Burners for gas boilers are provided. Such burners include those having a diffuser, suitable for diffusing pre-mixed fuel gases in a combustion chamber, the diffuser having a wall provided with a plurality of diffusion openings; and a distributor, suitable for distributing the combustion gases towards the diffuser, the distributor having a wall provided with a plurality of distribution openings; wherein the diffusion openings are positioned at a diffuser portion and the distribution openings are positioned at a distributor portion, in which the diffuser portion and the distributor portion are laterally offset to each other relative to the direction of the fuel gas flow through said distribution openings and diffusion openings.
HIGH-STABILITY BURNERS

[0001] The present invention relates to a high-stability burner. Particularly, the present invention relates to a high-stability burner for gas boilers.

[0002] Prior art gas boiler comprise: a duct for feeding a burner with a pre-mixed gas-air mixture, a burner for the production of heat by means of combustion of said mixture in a combustion chamber, and optionally a support element that can be connected to the heat exchanger and/or feed duct in order to ensure the locking of the combustion chamber and/or for the positioning of the burner relative to this combustion chamber.

[0003] The burner further comprises a diffuser for the pre-mixed gas of fuel and air to be conveyed therethrough and which defines a flame pattern for producing heat.

[0004] The diffuser usually comprises a wall provided with a plurality of openings and having an inner surface fluidically connected to the feed duct, and accordingly in contact with the unburnt mixture, and an outer surface on which the burning is carried out. These surfaces are designated herein as the feed surface and burning surface.

[0005] Upstream of the diffuser (with reference to the flow direction of the gas-air mixture) a distribution device, or distributor, can be further provided.

[0006] The distributor usually comprises a wall provided with a plurality of openings, configured such as to distribute the gas-air mixture in a substantially uniform manner, or in any case as desired, towards the diffuser wall.

[0007] In the known burners, the diffuser openings and the distributor openings are positioned at portions which, in the operating position, result to be matching to each other. In most cases, these portions are central portions of the distributor and diffuser.

[0008] As it is well known, the heat produced by the combustion of the combustion surface is carried by means of the hot combustion gases to a heat exchanger for heating a fluid, for example water, which is subsequently conveyed to utility equipment, for example a heating system for an industrial process, of dwelling environments or the like and/or sanitary water.

[0009] Due to the particular requirements for a controlled and differentiated heating, it is essential that the heating power of the burner can be changed.

[0010] The heating power of the burner can be piloted by changing the flow rate of the fuel or mixture fed to the diffuser. However, the amplitude of the heating power range, i.e. the so-called modulation (ratio of minimum power to maximum power) of prior art burners is limited. This is due to the fact that, when the mixture flow rate is not comprised within an optimum range which depends on the material, the specific passage area (ratio of the passage area to the wall area) and on the diffuser flow resistance, flame instability problems occur, which prevent the proper operation of the burner.

[0011] Particularly, as the heating power is increased, the combustion area, and consequently the flame, tends to move away from the diffuser with serious consequences from the point of view of safety and emission of polluting substances, such as carbon monoxide (CO).

[0012] In order to solve this instability problem, it is known the use of an additional distributor at the diffuser or the use of diffusers suitably shaped by means of moulding. Both solutions are, however, difficult to carry out and considerably engrave on manufacturing costs of the burner.

[0013] The object of the present invention is thus to provide a high-stability burner which allows a high power modulation while overcoming said problems of flame blow-off and the consequent polluting emission.

[0014] This and other objects are achieved by means of a burner for gas boiler comprising:

[0015] a diffuser, suitable to diffuse pre-mixed combustion gases into a combustion chamber, comprising a wall provided with a plurality of diffusion openings; and

[0016] a distributor, suitable to distribute the combustion gases on the diffuser, comprising a wall provided with a plurality of distribution openings;

[0017] wherein the diffusion openings are positioned at a diffuser portion and the distribution openings are positioned at a distribution portion, said portions being configured such that, in the operating position, the distribution openings result to be alternated with the diffusion openings relative to the mixture flow direction.

