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(54) **Burner-heat exchange group**

(57) It is illustrated a burner-heat exchanger group (1) for a gas boiler, comprising:
- a burner (2) including a diffuser (3) suitable for diffusing premixed combustion gases in a combustion chamber (4); and
- a heat exchanger (5) adjacent to the combustion chamber (4);

wherein said burner-heat exchanger group (1) further comprises a heat accumulation barrier (6) made from porous material arranged between the diffuser (3) and a portion of the heat exchanger (5) and spaced apart from the diffuser (3) so as to define a first combustion area (7), between the burner (2) and the heat accumulation barrier (6), and a second combustion area (8), between the heat accumulation barrier (6) and the heat exchanger (5) and such as to accumulate heat in said first combustion area (7).

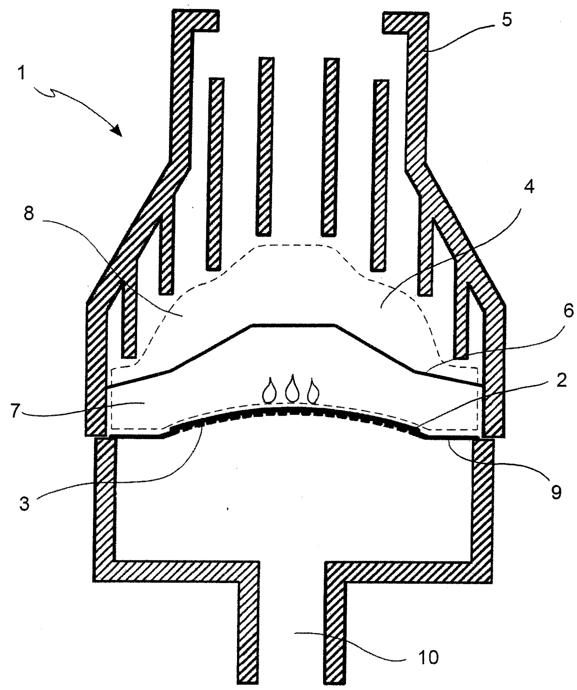

FIG. 1

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Description

[0001] The present invention describes a burner-heat exchanger group for gas boilers.

[0002] Gas boilers of the prior art comprise a conduit for feeding a burner with a premixed gas-air mixture, a burner for heat production through combustion of such mixture in a combustion chamber, and optionally a support element connectable to the heat exchanger and/or to the feeding conduit for ensuring the closure of the combustion chamber and/or for positioning the burner relative to such combustion chamber.

[0003] The burner further comprises a diffuser through which the premixed fuel and air gas is conveyed and which causes a flame pattern for heat production. The diffuser usually comprises a wall provided with a plurality of openings and having an inner surface in fluid communication with the feeding conduit and an outer surface whereon the combustion takes place. It therefore defines a surface that is herein called outer combustion surface.

[0004] 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 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.

[0005] As well known, the heat produced by the combustion on the outer side of the diffuser wall is conveyed by means of the hot combustion gases to a heat exchanger for heating a fluid, for example water, that is then conveyed to a utility, for example to a heating system of an industrial process, of living environments or the like, and/or of sanitary water.

[0006] The burner-heat exchanger groups for gas boilers of the prior art exhibit drawbacks related to the emissions of polluting substances, and in particular carbon monoxide (CO).

[0007] At present, chemical combustion catalysts are used for reducing the emissions of such polluting substances. However, they are very expensive and have a short life, with consequent drawbacks from the point of view of the group maintenance, besides economical drawbacks.

[0008] In some cases, in order to reduce said emissions, groups are used which comprise the so-called *"swirl"* burners wherein the combustion takes place in a highly turbulent state. Such groups exhibit the drawback of being expensive and cumbersome and thus in many cases, such as in household boilers, they cannot be used.

[0009] The object of the present invention is therefore to provide a burner-heat exchanger group for gas boilers having a reduced emission of polluting substances compared to the prior art groups while having such costs and dimensions as to make it suitable for all applications, including household ones.

