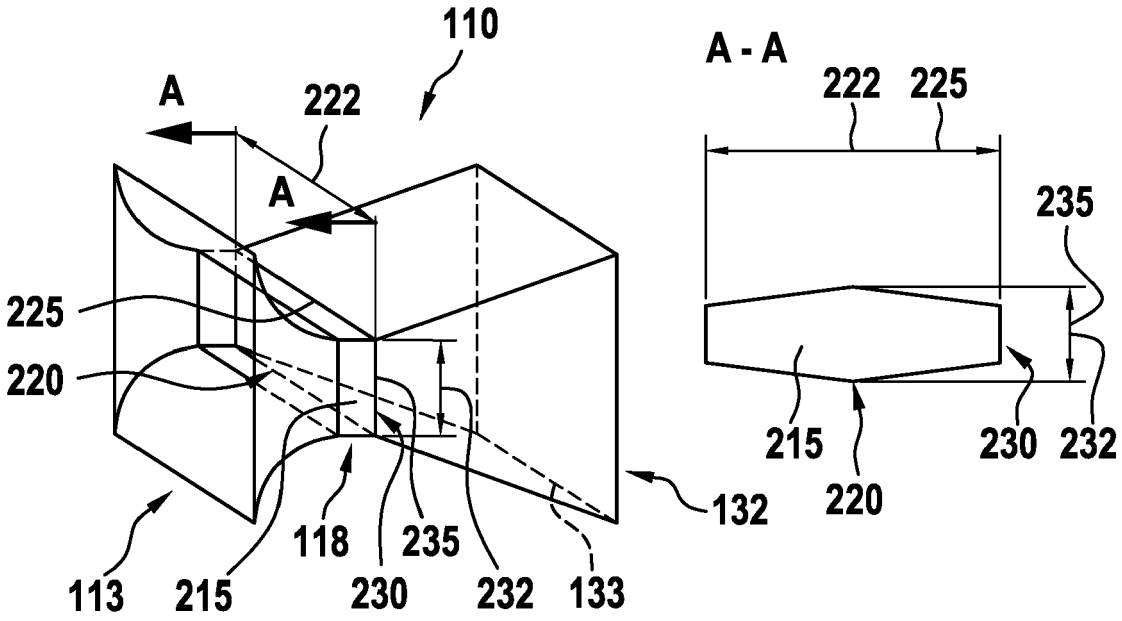
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Fig. 4D

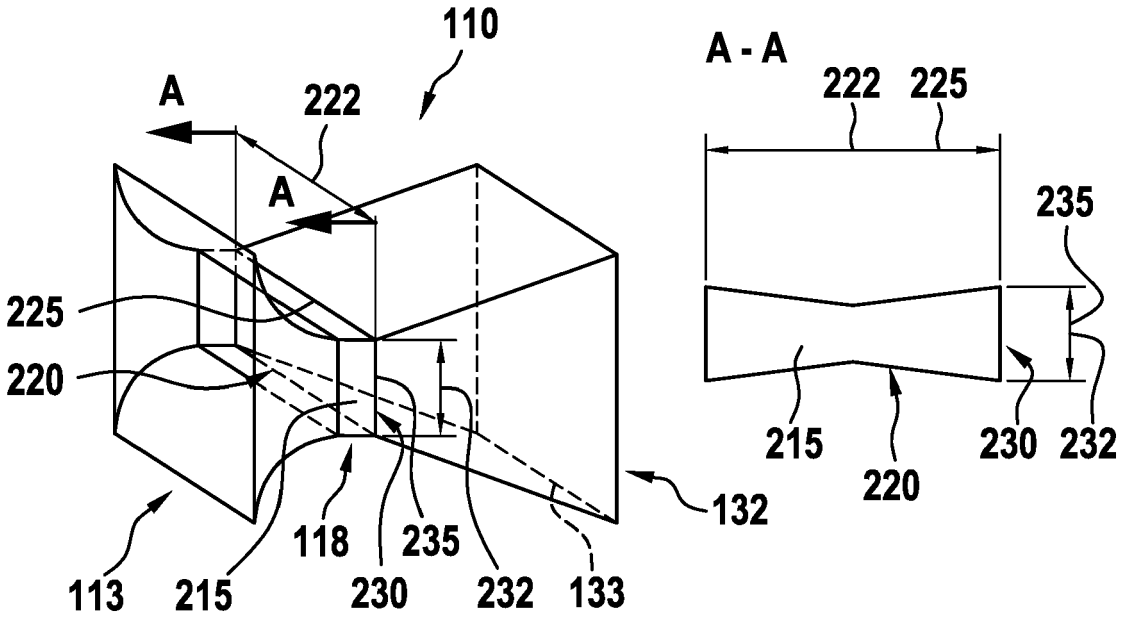
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Fig. 5A

