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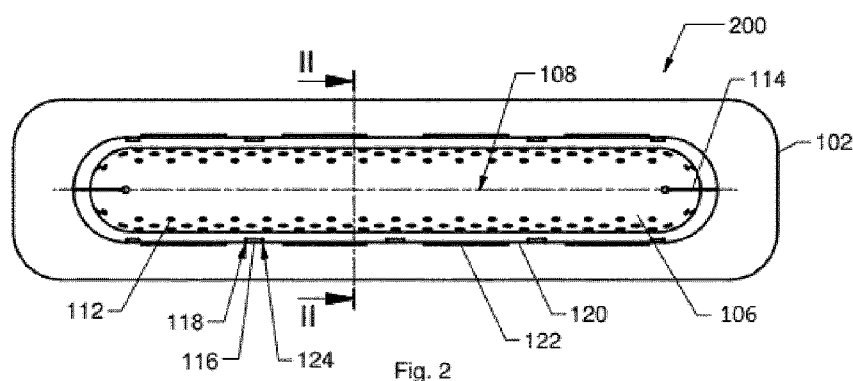
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(54) Title: PREMIX GAS BURNER



(57) Abstract: A premix gas burner comprises a metal mounting plate (102), a mixing chamber (108), a porous burner deck (110) and a plate structure (106). The porous burner deck encloses the mixing chamber. Combustion is stabilized on the porous burner deck after premix gas has flown from the mixing chamber through the porous burner deck. The plate structure comprises a plurality of perforations; and is provided in the mixing chamber for flow of premix gas through the perforations of the plate structure before the premix gas flows through the porous burner deck. The circumference of the porous burner deck has the shape of a rectangle of which the two short sides have been rounded. The plate structure is provided via cutting and folding a metal plate. In the assembly of the burner, the plate structure is deformed and allowed to recover such that in the burner elastic forces of the plate structure ensure that the plate structure is positioned against supporting elements of the metal mounting plate.

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Premix gas burner**Description****Technical Field**

- [1] The invention relates to the field of premix gas burners, more particularly to surface stabilized premix gas burners comprising a porous burner deck onto which the flames are stabilized.

Background Art

- [2] Premix gas burners of which the circumference of the porous burner deck has the shape of a rectangle of which the two short sides are continuously rounded find application in a broad range of boilers and heating appliances.
- [3] WO2015/000869 A1 discloses a premix gas burner wherein the circumference of the porous burner deck has the shape of a rectangle of which the two short sides are continuously rounded. The burner comprises a metal mounting plate, a mixing chamber, a porous burner deck and a distributor. The porous burner deck encloses the mixing chamber. Combustion of premix gas occurs on the porous burner deck after premix gas has flown from the mixing chamber through the porous burner deck. A distributor is provided in the mixing chamber for flow of the premix gas through the perforations of the distributor before the premix gas flows through the porous burner deck.

Disclosure of Invention

- [4] The first aspect of the invention is a premix gas burner comprising a metal mounting plate, a mixing chamber, a porous burner deck and a plate structure. The porous burner deck encloses the mixing chamber. Combustion is stabilized on the porous burner deck after premix gas has flown from the mixing chamber through the porous burner deck. The plate structure comprises a plurality of perforations; and is provided in the mixing chamber for flow of premix gas through the perforations of the plate structure before the premix gas flows through the porous burner deck. The circumference of the porous burner deck has the shape of a rectangle of which the two short sides have been – preferably continuously - rounded. The plate structure is provided via cutting and folding a metal plate. In the assembly of the burner, the plate structure is deformed and allowed to recover such that in the burner elastic forces of the plate structure ensure that the plate structure is positioned against supporting elements of the metal mounting plate.
- [5] It is a benefit of the invention that a burner of which the circumference of the porous burner deck has the shape of a rectangle of which the two short sides are continuously rounded can be assembled in a simple and reliable way. The position of the plate structure is well defined, such that all perforations in the plate structure are correctly positioned and sized in the burner, thereby ensuring correct operation of the burner. If perforations would not be well defined in the burner, burner operation could be or could become unreliable, even leading to flashback. Unreliable burner operation would

especially be the case when the burner is a gas adaptive burner in which a property of combustion (e.g. ionization current) is measured and used in a feedback control system of the burner.