[0010] These and other objects are achieved by a burner-heat exchanger group for gas boilers comprising:

- a burner including a diffuser suitable for diffusing premixed combustion gases in a combustion chamber; and
- a heat exchanger adjacent to the combustion chamber;
  wherein said burner-heat exchanger group comprises a heat accumulation barrier of the continuous type made from porous material arranged between the diffuser and a portion of the heat exchanger and spaced apart from the diffuser so as to define a first combustion area, between the burner and the heat accumulation barrier, and a second combustion area, between the heat accumulation barrier and the heat exchanger and such as to accumulate heat in said first combustion area, and configured so that all the combustion gases passing from the first combustion area to the second combustion area pass therethrough.

[0011] Thanks to the presence of a heat accumulation barrier with the above-mentioned features it is possible to increase the temperature in the first combustion area, that is, in the area close to the diffuser, and thus to reduce the unburnt products such as CO and other harmful substances.

[0012] Moreover, the above-mentioned heat accumulation barrier can be configured so as to increase the resistance to the flow passage.

[0013] Within the scope of the present invention and in the following claims, by the term "combustion gas" it is meant a fuel-combustive agent mixture, for example methane and air.

[0014] In the present context, the expression "of the continuous type" referred to the heat accumulation barrier indicates that it exhibits no openings or other discontinuities besides the porosity of the material it is made from.

[0015] To better understand the invention and appreciate its advantages, some exemplary non-limiting embodiments thereof will now be described with reference to the annexed figures, wherein:

- figure 1 shows a longitudinal section view of a burner-heat exchanger group for gas boilers according to a first embodiment of the invention;
- figure 2 shows a longitudinal section view of a burner-heat exchanger group for gas boilers according to a second embodiment of the invention;
- figure 3 shows a schematic elevation view of a burner-heat exchanger group for gas boilers according to a third embodiment of the invention;
- figure 4 shows a view according to section A-A of figure 3;
- figure 5 shows two schematic diagrams of the gas temperature within the combustion chamber of a burner-heat exchanger group, respectively accord-

ing to the prior art (with dashed line) and according to the present invention (with continuous line).

[0016] With reference to figures 1-4, a burner-heat exchanger group for gas boilers is globally indicated with reference number 1.

[0017] In particular, reference number 1 indicates a group wherein a burner produces heat by the combustion of a premixed fuel gas, generally comprising fuel gas and air. Preferably but not necessarily, such fuel gases are totally premixed, that is, no further component is added to the mixture supplied to the burner.

[0018] The burner-heat exchanger group 1 comprises a burner 2 mounted on a frame 9. The latter is fixed to the exchanger, or to the mixture feeding system, either directly or through a support element, so as to identify a combustion chamber 4 (indicated with the dashed line in figure 1).

[0019] Burner 2 is provided with a diffuser 3 suitable for diffusing the premixed combustion gases in the combustion chamber 4. The burner is also provided with a distributor of the known type not shown in the figures.

[0020] As known, such diffuser 3 comprises a wall provided with a plurality of openings whose inner surface is in fluid communication with the gas feeding conduit. The combustion takes place on the outer surface of such wall, that is, on the side facing exchanger 5.

[0021] Burner 2 may exhibit a substantially flat, or slightly concave shape, as shown in figures 1 and 2. As an alternative it may be of the cylindrical or frusto-conical type, as shown in figures 3 and 4. Of course, the geometry of the burner-heat exchanger group 1 and of the relevant elements varies according to the type of burner 2.

[0022] Group 1 comprises a heat exchanger 5 that at the top delimits the volume portion that serves as combustion chamber 4. Generally, such volume portion is delimited by the ends of the heat exchange fins of exchanger 5.

[0023] According to the present invention, group 1 also comprises a heat accumulation barrier 6 arranged between diffuser 3 and the portion of heat exchanger 5 adjacent to the combustion chamber 4 so as to define a first combustion area 7 and a second combustion area 8 and so as to accumulate heat in said first combustion area 7. In particular, the first combustion area 7 is comprised between burner 2 and the heat accumulation barrier 6 and the second combustion area 8 is comprised between the same heat accumulation barrier 6 and the portion of the heat exchanger 5 that delimits the combustion chamber 4.

