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(54) Premixed burner

(57) A premixed burner (1) for a gas boiler is described comprising a diffuser (2), suitable for diffusing premixed combustion gases in a combustion chamber, and an ionisation sensor (3) suitable for monitoring the ionisation current, wherein at least one portion of the diffuser (2), at the ionisation sensor (3), has a radius of curvature r and in that the ratio between the distance d of the ionisation sensor (3) from the diffuser (2) in said at least one portion with radius of curvature r and the radius of curvature r is comprised between 0.015 and 0.6, said radius of curvature r being not greater than 30 mm.

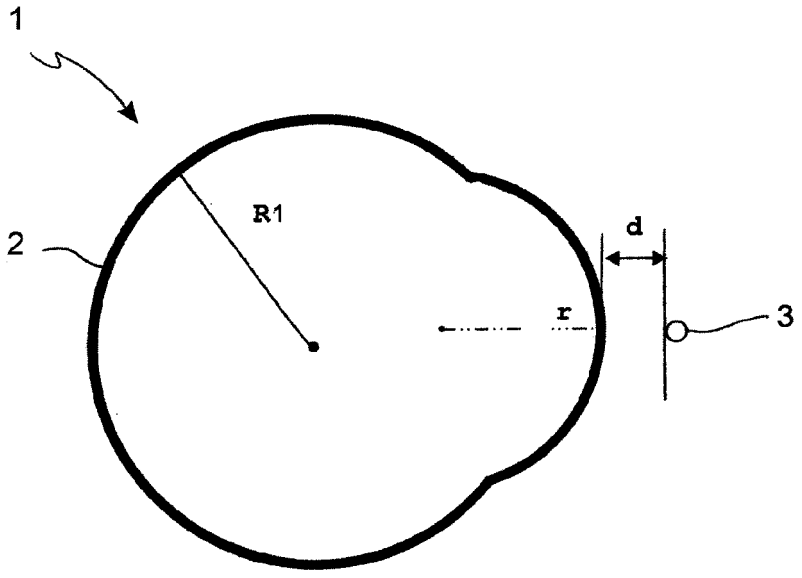

FIG. 2

EP 2 385 300 A1

Description

[0001] The present invention relates to a premixed burner, in particular a premixed burner for gas boiler provided with a ionisation sensor.

[0002] In a gas boiler, the burner produces heat by the combustion of a fuel and comburent mixture, generally a mixture of gas and air, which takes place in a combustion chamber.

[0003] The ionisation sensor is used for monitoring the combustion of such mixture introduced in the burner. Usually, such sensor verifies the presence of the flame and the combustion quality.

[0004] The burner comprises a diffuser wherethrough the premixed fuel and air gas is conveyed and which determines a flame scheme for heat production.

[0005] The diffuser usually comprises a wall provided with a plurality of openings and having an inner surface in fluid connection with a feeding conduit of the mixture and thus in contact with the unburnt mixture, and an outer surface whereon the combustion takes place. Therefore, such outer surface defines a surface that in the present context is called outer combustion surface.

[0006] Upstream of the diffuser (with reference to the flow direction of the gas-air mixture) there may further be provided a distribution device, or distributor, arranged on the diffuser side opposite to the combustion surface, usually comprising a wall with a plurality of through openings, configured so as to distribute the gas-air mixture in a substantially even manner or in any case in the desired manner towards the diffuser wall.

[0007] Upstream of the burner a fan or other ventilation means suitable for pushing the gas-air mixture towards the same burner is arranged.

[0008] It is known that the flame produced by the combustion of the mixture introduced in a burner, if combined with an electrical field, may generate an ionisation current passage in the area concerned by the flame.

[0009] The ionisation sensor is arranged in the proximity of the burner diffuser surface, so as to be in the area concerned by the ionisation produced by the flame and generate a current signal proportional to the air/gas ratio, that is, to the mixing ratio, which is indicative of the combustion quality.

[0010] If the current signal S produced by the ionisation sensor drops below a predetermined minimum value (S_{min}) or exceeds a predetermined maximum value (S_{max}), or becomes unstable, this means that the combustion is absent or of unacceptable quality and that it is therefore necessary to intervene for restoring regular combustion conditions.

[0011] In modulating burners, as the power at which the burner is operated decreases, the ionisation produced by the flame is substantially constant until the operating power of the burner reaches a minimum value (P_{min}) that in known burners is equal to about 20% of the nominal power of the burner. Once such minimum power value has been reached, the ionisation intensity suddenly decreases up to dropping below the limit sensitivity value of the sensor. Correspondingly, also the signal generated by the ionisation sensor remains substantially constant until the operating power becomes lower than P_{min}. At this power value, the signal suddenly drops below the value S_{min} and the ionisation sensor cannot be used anymore for a correct combustion adjustment and control.