- [6] Preferably, the porous burner deck has a double curved surface. Where a surface is at a point on it double curved, there is at that point no direction in which the radius of curvature at that point is infinite. As an example, a cylindrical burner is a burner that has a single curved surface, not a double curved surface.
- [7] Preferably, the metal mounting plate surrounds the complete burner deck.
- [8] Preferably, the plate structure comprises an open ended slit ending at each of the two short sides of the circumference of the porous burner deck. Each of the open ended slits ending at the two short sides is parallel with the length direction of the circumference of the porous burner deck. Burners according to such embodiments are easier to produce because of the ease of production and shaping of the plate structure. The supporting elements ensure that well-defined slit sized through openings are obtained in the plate structure through which premix gas flows towards the porous burner deck. If the slit sized openings would not be well defined, burner operation could be or could become unreliable, even leading to flashback. Unreliable burner operation would especially be the case when the burner is a gas adaptive burner in which a property of combustion (e.g. ionization current) is measured and used in a feedback control system of the burner.
- [9] In a preferred embodiment, the porous burner deck is provided in a convex shape; more preferably the porous burner deck is provided in a convex shape over the full surface of the porous burner deck provided for stabilizing the flames.
- [10] In a preferred embodiment, the porous burner deck is a woven metal wire mesh. Preferably, the woven wire mesh has a thickness between 0.6 and 1.3 mm. As an example, a woven wire mesh of 0.9 mm thickness can be advantageously used in the invention.
- [11] In a preferred embodiment, the porous burner deck is provided by a woven, knitted or braided fabric comprising metal fibers. More preferably, the porous burner deck is provided by a woven, knitted or braided fabric comprising yarns. The yarns comprise a plurality of metal fibers in their cross section.
- [12] Preferably, supporting elements are only provided along the two long sides of the rectangular shape of the porous burner deck. No supporting elements are provided along the two rounded short sides of the rectangular shape of the porous burner deck. Such embodiments are particularly favored for the ease of burner assembly to a reliably operating gas premix burner.
- [13] In a preferred embodiment, wherein the plate structure comprises an open ended slit ending at each of the two short sides of the circumference of the porous burner deck; and wherein each of the open ended slits ending at the two short sides is parallel with the

- length direction of the circumference of the porous burner deck; the metal mounting plate comprises at one or at both short sides of the rectangular shape of the porous burner deck at least one short side supporting element. The plate structure is positioned against the at least one short side supporting element. It is a benefit of such embodiment that the short side supporting element(s) control the size of the open ended slit in the plate structure. This control is provided, as the short side supporting element(s) contact the plate structure such that the supporting plate structure is pressed to a constant and defined shape and position. Such control is beneficial to control the flow of premix gas through the plate structure. This way, burners can be made that are constant in quality.
- [14] Preferably, the metal mounting plate comprises an opening. The porous burner deck is inserted through the opening of the metal mounting plate. More preferably, the opening is at the center of the metal mounting plate.
- [15] Preferably, the plate structure comprises at its circumference a plurality of notches. The notches can preferably be provided in a flange at the circumference of the plate structure. The metal mounting plate comprises upstanding ridges forming the supporting elements. In the gas premix burner notches of the plate structure hit the upstanding ridges of the metal mounting plate.
- [16] Preferably, the porous burner deck is bent such that a flange is formed at its circumference. The flange is held in the burner between the metal mounting plate and the plate structure. In a more preferred embodiment, the flange is along the circumference of the porous burner deck split in a plurality of flange segments.
- [17] In embodiments wherein the porous burner deck is bent such that a flange is formed at the circumference of the porous burner deck, the bent angle providing the flange of the porous burner deck is preferably at least 90°.
- [18] In embodiments wherein the porous burner deck is bent such that a flange is formed at the circumference of the porous burner deck, a flange is only provided along the long sides of the rectangular circumference of the porous burner deck. It means that no such flange is provided along the short sides of the rectangular circumference of the porous burner deck.
- [19] In a preferred embodiment, the flange of the porous burner deck is held between the metal mounting plate and the plate structure such that along the full flange play is present between the flange on the one hand; and the metal mounting plate and the plate structure on the other hand. The metal mounting plate and the plate structure are attached to each other, by welding or by a mechanical joining technique. Different welding techniques can be used, e.g. capacitor discharge welding, TIG welding or laser welding.
- [20] In a preferred embodiment, the flange is attached into the burner by welds onto the metal mounting plate or onto the plate structure or onto both the metal mounting plate and the

plate structure. Different welding techniques can be used, e.g. capacitor discharge welding, TIG welding or laser welding.

- [21] In a preferred embodiment, at or around the supporting elements, the metal plate structure is welded onto the metal mounting plate. When notches and ridges are provided, the welds can be performed at or around the notches contacting the ridges. Different welding techniques can be used, e.g. capacitor discharge welding, TIG welding or laser welding.
- [22] Preferably, all zones of the plate structure provided with perforations are provided at a distance from the porous burner deck. It is meant that no perforation makes contact with the porous burner deck, but that the perforation is positioned at a distance from the porous burner deck.
- [23] The second aspect of the invention is a condensing boiler comprising a premix gas burner as in any embodiment of the first aspect of the invention. Preferably, the condensing boiler comprises a cast aluminium heat exchanger.

Brief Description of Figures in the Drawings

- [24] Figure 1 shows a top view of a gas premix burner according to the invention.
Figure 2 shows a bottom view of the burner of figure 1.
Figure 3 shows a cross section of figure 2 along II – II.
Figure 4 shows the woven wire mesh forming the porous burner deck of the burner of figure 1.
Figure 5 shows the metal mounting plate of the burner of figure 1.
Figure 6 shows the plate structure of the burner of figure 1 before it is shaped.
Figure 7 shows the shaped plate structure as included in the burner of figure 1.
Figure 8 shows the plate structure of another burner of the invention before it is shaped.
Figure 9 shows the shaped plate structure derived from the plate structure shown in figure 8.
Figure 10 shows the metal mounting plate used in combination with the shaped plate structure of figure 9.
Figure 11 shows a cross section of the premix gas burner according to the invention made with the metal mounting plate of figure 10 and with the shaped plate structure of figure 9.
Figure 12 shows another burner embodiment according to the invention.