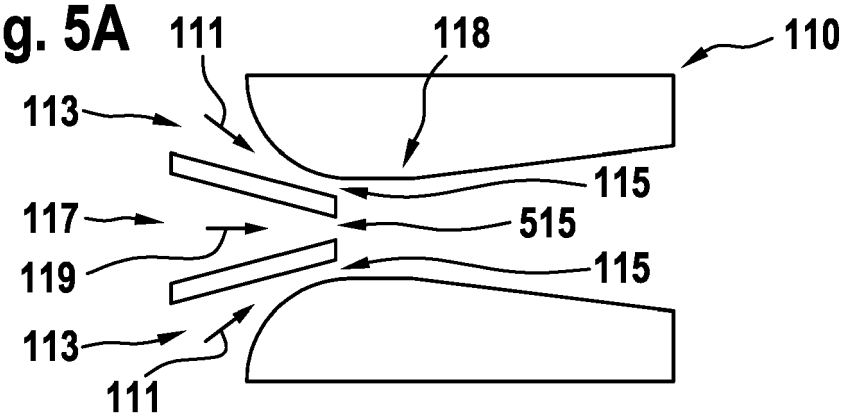

Fig. 5B

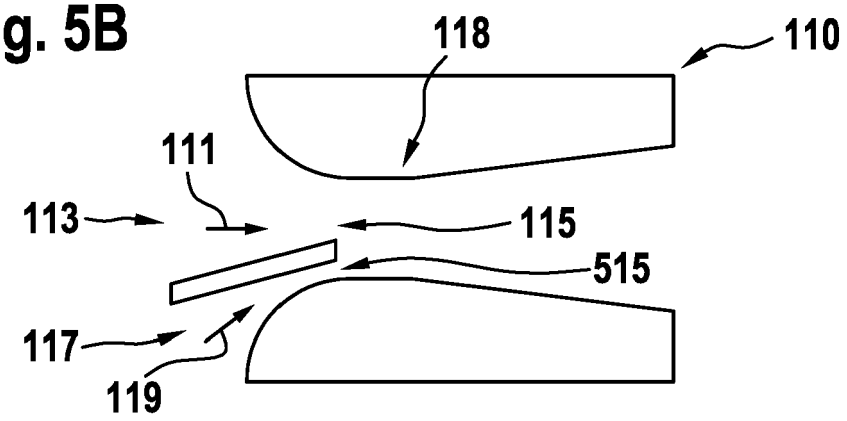

Fig. 5C

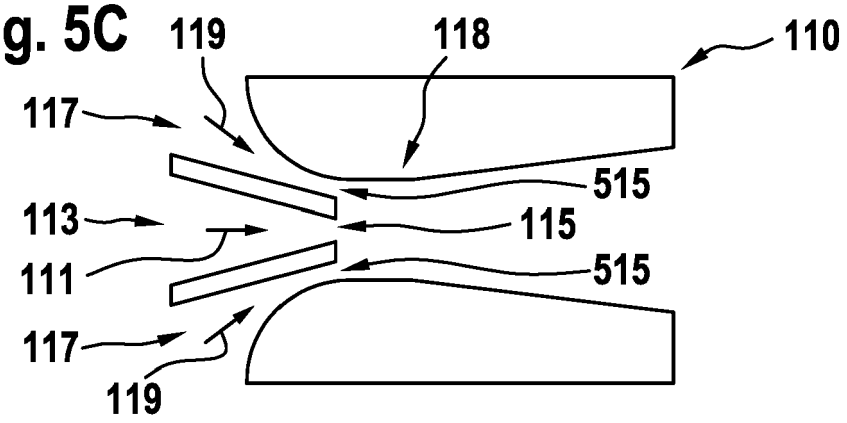