[0024] Preferably, the ratio between said first combustion area 7 and said second combustion area 8 is within the range 0.05 - 40.

[0025] The heat accumulation barrier 6 is suitable for absorbing thermal energy due to the combustion gases and for redistributing it through radiant emission with the effect of accumulating heat in the first combustion area 7.

[0026] Thanks to said heat accumulation barrier 6, the temperature within the first combustion area 7 is higher than the prior art and thus the forming of polluting products is limited.

[0027] This is well shown in the diagram of figure 5. Such diagram shows the temperature (T) trend of the mixture gases based on the distance from diffuser 3 (D), starting from the flame front, passing through the heat accumulation barrier 6, to end close to the surface of the heat exchanger 5 and pass it through. In particular, the dashed line shows the trend in the case of known burner-heat exchanger groups, whereas the continuous line shows the diagram of group 1 according to the present invention.

[0028] The inner surface of the heat accumulation barrier 6 is positioned at a distance D1 from diffuser 3 and the outer surface thereof is at a distance D2. As may be seen, in the area comprised between diffuser 3 and the heat accumulation barrier 6, the temperature is higher than the temperature that would be found in known groups of the same type. On the contrary, in the area comprised between the heat accumulation barrier 6 and the heat exchanger 5, the temperature is lower than the one that would be found in known groups of the same type.

[0029] At the heat accumulation barrier 6, the gas temperature varies from T1 to T2 in a reduced spatial interval. In particular, the gas temperature upstream of the heat accumulation barrier 6 is equal to T1 and the gas temperature downstream of such barrier 6 is equal to T2. In fact, close to the heat accumulation barrier 6, the thermal energy is transferred by convection from the fluid to the barrier 6 itself. The heat accumulation barrier 6 therefore creates a greater temperature difference between the first combustion area 7 and the second combustion area 8. This thermal jump due to the absorption by convection is caused also by the radiant effect since the heat accumulation barrier 6 radiates thermal energy further increasing the gas temperature in the first combustion area 7. In other words, barrier 6 creates a temperature gradient ΔT equal to T1 - T2.

[0030] Moreover, the heat accumulation barrier 6 may be configured so as to increase the resistance to the flow passage.

[0031] According to a preferred embodiment of the present invention, the heat accumulation barrier 6 is made from a catalytically inert material. In the present context, the expression "catalytically inert material" denotes a material that does not modify the chemical combustion process thanks to its chemical composition, that is, a material that does not provide an alternative reactive combustion path.

[0032] Influencing the fuel oxidation process without altering the chemical path thereof allows using commonly used materials (ceramic, steel) whose cost is much lower than the catalytic materials used in the known groups for catalysing the combustion.

[0033] Moreover, the efficacy of the heat accumulation barrier 6 of a catalytically inert material is not subject to deterioration, as it happens, on the other hand, for the catalytic materials that require periodical replacement, with consequent increase in costs.

[0034] According to one embodiment of the present invention, the heat accumulation barrier 6 is made from a homogeneous material, that is, non-stratified.

[0035] According to the first embodiment of the present invention, shown in figure 1, the heat accumulation barrier 6 is connected to the heat exchanger 5. In particular, it is connected to the end of the heat exchanger 5 that is closer to burner 2.

[0036] On the other hand, according to the second embodiment of the present invention, shown in figure 2, the heat accumulation barrier 6 is connected to burner 2, in particular to frame 9 of burner 2.

[0037] Preferably, said heat accumulation barrier 6, in the connection point with burner 2 or with the heat exchanger 5 is thermally insulated therefrom so as to prevent or at least limit the heat dispersions by conduction.