Mode(s) for Carrying Out the Invention

- [25] Figures 1 – 7 show in combination a first example of a gas premix burner according to the invention. Figure 1 shows a top view 100 of a gas premix burner according to the invention. Figure 2 shows a bottom view 200 of the burner of figure 1. Figure 3 shows a

cross section 300 of figure 2 along II – II.

Figure 4 shows the woven wire mesh forming the porous burner deck of the burner of figure 1. Figure 5 shows the metal mounting plate 102 of the burner of figure 1.

Figure 6 shows the plate structure 104 of the burner of figure 1 before it is shaped.

Figure 7 shows the shaped plate structure 106 as included in the burner of figure 1.

- [26] The premix gas burner comprises a metal mounting plate 102, a mixing chamber 108, a porous burner deck 110 and a plate structure 106. In the exemplary burner, the porous burner deck is a woven metal wire mesh, e.g. 0.9 mm thick. The circumference of the porous burner deck has the shape of a rectangle of which the two short sides have been continuously rounded. The metal mounting plate comprises an opening. The woven wire mesh burner deck is inserted through the opening of the metal mounting plate.
- [27] The plate structure 106 comprises a plurality of perforations 112; and is provided in the mixing chamber for flow of premix gas through the perforations of the plate structure before the premix gas flows through the porous burner deck. The plate structure is provided via cutting and folding a metal plate, figure 6 shows the flat metal plate structure 104 after cutting and before folding it. Figure 7 shows the shaped plate structure 106 after folding it, meaning as included in the burner of figure 1. The plate structure comprises an open ended slit 114 ending at each of the two short sides of the circumference of the porous burner deck. Each of the open ended slits ending at the two short sides is parallel with the length direction of the circumference of the porous burner deck. The two open ended slits are a consequence of way the plate structure is produced, by folding the flat structure of figure 6 into the shaped structure of figure 7.
- [28] In the exemplary burner, all zones of the plate structure provided with perforations 112 are provided at a distance from the porous burner deck.
- [29] As is best illustrated in figure 3, in the assembly of the burner, the plate structure is deformed and allowed to recover such that in the burner elastic forces of the plate structure ensure that the plate structure is positioned against supporting elements 116 of the metal mounting plate. In the exemplary burner, supporting elements are only provided along the two long sides of the rectangular shape of the porous burner deck. No supporting elements are provided along the two rounded short sides of the rectangular shape of the porous burner deck.
- [30] The plate structure comprises at its circumference a plurality of notches 118 provided in a flange 120 at the circumference of the plate structure. The metal mounting plate comprises upstanding ridges 116 forming the supporting elements. In the gas premix burner notches of the plate structure are positioned against the upstanding ridges of the metal mounting plate. This way, the plate structure is correctly positioned in the burner, controlling the sizes of the open ended slits 114. This is best shown in figure 3.
- [31] The porous burner deck is bent such that a flange – split is a plurality of flange segments 122 - is formed at its circumference. The bent angle providing the flange of the porous burner deck is more than 90°. The flange is held in the burner between the metal

mounting plate and the plate structure (see figure 2). The openings 124 in between the flange segments 122 are positioned around second ridges 126 of the metal mounting plate. The height of the second ridges 126 determines the space between the metal mounting plate and the metal plate structure. This distance is selected to be larger than the thickness of the woven wire mesh burner deck, such that the flange segments are present between the metal mounting plate and the metal plate structure such that play is present between the flange segments on the one hand; and the metal mounting plate and the plate structure at the other hand. This way, the burner deck can efficiently cope with thermal expansion and contraction.

- [32] In the exemplary burner, flange segments are only provided along the long sides of the rectangular circumference of the porous burner deck. No flange is provided along the short sides of the rectangular circumference of the porous burner deck.
- [33] The metal mounting plate and the plate structure are attached to each other, by means of welds at or around the notches and the ridges. Different welding techniques can be used, e.g. capacitor discharge welding, TIG welding or laser welding.
- [34] Figures 8 – 11 illustrate in combination a second example of premix gas burner according to the invention. Figure 8 shows the plate structure of another burner of the invention before it is shaped. Figure 9 shows the shaped plate structure derived from the plate structure shown in figure 8. Figure 10 shows the metal mounting plate used in combination with the shaped plate structure of figure 9. Figure 11 shows a cross section of the premix gas burner according to the invention made with the metal mounting plate of figure 10 and with the shaped plate structure of figure 9. The burner deck 110 of figure 4 is used in the second exemplary burner.
- [35] The premix gas burner comprises a metal mounting plate 802, a mixing chamber 808, a porous burner deck 810 and a plate structure 806. The circumference of the porous burner deck has the shape of a rectangle of which the two short sides have been continuously rounded. The metal mounting plate comprises an opening. The woven wire mesh burner deck is inserted through the opening of the metal mounting plate.
- [36] The plate structure 806 comprises a plurality of perforations 812. The plate structure is provided via cutting and folding a metal plate, figure 8 shows the flat metal plate structure 804 after cutting and before folding it. Figure 9 shows the shaped plate structure 806 after folding it, meaning as included in the burner. The plate structure comprises an open ended slit 814 ending at each of the two short sides of the circumference of the porous burner deck. Each of the open ended slits ending at the two short sides is parallel with the length direction of the circumference of the porous burner deck. The two open ended slits are a consequence of way the plate structure is produced, by folding the flat structure of figure 8 into the shaped structure of figure 9.
- [37] In the exemplary burner, all zones of the plate structure provided with perforations 812 are provided at a distance from the porous burner deck.

