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- **Van Den Berg, Wilhelm Salvatore**
9474 PE Zuidlaarderveen (NL)
- **Heuveling, Eric**
7876 CD Valthermond (NL)

(71) Applicant: **BEKAERT COMBUSTION TECHNOLOGY B.V.**
9403 AR Assen (NL)

(74) Representative: **Messely, Marc**
NV Bekaert SA
D.I.E.
Bekaertstraat 2
8550 Zwevegem (BE)

(72) Inventors:
• **Ten Hoeve, Dirk**
7961 LD Ruinerwold (NL)

(54) **Gas premix burner**

(57) The patent application discloses a gas premix burner (100) comprising
- a perforated plate, a woven wire mesh or expanded metal sheet;
- a fiber based burner deck (130) placed on the perforated plate, woven wire mesh or expanded metal sheet; where-
in the fiber based burner deck (130) has a same mass per unit of surface area over the full surface of the burner

deck (130);
- an ignition electrode (160) to ignite the gas premix burner,

The fiber based burner deck (130) is thicker in at least part of the region where the ignition electrode (160) is located, than in at least some other areas of the fiber based burner deck (130). Burners of the invention show improved ignition characteristics.

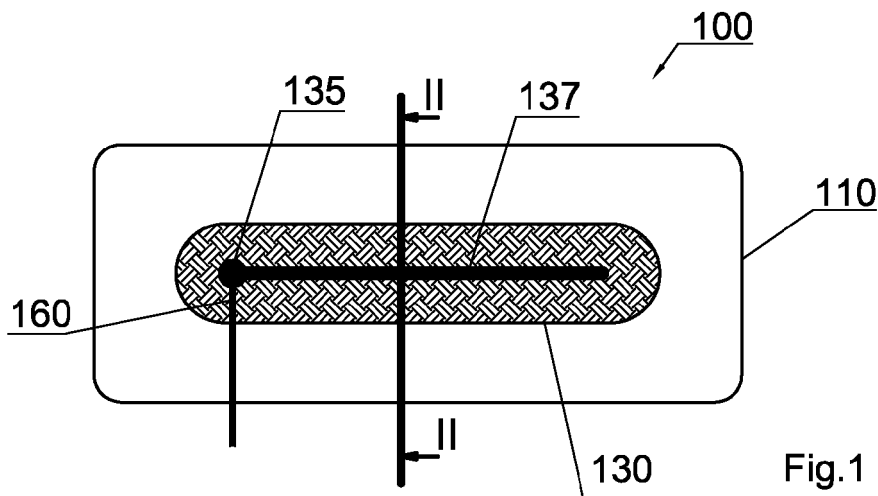


Fig.1

Description

Technical Field

[0001] The invention relates to gas premix burners that have a fiber based burner deck. The gas premix burners use an ignition electrode to ignite the burner. Such gas premix burner can e.g. be used in boilers or in instantaneous water heaters.

Background Art

[0002] Gas premix burners with fiber based burner decks are known. Such burners can have a metal fiber based knitted or woven fabric as burner deck positioned on a perforated plate or woven screen (a woven wire mesh) which is acting as gas distribution plate. It is a benefit of such burners that the metal fiber based burner deck (e.g. a knitted or woven fabric) can freely expand when hot, while the perforated plate, the woven wire mesh or the expanded metal sheet is remaining sufficiently cool. Such burners are e.g. known from US4657506 and WO2004/092647.

[0003] The ignition of such burners can be difficult or problematic. DE29708377U provides an improvement to the ignition problem by providing the perforated gas distribution plate with a higher percentage of perforated surface area in the region where the ignition electrode is positioned than elsewhere.

[0004] However, this solution is not ideal, as it cannot be easily used in burners of small size or in burners with complex shape burner decks. The solution can also not readily be used or adapted for burners that have a woven wire mesh as gas distribution surface.

Disclosure of Invention

[0005] The primary objective of the invention is to provide a gas premix burner with a fiber based burner deck which can be reliably ignited by means of the ignition electrode of the burner.