Fig. 5D

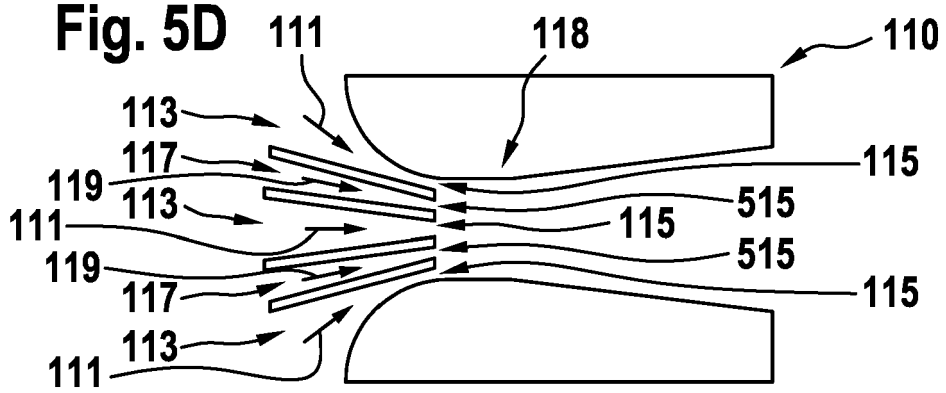

Fig. 6A

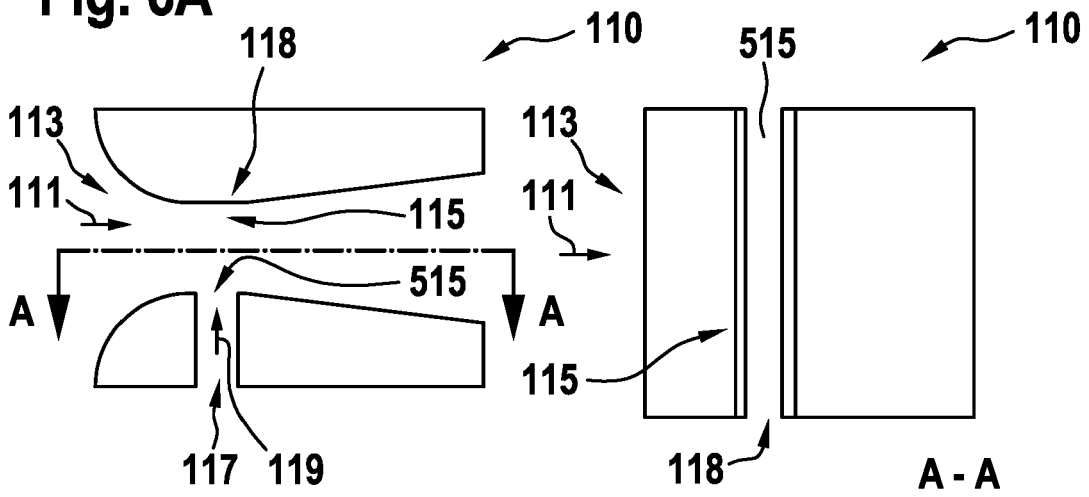

Fig. 6B

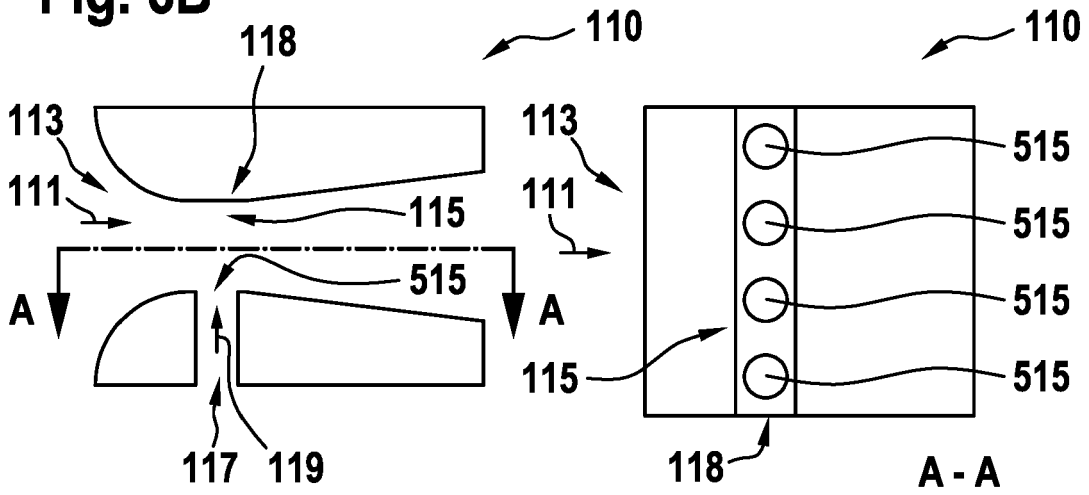