- [38] As is best illustrated in figure 11, in the assembly of the burner, the plate structure is deformed and allowed to recover such that in the burner elastic forces of the plate structure ensure that the plate structure is positioned against supporting elements (formed by upstanding ridges) 816 of the metal mounting plate. In the exemplary burner, supporting elements are only provided along the two long sides of the rectangular shape of the porous burner deck. No supporting elements are provided along the two rounded short sides of the rectangular shape of the porous burner deck.
- [39] The plate structure comprises at its circumference a plurality of notches 818 provided in a flange 820 at the circumference of the plate structure. In the gas premix burner notches of the plate structure are positioned against the upstanding ridges of the metal mounting plate. This way, the plate structure is correctly positioned in the burner, controlling the sizes of the open ended slits 814. This is shown in figure 11.
- [40] The porous burner deck is bent such that a flange – split in a plurality of flange segments 822- is formed at its circumference. The bent angle providing the flange of the porous burner deck is more than 90°. The flange is held in the burner between the metal mounting plate and the plate structure. The openings 824 in between the flange segments 122 are positioned around the ridges 816 of the metal mounting plate.
- [41] The flange segments are positioned without play between the metal mounting plate and the metal plate structure. The flange segments are attached into the burner by welds onto the metal mounting plate and onto the plate structure or onto both the metal mounting plate and the plate structure. To this end, different welding techniques can be used.
- [42] Figure 12 shows a premix gas burner 1200 according to the invention. The premix gas burner comprises a metal mounting plate 1202, a mixing chamber 1208, a porous burner deck (not visible in figure 12, but similar to figure 1) and a plate structure 1206. In the exemplary burner, the porous burner deck is a woven metal wire mesh, similar to figures 1 – 5 and inserted in the same way through the opening of the metal mounting plate as in figures 1 – 5. The circumference of the porous burner deck has the shape of a rectangle of which the two short sides have been continuously rounded. The plate structure 1206 comprises a plurality of perforations 1212; and is provided in the mixing chamber for flow of premix gas through the perforations of the plate structure before the premix gas flows through the porous burner deck. The plate structure is provided via cutting and folding a metal plate. The plate structure comprises an open ended slit 1214 ending at each of the two short sides of the circumference of the porous burner deck. Each of the open ended slits ending at the two short sides is parallel with the length direction of the circumference of the porous burner deck. The two open ended slits are a consequence of the way the plate structure is produced, by folding a flat structure into shape. The plate structure 1206 comprises at its circumference a plurality of notches 1218 provided in a flange 1220 at the circumference of the plate structure. The metal mounting plate comprises upstanding ridges 1216 forming the supporting elements. In the gas premix burner notches of the plate structure are positioned against the upstanding ridges of the metal mounting plate.

The metal mounting plate 1202 comprises at both short sides of the rectangular shape of the porous burner deck a short side supporting element 1232. The plate structure is positioned against the short side supporting elements 1232, in the example notches 1234 are provided to this end at the short sides of the plate structure. This way, the plate structure is correctly positioned in the burner, controlling the sizes of the open ended slits 1214.

Claims

1. Premix gas burner comprising,
 - a metal mounting plate;
 - a mixing chamber;
 - a porous burner deck enclosing the mixing chamber and onto which combustion is stabilized after premix gas has flown from the mixing chamber through the porous burner deck; and
 - a plate structure comprising a plurality of perforations, wherein the plate structure is provided in the mixing chamber for flow of premix gas through the perforations of the plate structure before the premix gas flows through the porous burner deck;wherein the circumference of the porous burner deck has the shape of a rectangle of which the two short sides have been – preferably continuously – rounded;
wherein the plate structure is provided via cutting and folding a metal plate;
wherein in the assembly of the burner, the plate structure is deformed and allowed to recover such that in the burner elastic forces of the plate structure ensure that the plate structure is positioned against supporting elements of the metal mounting plate.
2. Premix gas burner as in claim 1;
wherein the plate structure comprises an open ended slit ending at each of the two short sides of the circumference of the porous burner deck; and
wherein each of the open ended slits ending at the two short sides is parallel with the length direction of the circumference of the porous burner deck.
3. Premix gas burner as in any of the preceding claims, wherein the porous burner deck is provided in a convex shape; preferably wherein the porous burner deck is provided in a convex shape over the full surface of the porous burner deck provided for stabilizing the flames.
4. Premix gas burner as in any of the preceding claims 1 – 3; wherein the porous burner deck is a woven metal wire mesh.
5. Premix gas burner as in any of the preceding claims 1 – 3; wherein the porous burner deck is provided by a woven, knitted or braided fabric comprising metal fibers.
6. Premix gas burner as in any of the preceding claims, wherein supporting elements are only provided along the two long sides of the rectangular shape of the porous burner deck.
7. Premix gas burner as in claim 2 and as in any of the preceding claims 2 – 5; wherein the metal mounting plate comprises at one or at both short sides of the rectangular shape of the porous burner deck at least one short side supporting element;
wherein the plate structure is positioned against the at least one short side supporting element.