[0018] In other words, each straight line parallel to the mixture flow direction, i.e. substantially orthogonal to the burner, univocally intersects a distribution opening or a diffusion opening.

[0019] More precisely, each straight line substantially orthogonal to the burner only intersects the distributor portion in which the distribution openings are provided or the diffuser portion in which the diffusion openings are provided.

[0020] This burner achieves, with the diffuser surface being the same, an increase in the burner maximum work power, without being affected by flame blow-off problems. Accordingly, it achieves an increase in the maximum power per surface unit of the diffuser (maximum specific power). This implies an increase in the modulation range.

[0021] The burner of the invention further obtains, with the power being the same, a reduction in the diffuser surface and accordingly a reduction in the costs, in addition to an increase in the maximum specific power.

[0022] Furthermore, the reduction in the diffuser surface implies a reduction in the burner volume with obvious advantages in terms of manufacturing and transport of the latter.

[0023] Furthermore, the flame stability that can be obtained with the burner of the invention results in reduced emissions of CO, because a flame less blow-off from the burner is less polluting.

[0024] The term “openings” herein means through openings.

[0025] Preferably, said diffuser portion in which the diffusion openings are positioned corresponds to a central portion of the diffuser and said distributor portions in which the distribution openings are positioned corresponds to a peripheral portion of the distributor.

[0026] With such a configuration the mixture flow can be reduced at the diffuser peripheral portions, and the occurrence of the flame blow-off can be thus prevented, even with very high power modulations.

[0027] In order to better understand the invention and appreciate the advantages thereof, a description of several non-limiting exemplary embodiments of the inventive burner will be provided herein below with reference to the annexed drawings, in which:
FIG. 1 is a longitudinal sectional view of a boiler portion comprising a high-stability burner according to the present invention;

FIG. 2 is a longitudinal sectional view of a high stability burner according to a first embodiment of the invention;

FIG. 3 is a longitudinal sectional view of a burner for a gas boiler according to the prior art, and

FIG. 4 is a longitudinal sectional view of a high stability burner according to a second embodiment of the invention.

With reference to FIG. 1-4, a high stability burner for a gas boiler, is generally designated with numeral reference 1.

Particularly, the reference 1 designates a burner that produces heat by means of the combustion of a pre-mixed fuel gas, generally comprising fuel gas and air. Preferably, these combustion gases are completely pre-mixed, i.e. no further component is added to the mixture delivered to the burner.

The burner 1 comprises a diffuser 2, which is suitable to diffuse combustion gases into a combustion chamber 3 (indicated with a dotted line in FIG. 1).

The burner 1 is mounted to a frame 9. The latter can be connected to the combustion chamber 3 by means of connecting portions.

The frame 9 further defines an opening for the mixture of fuel and air to pass therethrough.

The diffuser 2 includes a wall provided with a plurality of diffusion openings 5. The inner surface of this wall is fluidically connected with the gas feeding duct and is accordingly called the feeding surface. The outer surface of this wall, i.e. the surface on which the combustion is carried out, is called the combustion surface.

The burner 1 also comprises a distributor 4, suitable to distribute the mixture to the diffuser 2, which is arranged upstream of the diffuser 2, with reference to the mixture flow direction 7.

The distributor 4 comprises a wall provided with a plurality of distribution openings 6.

According to the present invention, the diffusion openings 5 are positioned at a diffuser portion 2 and the distribution openings 6 are positioned at a distribution portion 4. These portions are configured such that, in the operating position, the distribution openings 6 result to be alternated with the diffusion openings 5 relative to the mixture flow direction 7.

The mixture flow direction 7 as outlined in FIG. 1-4 with arrows with which the numeral 7 is associated, is substantially orthogonal to the burner 1.

In other words, while in the prior art, as shown in FIG. 3, during the operation of the burner, i.e. after the assembly has been carried out, the distribution openings 6 correspond to the diffusion openings 5 and accordingly a straight line parallel to the mixture flow direction that crosses the former also crosses the latter, in the burner 1 of the present invention, a straight line parallel to the mixture flow direction only crosses the distribution openings 6 or the diffusion openings 5.