Fig. 6C

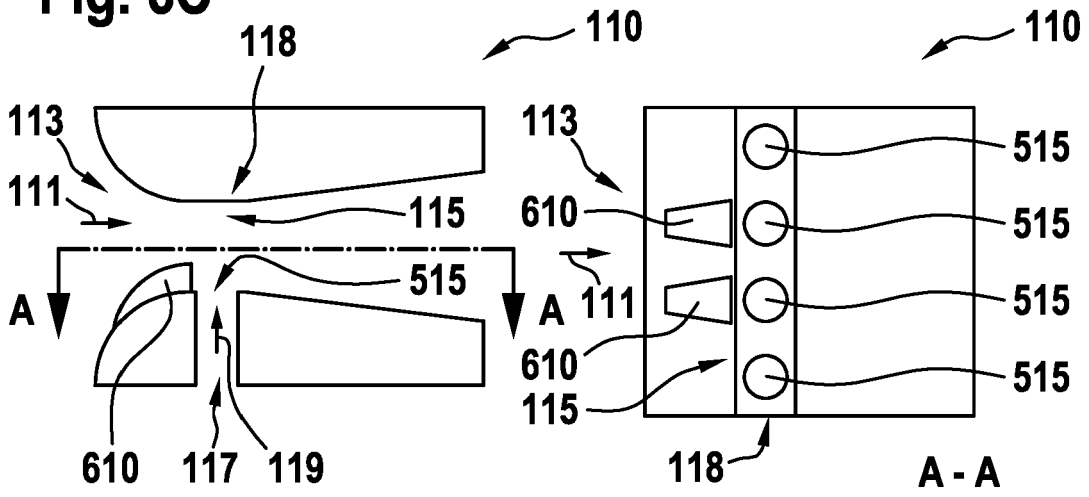

Fig. 7A

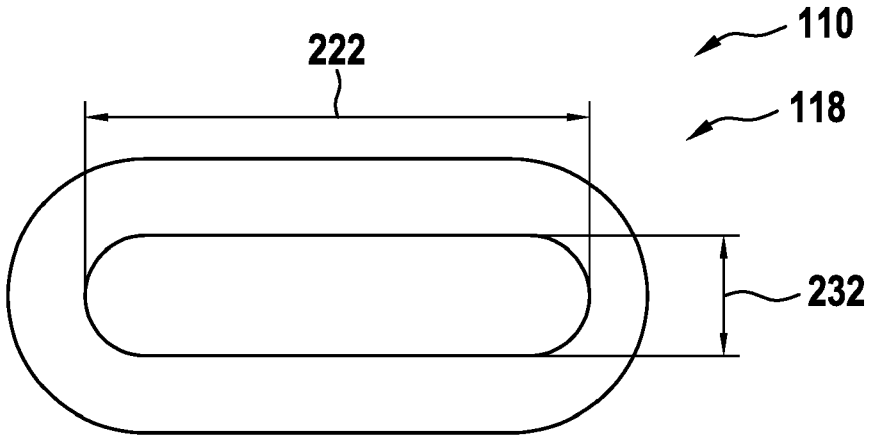

Fig. 7B