[0006] The objective is achieved by a gas premix burner comprising:

- a perforated plate, a woven wire mesh or expanded metal sheet. The perforated plate, the woven wire mesh or the expanded metal sheet are preferably perforated or having openings in a uniform way over their surface. The premix of air and gas will be distributed from a mixing chamber through the perforated plate, the woven wire mesh or the expanded metal sheet.
- a fiber based burner deck placed on the perforated plate, woven wire mesh or expanded metal sheet. The fiber based burner deck has a same mass per unit of surface area over the full surface of the burner deck. Preferably, the fiber based burner deck is showing a three dimensional porosity with open cell

pores. The gas premix is flowing first through the perforated plate, woven wire mesh or the expanded metal sheet and then through the fiber based burner deck after which the gas is combusted.

- an ignition electrode to ignite the gas premix burner.

The burner is **characterized in that** the fiber based burner deck is thicker in at least part of the region where the ignition electrode is located, than in at least some other areas of the fiber based burner deck. Such at least part of the region can be circular in shape, but can also be oval or can have another shape.

Preferably, the burner is a fully premixed gas burner.

[0007] The characterizing feature ensures that the gas premix burner can be ignited in a proper and reliable way, eliminating problems of bad, late or noisy ignition.

[0008] It is a further benefit that burners according to the invention can be made that have

- a woven wire mesh or expanded metal sheet as support for the fiber based burner deck as more complex burner shape decks can be provided,
- and that are showing easy and good ignition.

Preferably using a woven wire mesh as support for the fiber based burner deck, burners according to the invention can be made that have a small size as well as burners with burner decks of complex shape, e.g. burners with undulated, or double curved burner deck or at least double curved burner deck, while having excellent ignition properties.

[0009] In a preferred embodiment, the part of the region in which the fiber based burner deck is thicker in at least part of the region where the ignition electrode is located, comprises a circular surface of at least 15 mm diameter, and preferably of at least 20 mm diameter, e.g. of 25 mm diameter. The circular surface is determined when the fiber based burner deck is taken off the burner and put flat on a surface to observe or determine the region.

[0010] In a preferred embodiment, the fiber based burner deck is in one or more elongated zones of the fiber based burner deck thicker than in at least some other areas of the fiber based burner deck, wherein at least one of the elongated zones is starting from the at least part of the region at the ignition electrode where the fiber based burner deck is thicker. Preferably, such elongated zones cover substantially the full length of the burner, in order to facilitate ignition over the full length of the burner. Preferably such elongated zones have a width of at least 8 mm, and preferably of less than 20 mm. A preferred range of the width of elongated zones is between 10 and 15 mm.

Preferably, outside where the fiber based burner deck is thicker in at least part of the region where the ignition electrode is located; and outside where the fiber based burner deck is thicker in the one or more elongated zones of the fiber based burner deck than in at least some other

areas of the fiber based burner deck, the thickness of the fiber based burner deck is constant.

[0011] In preferred embodiments, the fiber based burner deck is a weft knitted fabric which is in one or more elongated zones of the fiber based burner deck thicker than in at least some other areas of the fiber based burner deck and wherein at least one of the elongated zones is starting from the at least part of the region at the ignition electrode where the fiber based burner deck is thicker. Preferably, at least one of the elongated zones is substantially parallel with the production direction of the weft knitted fabric. Surprisingly burners according to this embodiment have shown extremely beneficial ignition behaviour, especially in terms of speed of ignition after valve opening, and non-occurrence of pressure pulses during valve opening.

[0012] Preferred is when the thickness of the fiber based burner deck where it is thicker is at least 40% higher than the thickness outside where it is thicker.

[0013] Preferred is when the porosity of the fiber based burner deck where it is thicker is less than 92%.

[0014] Preferred is when the porosity of the fiber based burner deck outside where it is thicker, is higher than 75% but preferably below 85%.

[0015] In preferred embodiments of the invention, the fiber based burner deck comprises metal fibers, preferably stainless steel fibers.

[0016] The different thickness values of the fiber based burner deck can be obtained by locally compressing the fiber based burner deck or by compressing the full surface of the fiber based burner deck, but with a lower pressure in the areas where a higher thickness is required. The variation in fabric thickness can be made before or after applying the fiber based burner deck onto the perforated plate, woven wire mesh or expanded metal sheet.

[0017] The fiber based burner deck can comprise metal fibers. Examples of preferred ranges of metal fibers are stainless steel fibers. A specifically preferred range of stainless steel fibers are chromium and aluminium comprising stainless steel fibers as in DIN 1.4767, e.g. as are known under the trademark FeCrAlloy.