[0038] The heat accumulation barrier 6 may be made from a material selected from: Fe-Cr-Al alloys; Ni-Cr alloys; Si-C alloys; refractory ceramic materials such as Al_2O_3; aluminosilicate materials; cordierite. Preferably, the heat accumulation barrier 6 is made from a refractory metal material resistant to high temperatures such as Ni-Cr alloys.

[0039] Barrier 6 is of the continuous type, that is, it exhibits no openings or other discontinuities except for those intrinsic of the porous material it is made from.

[0040] Moreover, it is configured so that all the combustion gases passing from the first combustion area 7 to the second combustion area 8 pass therethrough, that is, through the porosities thereof.

[0041] According to preferred embodiments, the empty/full ratio of the porous material constituting the heat accumulation barrier 6 is higher than 40%. In this way it is possible to ensure that the combustion gases evenly distribute the heat on the heat accumulation barrier preventing the forming of fluid regions or fluid veins not involved in the heat exchange.

[0042] In the burner-heat exchanger group 1, according to preferred embodiments of the invention, the heat accumulation barrier 6 is spaced apart from the diffuser 3 by a distance ranging from about 2 cm to about 8 cm. Of course, in boilers whose dimensions are particularly large, for example in boilers for industrial uses, such distances will be suitably calculated proportionally to the dimensions of group 1.

[0043] Group 1 of the invention further comprises an ignition electrode not shown in the figures, which may be arranged in the first combustion area 7.

[0044] According to some embodiments, such ignition electrode may be equally spaced apart from diffuser 3 and from the heat accumulation barrier 6. In particular, it may be arranged at a distance ranging from about 5 mm to about 10 mm from both of them.

[0045] The heat accumulation barrier 6 has such a shape as to withstand heat deformations. In other words, the shape of barrier 6 is such that, deforming by the effect of the heat expansions, it takes a suitable predetermined shape without breaking or losing functionality.

[0046] In the embodiments shown in figures 1 and 2, barrier 6 is a box-shaped or plate-shaped wall, in particular it comprises a wall with a profile including a portion perpendicular to the flow direction of the fuel-combustive agent mixture, two outer portions for the connection to group 1 and two connecting portions between said portion perpendicular to the flow direction and said connecting portions.

[0047] In the embodiment shown in figures 3 and 4, that is, in the case of a cylindrical burner 2, barrier 6 is cylindrical as well.

[0048] Moreover, said heat accumulation barrier 6 exhibits stiffening ribs suitable for preventing breakage.

[0049] The present invention also relates to a gas boiler comprising a burner-heat exchanger group 1 as described above.

[0050] Moreover, the present invention discloses a method for heating a fluid through combustion of a premixed fuel-combustive agent mixture comprising the steps of:

- providing a flow of said mixture;
- conveying said flow inside a burner-heat exchanger group 1 provided with a diffuser 3;
- diffusing said mixture inside a combustion chamber 4 through the diffuser 3;
- thermally radiating the mixture in a first combustion area 7 of the combustion chamber 4 so as to accumulate thermal energy in such a first combustion area 7.

[0051] Preferably, the step of thermally radiating the mixture in a first combustion area 7 is carried out by means of the heat accumulation barrier 6 described above.

[0052] 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.

[0053] It is clear that a man skilled in the art may make further changes and adjustments to the burner-heat exchanger group for gas 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. Burner-heat exchanger group (1) for a gas boiler comprising:

- a burner (2) including a diffuser (3) suitable for diffusing premixed combustion gases in a combustion chamber (4); and
- a heat exchanger (5) adjacent to the combustion chamber (4);
characterised in that it comprises a heat accumulation barrier (6) of the continuous type made from porous material arranged between the diffuser (3) and a portion of the heat exchanger (5) and spaced apart from the diffuser (3) so as to define a first combustion area (7), between the burner (2) and the heat accumulation barrier (6), and a second combustion area (8), between the heat accumulation barrier (6) and the heat exchanger (5) and such as to accumulate heat in said first combustion area (7), and configured so that all the combustion gases passing from the first combustion area (7) to the second combustion area (8) pass therethrough.