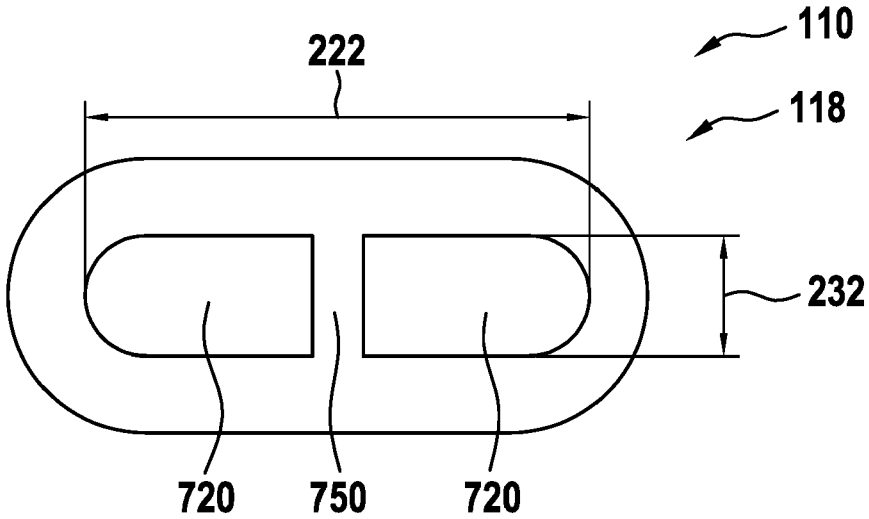

Fig. 8A

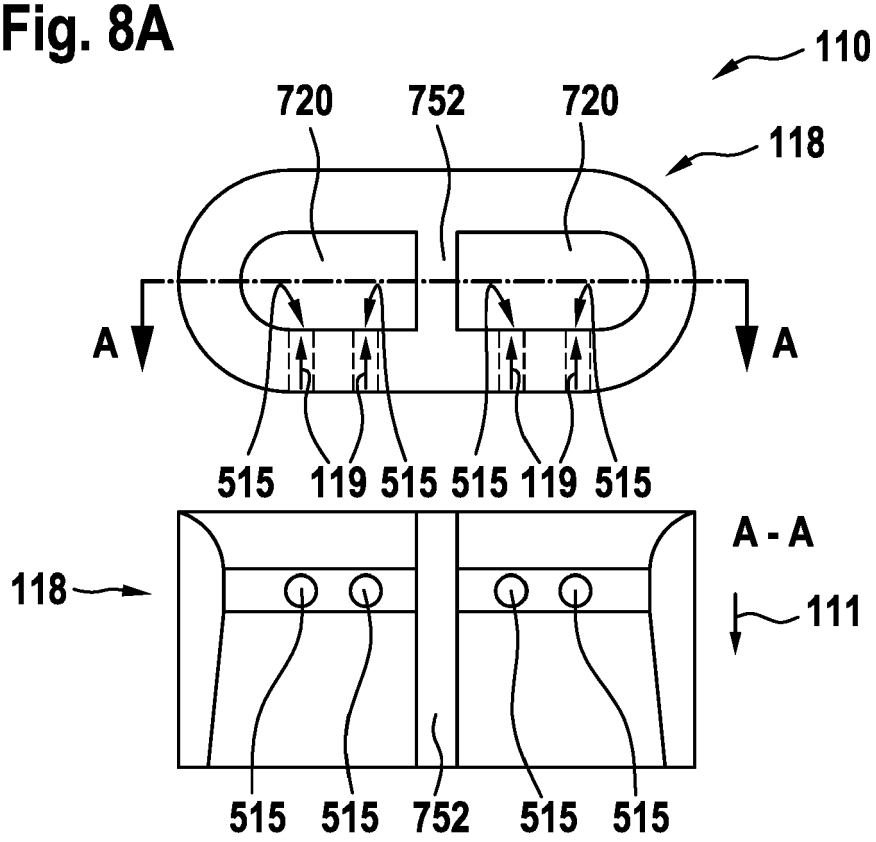
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Fig. 8B