More precisely, according to the present invention, a straight line parallel to the mixture flow direction 7, only crosses the diffuser portion 2 in which the diffusion openings 5 are provided or the distributor portion 4 in which the distribution openings 6 are provided. This line, accordingly, does not cross both the diffuser portion 2 in which the diffusion openings 5 are provided and the distributor portion 4 in which the distribution openings 6 are provided, as it happens in the prior art.

In other words, where the distributor openings 4 are provided, the diffuser openings 2 are not provided, and vice versa.

In accordance with both embodiments of the invention shown in FIGS. 2 and 4, said portion of diffuser 2 in which the diffusion openings 5 corresponds to a central portion of the diffuser 2 and said portion of distributor 4 in which the distribution openings 6 are positioned corresponds to a peripheral portion of the distributor 4.

Particularly, in the first embodiment of the invention, shown in FIG. 2, the burner 1 is of a flat type, particularly rectangular, and said peripheral portion of the distributor 4, in which the distribution openings 6 are positioned, comprises a perimeter portion of the distributor 4, i.e. it extends at the four perimeter edges of the distributor 4.

According to the second embodiment of the invention, shown in FIG. 4, the burner 1 is of a three-dimensional type, particularly cylindrical, and said peripheral portion of the distributor 4, having the distribution openings 6, comprises a portion extending at the upper edge and a portion at the lower edge of the distributor 4.

It is possible to provide that this peripheral portion having the distribution openings 6 comprises a portion at only one of said upper and lower edges.

In FIG. 1, a heat exchanger 8 is schematically illustrated in contact with the combustion chamber 3, which is suitable to receive the heat produced from the combustion on the combustion surface of the diffuser 2.

The diffuser 2 is preferably made from a compact material having said diffusion openings 5.

It can comprise, at the portions having the diffusion openings 5, a net or a yarn, or fiber-woven wire, or ceramic mesh or a metal or ceramic sintered material.

Similarly, the distributor 4 comprises a plate which can be pierced or micro-stretched at those portions having the distribution openings 6.

Alternatively, it can comprise, at the portions having the distribution openings 6, a wire net or a porous material.

Those skilled in the art, with the aim of meeting contingent and specific requirements, will be able to carry out modifications and variations, which are however contemplated within the scope of protection of the present invention, to the high-stability burner 1 according to the present invention.

For example, the burner 1 could be an inner combustion hollow burner, such that described in the U.S. patent application Ser. No. 12/213,078 in the name of the same Applicant.

1-7. (canceled)

8. A burner for a gas boiler comprising:
   a diffuser suitable for diffusing pre-mixed fuel gases into a combustion chamber, said diffuser comprising a diffuser wall provided with a plurality of diffusion openings formed in a diffuser portion of said diffuser wall; and
   a distributor suitable for distributing the fuel gases towards the diffuser, said distributor comprising a distributor wall provided with a plurality of distribution openings formed in a distributor portion of said distributor wall; wherein said distributor portion and said diffuser portions being configured such that, in an operating position, the diffuser portion on which the diffusion openings are positioned
and the distributor portion on which the distribution openings are positioned are laterally offset to each other relative to the direction of the fuel gas flow through said distribution openings and diffusion openings.

9. The burner of claim 8, wherein said portion in which the diffusion openings are positioned corresponds to a central portion of the diffuser.

10. The burner of claim 8, wherein said distributor portion in which the distribution openings are positioned corresponds to a peripheral portion of the distributor.

11. The burner of claim 10, wherein the burner is of a flat type and said peripheral portion of the distributor comprises a portion at at least one of the perimeter edges of the distributor.

12. The burner of claim 10, wherein the burner is of a three-dimensional type and said peripheral portion of the distributor comprises a portion at at least one of the upper edge and the lower edge of the distributor.

13. The burner of claim 8, wherein said diffuser comprises a mesh comprising metal or ceramic fibers.

14. The burner of claim 8, wherein said distributor comprises a wire net.

15. The burner of claim 8, wherein said diffusion openings are overlapping with a region of the distributor wall having no distribution openings, and said distributor openings are overlapping with a region of the diffuser wall having no diffuser openings.

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