[0018] Metal fibers for the burner deck, e.g. stainless steel fibers, e.g. with a diameter less than 40 micrometers, e.g. less than 25 micrometers, can be obtained by a bundle drawing technique. This technique is disclosed e.g. in US-A-2050298, US-A-3277564 and in US-A-3394213. Metal wires form the starting material and are covered with a coating such as iron or copper. A bundle of these covered wires is subsequently enveloped in a metal pipe. Thereafter the thus enveloped pipe is reduced in diameter via subsequent wire drawing steps to come to a composite bundle with a smaller diameter. The subsequent wire drawing steps may or may not be alternated with an appropriate heat treatment to allow further drawing. Inside the composite bundle the initial wires have been transformed into thin fibers which are embedded separately in the matrix of the covering material. Such a bundle preferably comprises no more than 2000

fibers, e.g. between 500 and 1500 fibers. Once the desired final diameter has been obtained the covering material can be removed e.g. by solution in an adequate pickling agent or solvent. The final result is the naked fiber bundle.

[0019] Alternatively metal fibers for the burner deck, such as stainless steel fibers can be manufactured in a cost effective way by machining a thin plate material. Such a process is disclosed e.g. in US-A-4930199. A strip of a thin metal plate is the starting material. This strip is wound around the cylindrical outer surface of a rotatably supported main shaft a number of times and is fixed thereto. The main shaft is rotated at constant speed in a direction opposite to that in which the plate material is wound. A cutter having an edge line expending perpendicularly to the axis of the main shaft is fed at constant speed. The cutter has a specific face angle parallel to the axis of the main shaft. The end surface of the plate material is cut by means of the cutter.

[0020] Yet an alternative way of producing metal fibers for the burner deck is via extracting or extrusion from a melt.

[0021] Another alternative way of producing metal fibers is machining fibers from a solid block of metal.

[0022] As an alternative for or in combination with metal fibers, ceramic fibers can be used in the fiber based burner deck.

[0023] The fiber based burner deck can comprise a textile fabric, e.g. a textile fabric comprising yarns. The fiber based burner deck can e.g. comprise or be a woven fabric or a knitted fabric (weft knitted or warp knitted) or a braided fabric comprising yarns with e.g. metal fibers, preferably stainless steel fibers. The yarns can be spun from stretchbroken fibers (such as bundle drawn stretch broken fibers) or yarns made from shaved or machined fibers. The yarns can be plied yarns, e.g. two ply, three ply... Preferred fabrics made from metal fibers have a weight of between 0.6 and 3 kg/m²; preferably between 0.75 and 2.6 kg/m², even more preferred between 0.75 and 2.5 kg/m², and even more preferred between 0.75 and 1.3 kg/m².

Alternative fiber based burner decks that can be used in the invention can comprise or can be nonwoven fabrics, e.g. comprising metal fibers (preferably stainless steel fibers). The nonwoven fabrics can be consolidated by different techniques (e.g. needle punching) and can be sintered or not sintered.

[0024] The gas premix burner according to the invention can be provided in a wide range of different shapes. Examples are flat burners, cylindrical burners and burners that have a conical or frustoconical shape. As known by the person skilled in the art a flat burner can have and mostly has a curved shape or can even have an undulated shape. The class of flat burners is distinguished from the other main class of gas premix burners comprising burners that have a conical, cylindrical or frustoconical shape. Flat burners with undulated shape or with an otherwise complex shape (double curved or at least

double curved) can be made according to the invention, preferably by using a woven wire mesh onto which the fiber based burner deck is placed.

[0025] A second aspect of the invention are boilers or instantaneous water heaters that comprise a gas premix burner as in the first aspect of the invention.

[0026] Elements of different embodiments and/or elements of different examples of the invention can be combined within the scope of the invention.

Brief Description of Figures in the Drawings

[0027]

Figure 1 shows a flat gas premix burner according to the invention.

Figure 2 shows a cross section of the flat gas premix burner of figure 1.

Figure 3 shows an inventive cylindrical burner.

Mode(s) for Carrying Out the Invention

[0028] Figure 1 shows a flat gas premix burner 100 according to the invention. Figure 2 shows a cross section according to line II-II of the flat gas premix burner 100 of figure 1. The gas premix burner 100 has a frame 110 and a fiber based burner deck 130 supported by a woven wire mesh 120. In the same way, the fiber based burner deck can be supported by a perforated metal plate or by an expanded metal sheet.