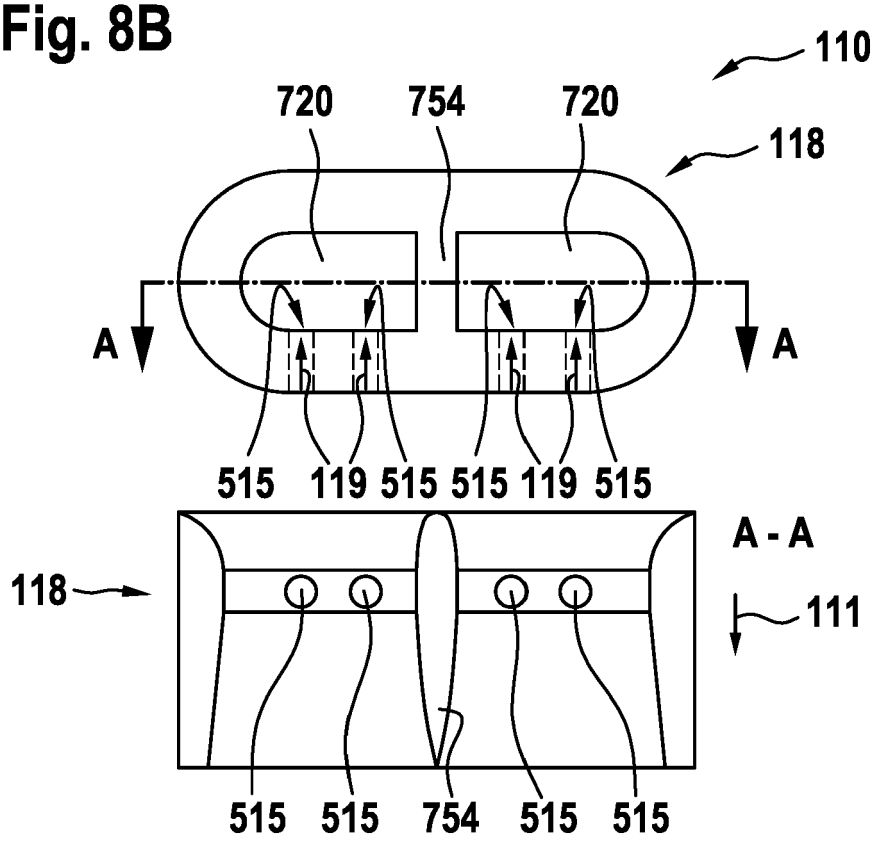
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Fig. 8C