[0012] Thus, in operating conditions at powers below about 20% of the nominal power, there is a sudden and clear decrease of the ionisation signal and thus the total inefficacy of the sensor for combustion monitoring purposes.

[0013] In other words, in known premixed burners at low power values the combustion cannot be monitored effectively with consequent obvious drawbacks.

[0014] In order to solve this problem, EP 1 036 984 discloses a premixed gas burner provided with a distributor comprising a plurality of holes for the mixture flow and a ionisation electrode, connected to a control device, wherein the surface load of the burner is increased in the ionisation electrode area assigning a pilot flame to the ionisation electrode or increasing the surface area of the openings for the mixture flow of the distributor in the ionisation electrode area.

[0015] Such known technique has the drawback of introducing potential thermal unbalances caused by the localised differential load, with consequent potential risks of breakage.

[0016] The object of the present invention therefore is to provide a premixed burner that allows extending the field of application of a ionisation sensor, associated with the burner, at operating conditions with powers supplied below 20%, that is with a modulation ratio below 1:5, which is free from said limits of the prior art.

[0017] A further object of the present invention is to provide a premixed burner, associated with a ionisation sensor, with a high power modulation, while obviating the problems of local thermal unbalance.

[0018] This and other objects are achieved by a premixed burner for a gas boiler comprising a diffuser, suitable for diffusing premixed combustion gases in a combustion chamber, and an ionisation sensor suitable for monitoring the ionisation current produced by the combustion, wherein at least one portion of the diffuser, at the ionisation sensor, has a radius of curvature r and wherein the ratio between the distance d of the ionisation sensor from the diffuser in said at least one portion with radius of curvature r and the radius of curvature r is comprised between 0.015 and 0.06, and wherein said radius of curvature r is not greater than 30 mm.

[0019] Thanks to the selection of the above-mentioned ratio between the distance d and the radius of curvature r, and in particular to the combination of such ratio with the specific range of values of r mentioned above it is possible to obtain a premixed burner with an ionisation sensor having a high field of application, and in particular operating even with a modulation ratio below 1:5.

[0020] Moreover, thanks to the combination of the

above-mentioned features, it is possible to achieve a flame stability also in case of increase of the heating power in premixed burners provided with ionisation sensor.

[0021] In other words, using the above-mentioned values of r and of d/r it is possible to increase the usage scope of a burner with ionisation sensor, the remaining parameters being unchanged, avoiding the increase of the specific load only at the sensor, as it happens in the burner disclosed by EP 1 036 984 and thus preventing undesired localised thermal phenomena. In particular, with the burner according to the present invention it is possible to achieve a modulation ratio equal to 1:10 with an effective combustion monitoring.

[0022] Moreover, the burner according to the present invention, thanks to the possibility of adjusting the combustion, provides the advantage of allowing to prevent the use of additional diaphragms and/or internal distributors suitable for preventing for example flashbacks, because since it allows operating in a constant mixture regime in terms of fuel-combustion supporter ratio, it does not exhibit risks of this kind.

[0023] To better understand the invention and appreciate its advantages, some exemplary non-limiting embodiments of the burner of the invention will now be described with reference to the annexed figures, wherein:

- figure 1 shows a cross sectional view of a gas burner provided with an ionisation sensor according to a first embodiment of the present invention;
- figure 2 shows a cross sectional view of a gas burner provided with an ionisation sensor according to a second embodiment of the invention; and
- figure 3 shows a schematic enlarged view of the burner of figure 1.

[0024] With reference to figures 1-3, a gas burner for a boiler is globally indicated with reference number 1.

[0025] In particular, reference number 1 indicates a burner that produces heat by the combustion of a premixed fuel gas, generally comprising fuel gas and air. Preferably, such fuel gases are totally premixed, that is, no further component is added to the mixture supplied to the burner.

[0026] Burner 1 comprises a diffuser 2, which is suitable for diffusing combustion gases in a combustion chamber, not shown in the figures.

[0027] Diffuser 2 includes a wall provided with a plurality of openings 4 whose inside surface fluidly communicates with the gas feeding conduit. The combustion takes place on the outer surface of such wall.

[0028] According to the preferred embodiments shown in the figures, burner 1 is of the cylindrical type and thus diffuser 2 has a cylindrical shape with a lateral surface having a radius of curvature R. Burner 1 may also be of the flat type or slightly concave with radius of curvature equal to R.

[0029] Burner 1 comprises an ionisation sensor 3 suitable for monitoring the ionisation current produced by the combustion. To this end, it is positioned outside diffuser 2, at the combustion area.