8. Premix gas burner as in any of the preceding claims,
wherein the metal mounting plate comprises an opening;
wherein the porous burner deck is inserted through the opening of the metal mounting plate.
9. Premix gas burner as in any of the preceding claims,
wherein the plate structure comprises at its circumference a plurality of notches;
wherein the metal mounting plate comprises upstanding ridges forming the supporting elements;
and wherein in the burner notches of the plate structure hit the upstanding ridges of the metal mounting plate.
10. Premix gas burner as in any of the preceding claims;
wherein the porous burner deck is bent such that a flange is formed at its circumference;
wherein the flange is held in the burner between the metal mounting plate and the plate structure.
11. Premix gas burner as in claim 9; wherein the flange is along the circumference of the porous burner deck split in a plurality of flange segments.
12. Premix gas burner as in claims 9 or 10; wherein a flange is only provided along the long sides of the rectangular circumference of the porous burner deck.
13. Premix gas burner as in any of the preceding claims 9 – 11;
wherein the flange is held between the metal mounting plate and the plate structure such that along the full flange play is present between the flange on the one hand and the metal mounting plate and the plate structure at the other hand.
14. Premix gas burner as in any of the preceding claims 9 – 11;
wherein the flange is attached into the burner by welds onto the metal mounting plate or onto the plate structure or onto both the metal mounting plate and the plate structure.
15. Premix gas burner as in any of the preceding claims; wherein at or around the supporting elements, the metal plate structure is welded onto the metal mounting plate.