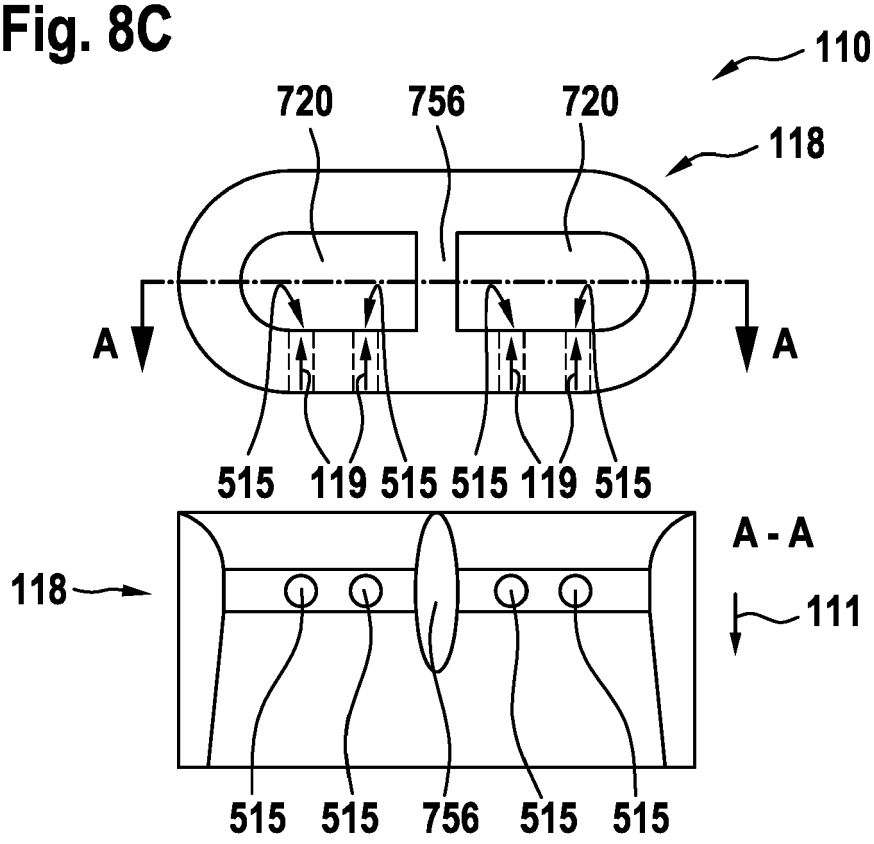
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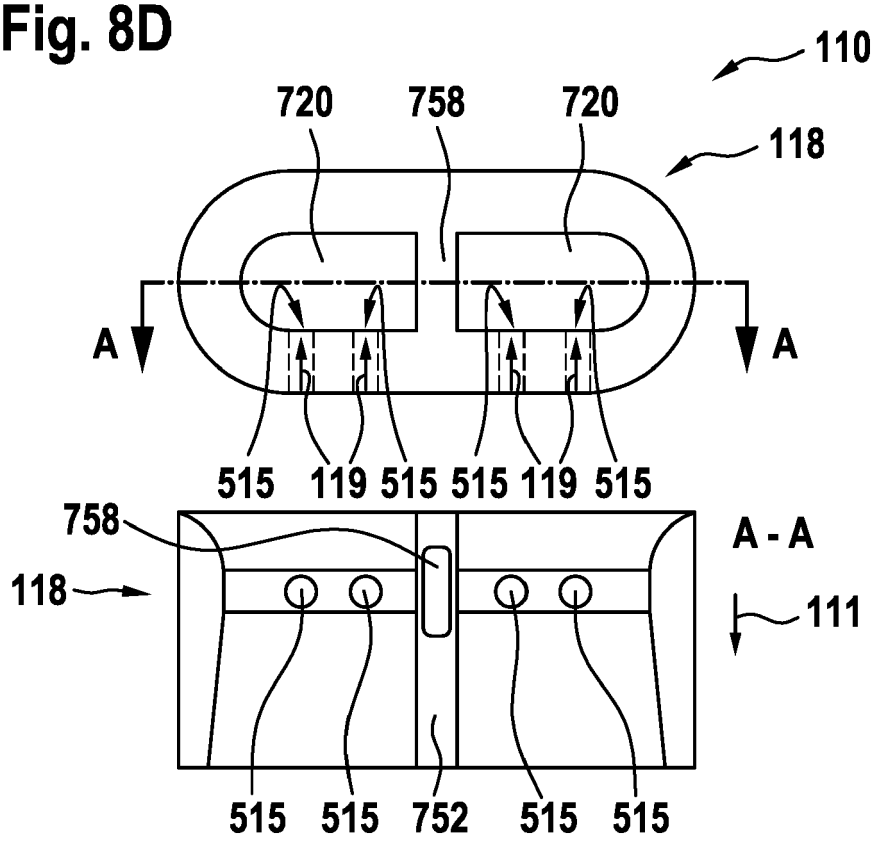
Fig. 8D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EUROPEAN SEARCH REPORT

Application Number
EP 22 16 9631

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	US 5 399 084 A (MCCULLOUGH SAM [CA] ET AL) 21 March 1995 (1995-03-21) * column 2, line 7 - column 3, line 66 * * figures 2-4 *	1-11	INV. F23D14/62 F23D14/36 F23C3/00
X	DE 102 15 688 A1 (SCHOTT GLAS [DE]) 6 November 2003 (2003-11-06) * column 2, paragraph 22 - column 3, paragraph 32 * * figures 1-5 *	1,2,6,11	
A	FR 2 794 521 A1 (GEMINOX [FR]) 8 December 2000 (2000-12-08) * page 2, line 21 - page 3, line 15 * * figures 1,4 *	1	

TECHNICAL FIELDS SEARCHED (IPC)

F23D
F23C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	31 August 2022	Gavriliu, Costin

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31-08-2022

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- JP H09145024 A **[0006]**
- CN 211232873 U **[0007]**