[0030] According to the present invention, at least one portion of diffuser 2, at the ionisation sensor 3, exhibits a radius of curvature r which is not higher than 30 mm. The ratio between distance d of the ionisation sensor 3 from diffuser 2 in said at least one portion with radius of curvature r and the radius of curvature r is comprised between 0.015 and 0.6.

[0031] According to preferred embodiments of the invention, the radius of curvature r is not less than 10 mm.

[0032] In the two embodiments shown in the figures, the portion of diffuser 2 with radius of curvature r has a convexity with respect to the ionisation sensor 3.

[0033] In that case, distance d is preferably not less than 7 mm and not higher than 12 mm.

[0034] And even more preferably, the radius of curvature r is not higher than 29.5 mm.

[0035] Figure 1 shows the first embodiment of the invention wherein diffuser 2 has a cylindrical configuration with radius of curvature R and the radius of curvature r of said portion of diffuser 2 at the ionisation sensor 3 coincides with the radius of curvature R of diffuser 2 of burner 1.

[0036] On the other hand, figure 2 shows the second embodiment of the present invention, wherein the radius of curvature r is the radius of curvature of a portion of diffuser 2 whereas the portions adjacent to such a portion have a radius of curvature R1 different from said radius of curvature r.

[0037] Preferably, such radius of curvature R1 of the portions adjacent to the portion of diffuser 2 with radius of curvature r is greater than the radius of curvature r.

[0038] Such radius of curvature R1 may coincide with the radius of diffuser 2.

[0039] As mentioned before, diffuser 2 comprises a plurality of openings 4 for the passage of the mixture in the combustion area. Preferably, such openings 4 are distributed in diffuser 2 homogeneously, as shown in figure 3. In other words, such openings are equally spaced from one another so as to not create areas with a different specific load or that may cause thermal unbalances.

[0040] The ionisation sensor 3 comprises an electrode that includes a metal bar.

[0041] In a known manner, diffuser 2 comprises a metal sheet or grid or a metal or ceramic mesh woven in wires or fibres. As an alternative, it may comprise a metal or ceramic sintered material or a compact material having openings 4.

[0042] Preferably, diffuser 2 comprises a metal woven mesh.

[0043] Such mesh extends on the entire surface of diffuser 2 or, as an alternative, only on the portions of diffuser 2 adjacent to the portion of diffuser 2 with a radius of curvature r. In other words, it is possible to provide for the metal mesh not to be provided at the ionisation sensor 3, in this way the mesh is prevented from tampering the ionisation signal or from short-circuiting the ionisation

sensor 3 should the mesh fibres or wires contact the sensor.

[0044] Diffuser 2 may comprise a distributor of the known type, suitable for distributing the mixture to diffuser 2 and arranged on the side of diffuser 2 opposite to the combustion chamber, that is, in the embodiments shown in the figures, within the cylindrical diffuser 2. However, according to preferred embodiments, diffuser 2 comprises a single diffuser layer, i.e. the distributor is not provided. In this way, in fact, it is possible to increase the power and thus obtain a wider modulation range using the same fans, for conveying the mixture towards the burner, or it is possible to reduce costs using less powerful fans, or reduce the operating costs with fans operating at reduced RPMs.

[0045] Of course, additional diaphragms of the known type may be inserted in burner 1, such as for example antiflashback diaphragms, that is, the diaphragms suitable for preventing flashbacks, however they would be deemed superfluous since as mentioned above, the burner according to the present invention does not exhibit risks of this type.

[0046] Within the scope of the above description and in the following claims, all numerical values indicating amounts, parameters, percentages and so on are always to be deemed as preceded by the term "about", if not otherwise stated. Moreover, all numerical value ranges include all possible combinations of the maximum and minimum numerical values and all possible intermediate ranges, besides those specifically indicated in the text.

[0047] A man skilled in the art may make further changes and adjustments to the gas burner for boilers according to the present invention in order to meet specific and incidental needs, all falling within the scope of protection of the present invention.

Claims

1. Premixed burner (1) for a gas boiler comprising a diffuser (2), suitable for diffusing premixed combustion gases in a combustion chamber, and an ionisation sensor (3) suitable for monitoring the ionisation current produced by the combustion, **characterised in that** at least one portion of the diffuser (2), at the ionisation sensor (3), has a radius of curvature r and **in that** the ratio between the distance d of the ionisation sensor (3) from the diffuser (2) in said at least one portion with radius of curvature r and the radius of curvature r is between 0.015 and 0.6, said radius of curvature r being not greater than 30 mm.

2. Gas burner (1) according to claim 1, wherein said radius of curvature r is not lower than 10 mm.

3. Premixed burner (1) according to claim 1 or 2, wherein said at least one portion of the diffuser (2) with radius of curvature r has a convexity with respect to the ionisation sensor (3).