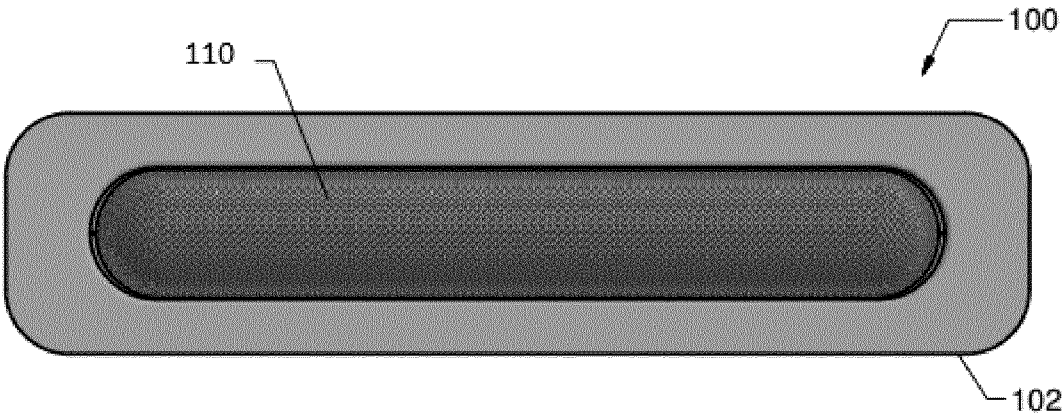


Fig. 1

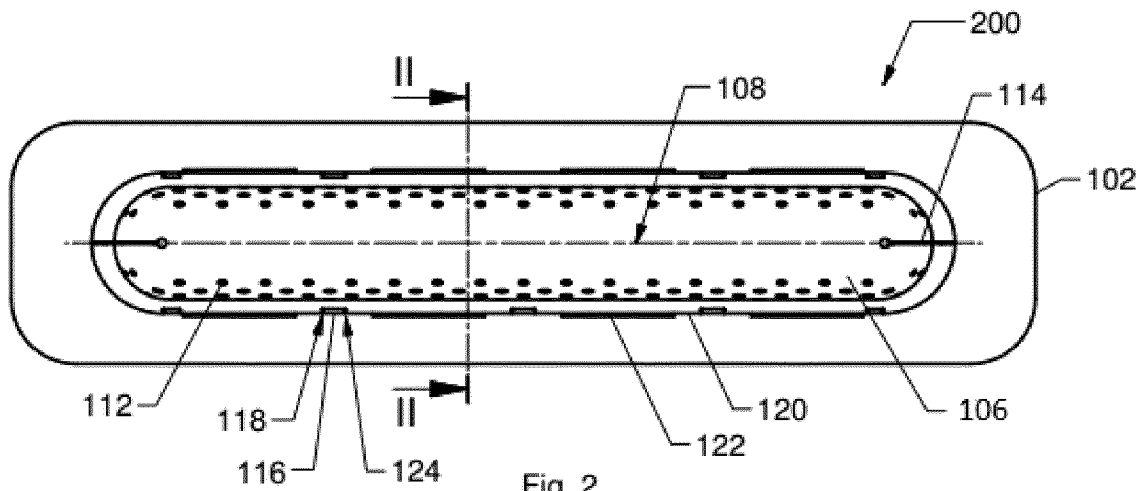


Fig. 2

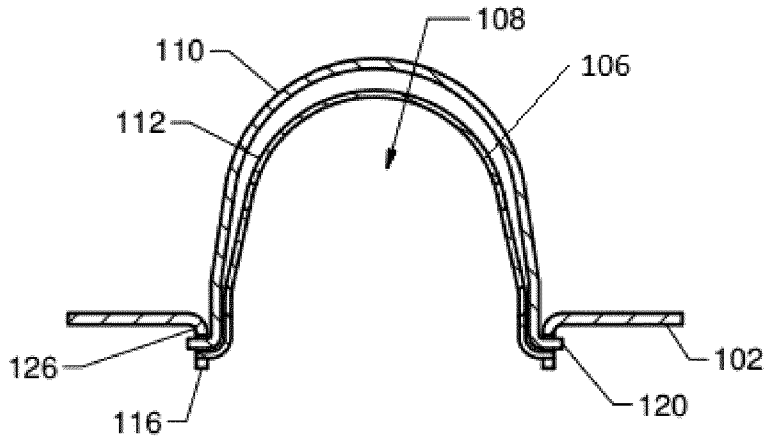


Fig. 3

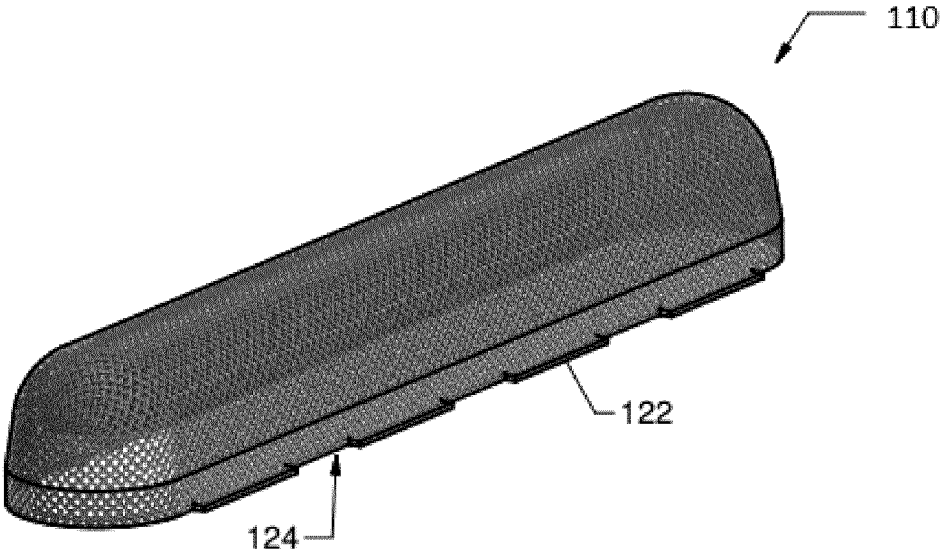


Fig. 4

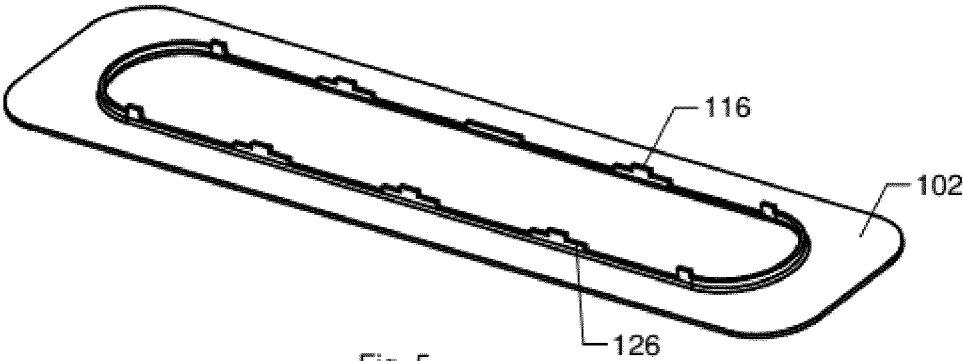