The fiber based burner deck 130 can e.g. have a length of 224 mm and a width of 70 mm.

The burner has an ignition electrode 160. The fiber based burner deck is thicker in the region 135 where ignition electrode 160 is located, than in other areas of the fiber based burner deck. This region 135 is e.g. circular in shape with a diameter of 25 mm. Preferably, and as in the example shown in figure 1, the fiber based burner deck is also in an elongated zone 137 of the fiber based burner deck thicker than in at least some other areas of the fiber based burner deck. This elongated zone 137 is starting from the region 135 at the ignition electrode where the fiber based burner deck is thicker. Preferably, the elongated zone 137 is positioned in the length direction of the burner 100. Preferably, the elongated zone 137 is positioned centrally with respect of the width of the fiber based burner deck 130. The elongated zone 137 e.g. has a width of 15 mm.

[0029] When using a knitted fabric as fiber based burner deck, it is preferred to have the elongated zone 137 aligned with the production direction of the knitted fabric.

[0030] Figure 3 shows a cylindrical gas premix burner 300. The burner 300 has a flange 305 with an inlet through which premix gas is entered into the cylindrical burner 300. The burner 300 has a cylindrical fiber based burner deck 330, supported by a cylindrical perforated metal plate (not shown on the figure). Alternatively, the fiber based burner deck 330 can be supported by a cylindrical

woven wire mesh or expanded metal sheet. The burner also has an end cap 340.

The burner has an ignition electrode 360. The fiber based burner deck is thicker in the region 335 where ignition electrode 360 is located, than in other areas of the fiber based burner deck. This region 335 is e.g. oval in shape. Preferably, and as in the example shown in figure 3, the fiber based burner deck is in one or more elongated zones 337 of the fiber based burner deck thicker than in at least some other areas of the fiber based burner deck. The elongated zones 337 are starting from the region 335 at the ignition electrode where the fiber based burner deck is thicker.

[0031] In the examples a fabric knitted from yarns made out of stainless steel fibers according to DIN 1.4767 was used as fiber based burner deck. The knitted fabric has a surface weight of 1.4 kg/m². Where the fabric is thicker, it has a thickness of 1.6 mm and a porosity of 89%. Outside the thicker zones, it has a thickness of 1.1 mm and a porosity of 82%.

[0032] The exemplary burners of the invention have shown to have reliable and fast ignition, without the occurrence of acoustic instabilities at ignition of the burner. Where the fiber based burner deck is thicker, the flow rate of premix gas is higher, resulting in it that ignition by the ignition electrode is facilitated.

In burners according to the invention in which the burner deck is thicker in one or more elongated zones of the fiber based burner deck ignition over the full surface burner deck is further facilitated as the thicker elongated zones showed to facilitate ignition of the full burner deck.

Claims

1. Gas premix burner comprising

- a perforated plate, a woven wire mesh or expanded metal sheet;
- a fiber based burner deck placed on said perforated plate, woven wire mesh or expanded metal sheet; wherein said fiber based burner deck has a same mass per unit of surface area over the full surface of the burner deck;
- an ignition electrode to ignite said gas premix burner,

characterized in that said fiber based burner deck is thicker in at least part of the region where said ignition electrode is located, than in at least some other areas of the fiber based burner deck.

2. Gas premix burner as in claim 1, wherein said part of the region in which said fiber based burner deck is thicker comprises a circular surface of at least 15 mm diameter.

3. Gas premix burner as in any of the preceding claims,

wherein the thickness of the fiber based burner deck where it is thicker is at least 40% higher than the thickness outside where it is thicker.