4. Gas burner (1) according to claim 3, wherein said distance d is not lower than 7 mm and not greater than 12 mm.

5. Gas burner (1) according to claim 4, wherein the radius of curvature r is not greater than 29.5 mm.

6. Gas burner (1) according to any one of the previous claims, wherein the diffuser (2) has a cylindrical configuration with radius of curvature R and wherein the radius of curvature r of said at least one portion of the diffuser (2) at the ionisation sensor (3) coincides with the radius of curvature R of the diffuser (2) of the burner (1).

7. Gas burner (1) according to any one of claims 1 to 5, wherein the radius of curvature r is the radius of curvature of a portion of the diffuser (2) and wherein the portions adjacent to such a portion have a radius of curvature R1 different to said radius of curvature r.

8. Gas burner (1) according to claim 7, wherein said radius of curvature R1 of the portions adjacent to the portion of diffuser (2) with radius of curvature r is greater than the radius of curvature r.

9. Gas burner (1) according to any one of the previous claims, wherein the diffuser (2) comprises a plurality of openings (4) homogeneously distributed over its surface.

10. Gas burner (1) according to any one of the previous claims, wherein said ionisation sensor (3) comprises an electrode including a metal bar.

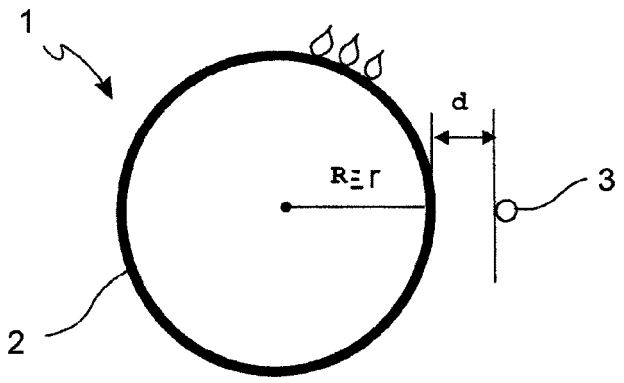

FIG. 1

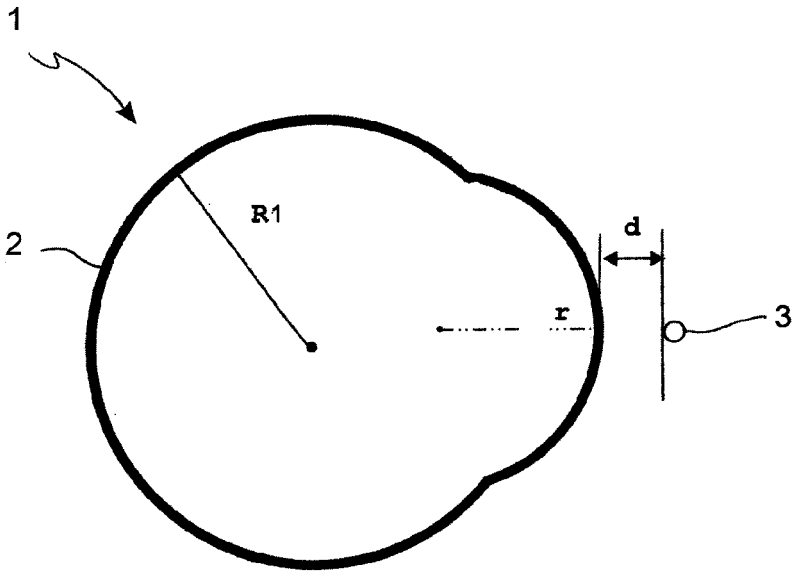

FIG. 2

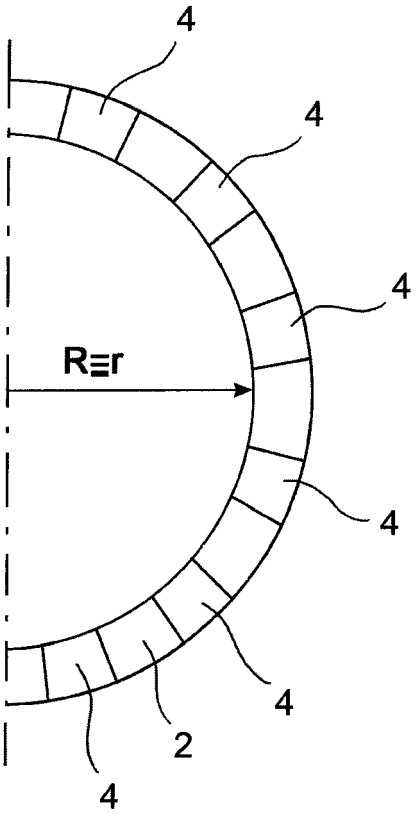

FIG. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 11 16 4797

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	30 August 2011	Mougey, Maurice

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