Fig. 5

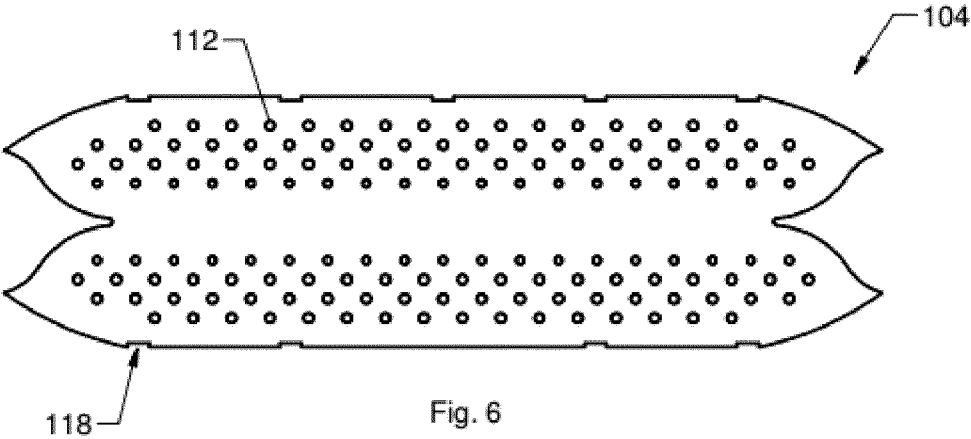


Fig. 6

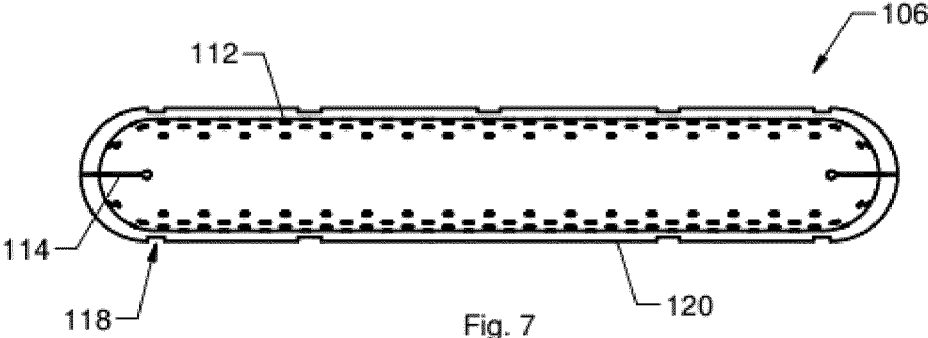


Fig. 7

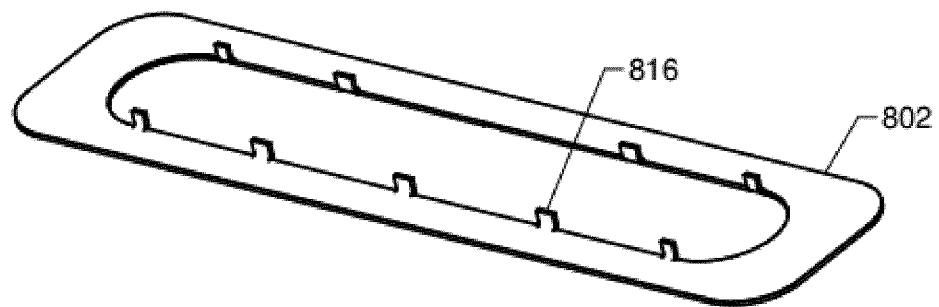
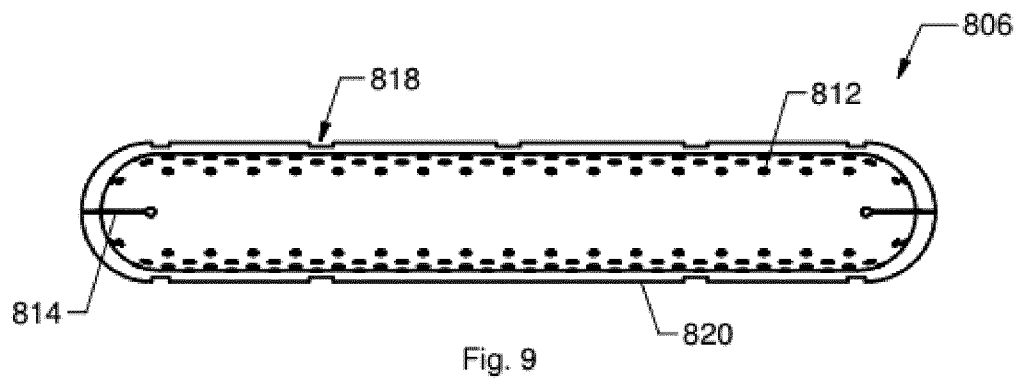
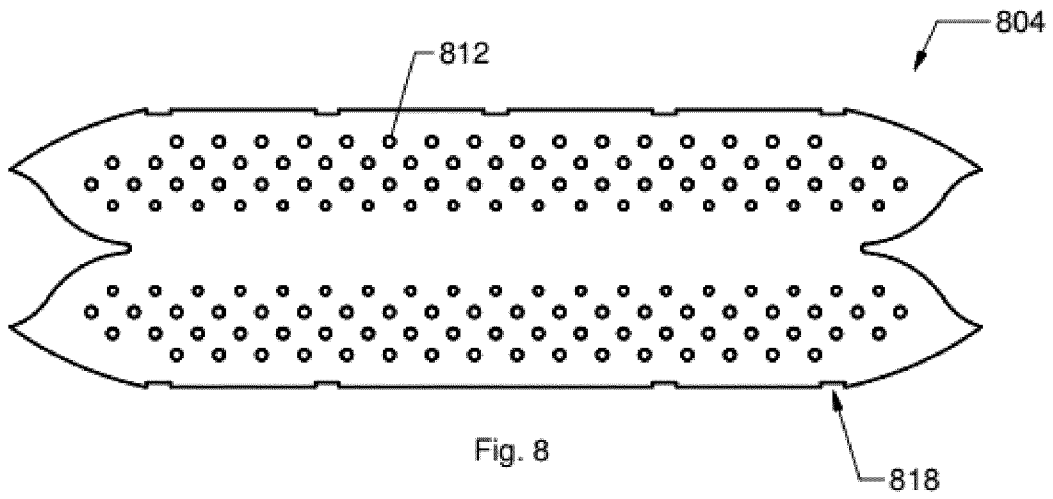