2. Burner-heat exchanger group (1) according to claim 1, wherein said heat accumulation barrier (6) is catalytically inert.

3. Burner-heat exchanger group (1) according to claim 1 or 2, wherein said heat accumulation barrier (6) is made from homogeneous material.

4. Burner-heat exchanger group (1) according to any one of the previous claims, wherein said heat accumulation barrier (6) is made from a material selected among: Fe-Cr-Al alloys; Ni-Cr alloys; Si-C alloys; refractory ceramic materials; aluminosilicate materials; cordierite.

5. Burner-heat exchanger group (1) according to any one of the previous claims, wherein the empty/full ratio of the porous material constituting the heat accumulation barrier (6) is higher than 40%.

6. Burner-heat exchanger group (1) according to any one of the previous claims, wherein the ratio between said first combustion area (7) and said second combustion area (8) is within the range 0.05 - 40.

7. Burner-heat exchanger group (1) according to any one of the previous claims, wherein said heat accumulation barrier (6) is spaced apart from the diffuser (3) by a distance ranging from about 2 cm and about 8 cm.

8. Gas boiler comprising a burner-heat exchanger group (1) according to any one of the previous claims.

9. Method for heating a fluid through combustion of a premixed fuel-combustive agent mixture comprising the steps of:

- providing a flow of said mixture;
- conveying said flow inside a burner-heat exchanger group (1) provided with a diffuser (3);
- diffusing said mixture inside a combustion chamber (4) through the diffuser (3);
- thermally radiating the mixture in a first combustion area (7) of the combustion chamber (4) so as to accumulate thermal energy in such a first combustion area (7).

10. Method according to claim 9, wherein the step of thermally radiating the mixture in a first combustion area (7) is carried out by means of a heat accumulation barrier (6).