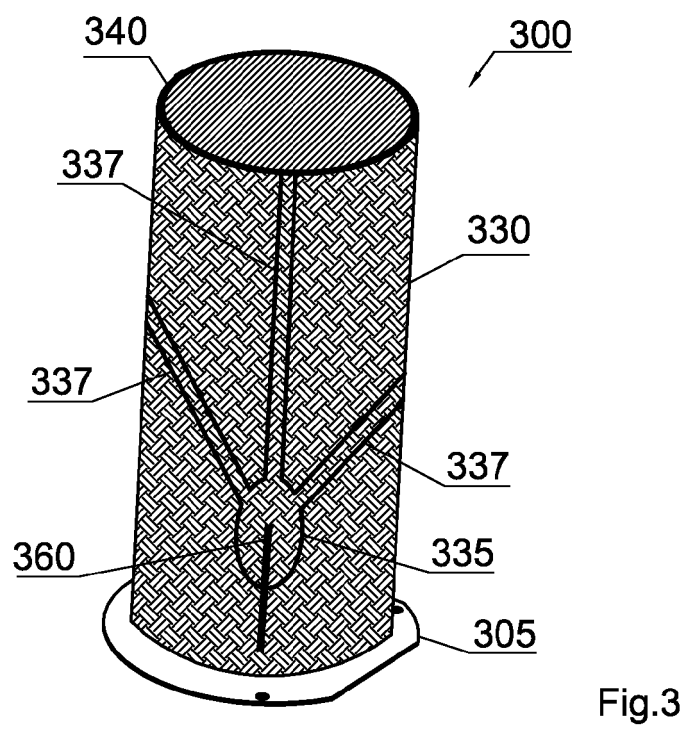
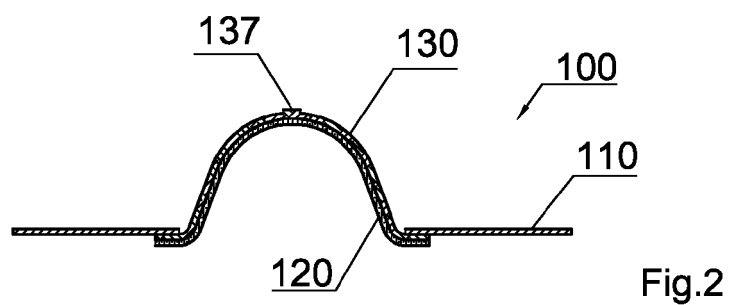
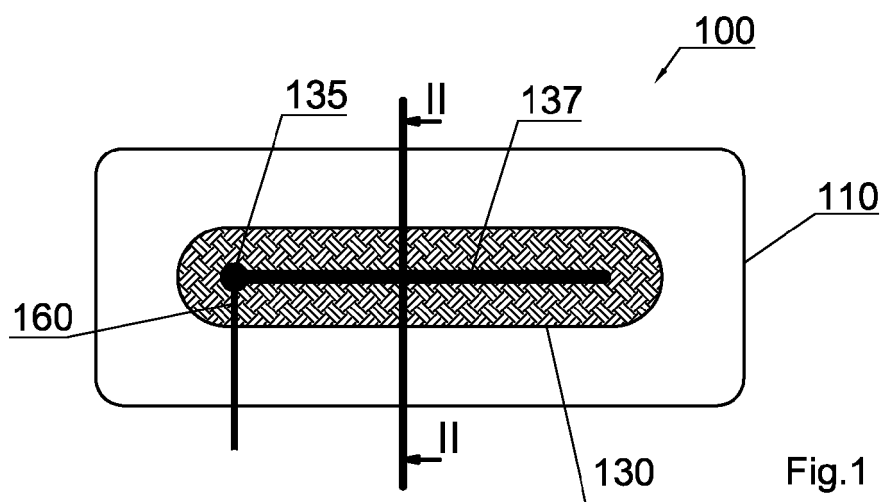
4. Gas premix burner as in any of the preceding claims, wherein the porosity of the fiber based burner deck where it is thicker is less than 92%. 5
5. Gas premix burner as in any of the preceding claims, wherein the porosity of the fiber based burner deck outside where it is thicker, is higher than 75%, but preferably below 85%. 10
6. Gas premix burner as in any of the preceding claims, wherein the fiber based burner deck comprises metal fibers, preferably stainless steel fibers. 15
7. Gas premix burner as in any of the preceding claims, wherein said fiber based burner deck is in one or more elongated zones of said fiber based burner deck thicker than in at least some other areas of the fiber based burner deck, wherein at least one of said elongated zones is starting from said at least part of the region at said ignition electrode where the fiber based burner deck is thicker. 20
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8. Gas premix burner as in claim 7, wherein said fiber based burner deck is a weft knitted fabric, preferably at least one of said elongated zones is substantially parallel with the production direction of said weft knitted fabric. 30
9. Boiler comprising a gas premix burner as in any of the preceding claims. 35
10. Instantaneous water heater comprising a gas premix burner as in claims 1 - 8. 40

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EUROPEAN SEARCH REPORT

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Place of search The Hague		Date of completion of the search 31 July 2013	Examiner Harder, Sebastian
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