Fig. 10

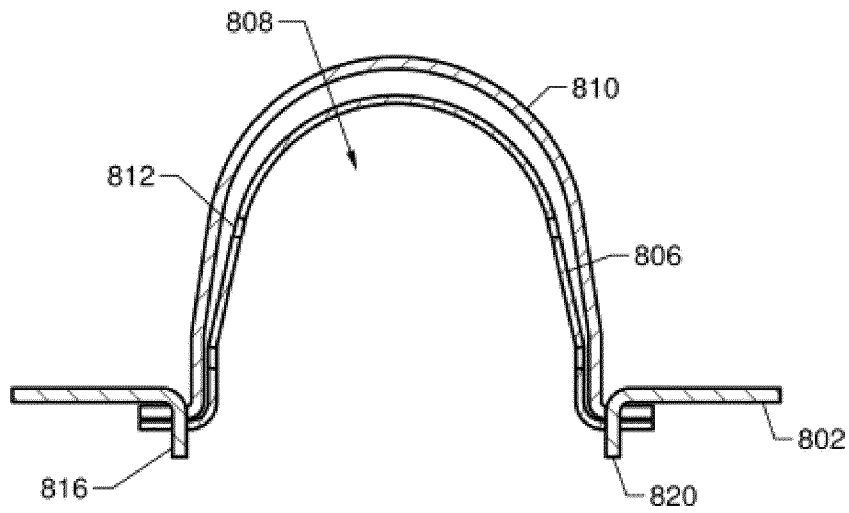


Fig. 11

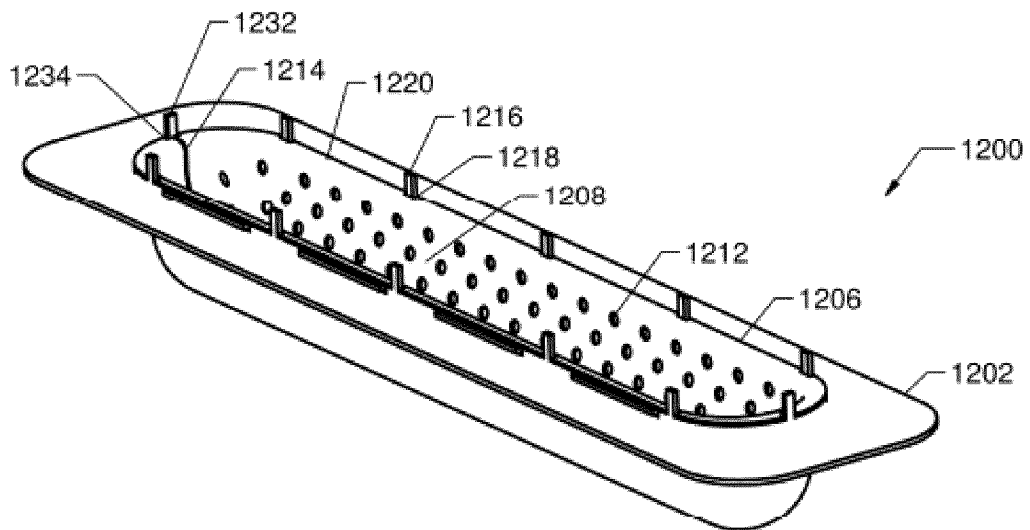


Fig. 12

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2018/068035

A. CLASSIFICATION OF SUBJECT MATTER
INV. F23D14/14 F23D14/62
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F23D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 1 616 128 A1 (BEKAERT SA NV [BE]; BEKAERT COMB TECHNOLOGY NV [BE]) 18 January 2006 (2006-01-18) paragraph [0001]; figures 4a-4d paragraphs [0012], [0013], [0023] -----	1-15
A	EP 0 006 048 A1 (RIPPES SA [FR]) 12 December 1979 (1979-12-12) page 1, lines 1,2; figures 1,3 page 2, line 14 - page 3, line 14 -----	1
A	NL 6 812 647 A (FARGAS) 9 December 1969 (1969-12-09) the whole document -----	1



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Information on patent family members

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