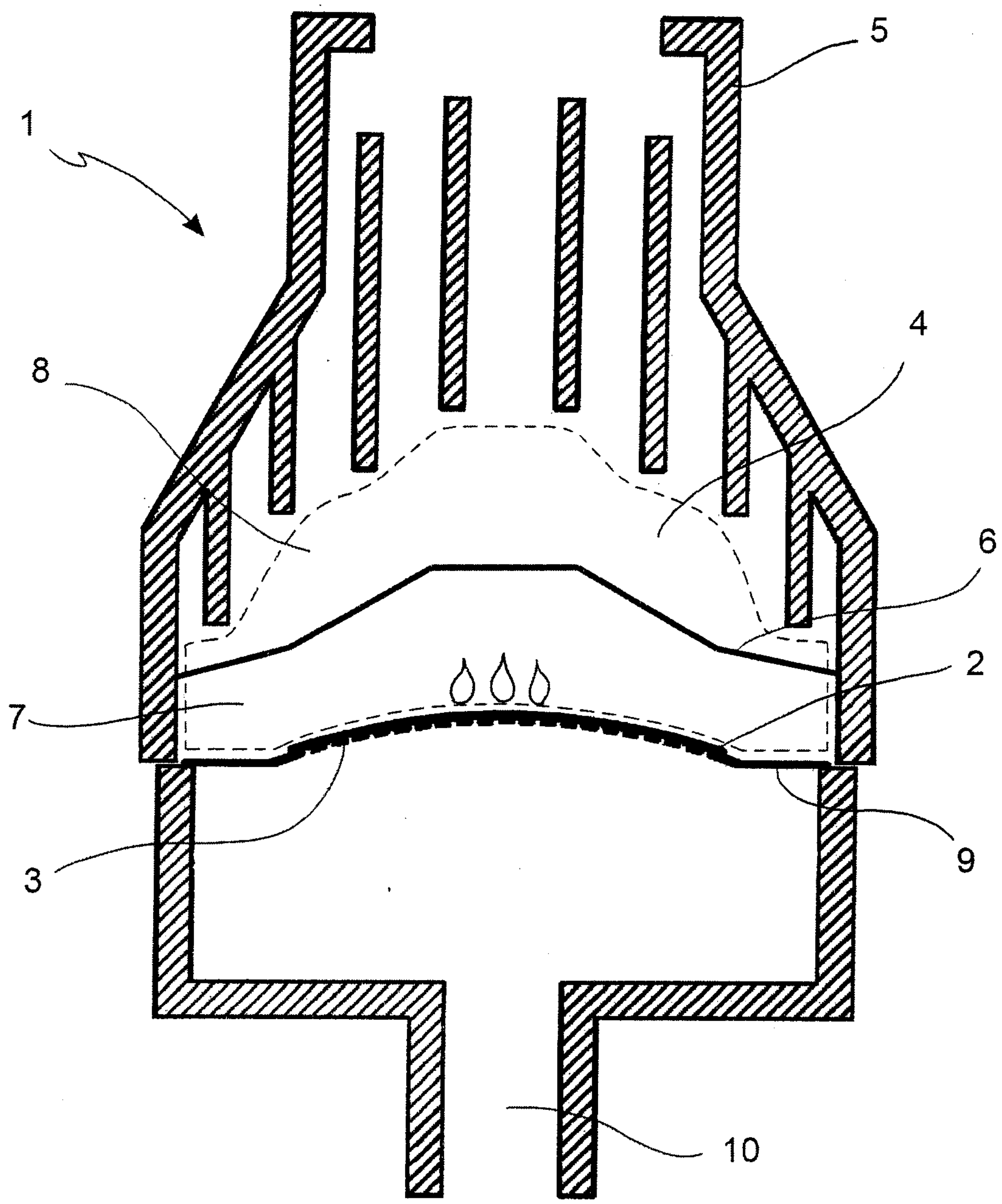

FIG. 1

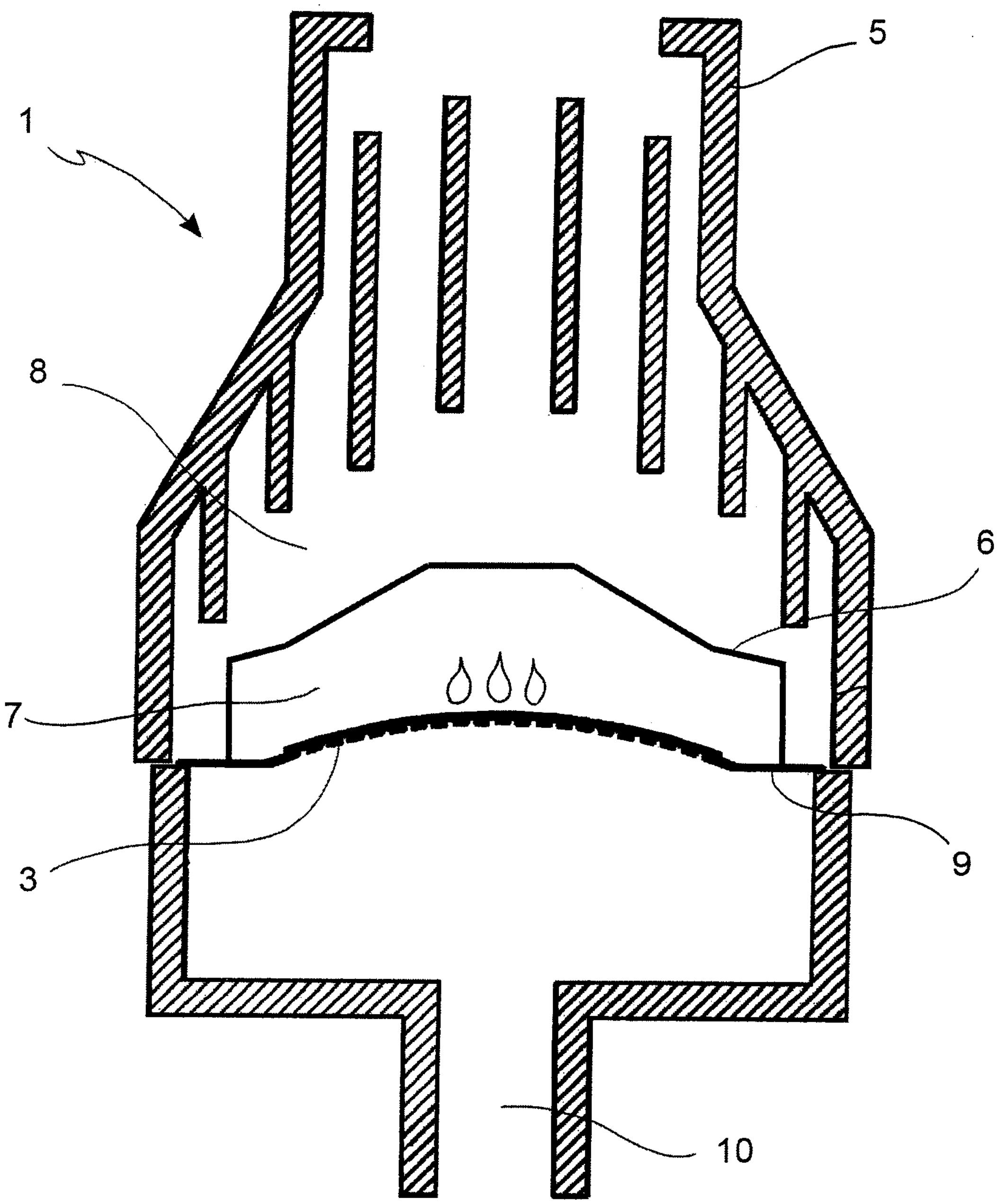

FIG. 2

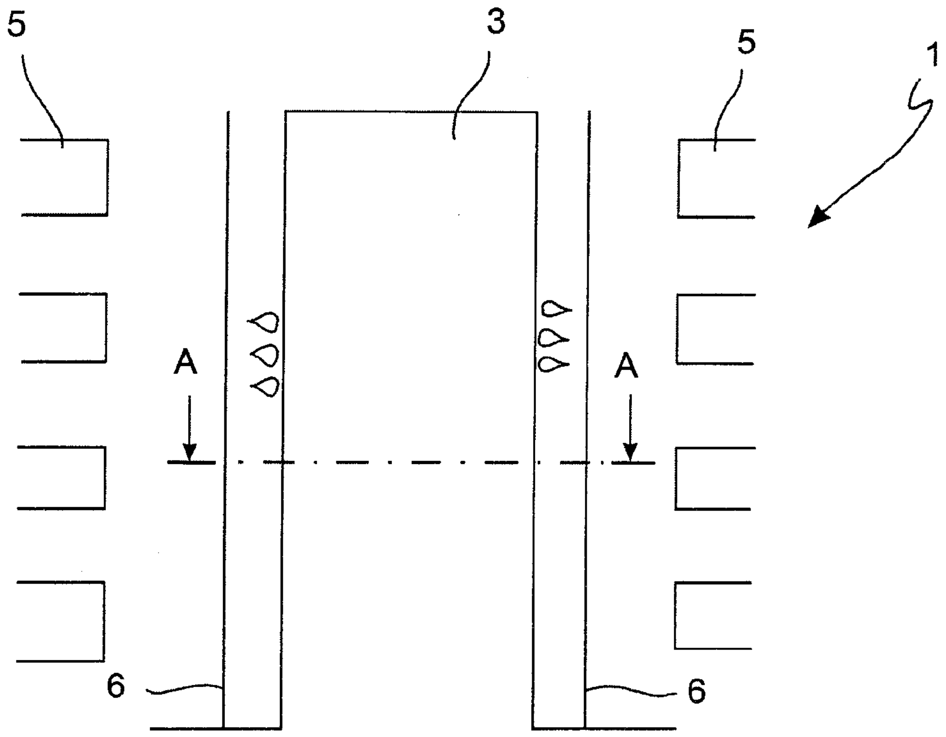

FIG. 3

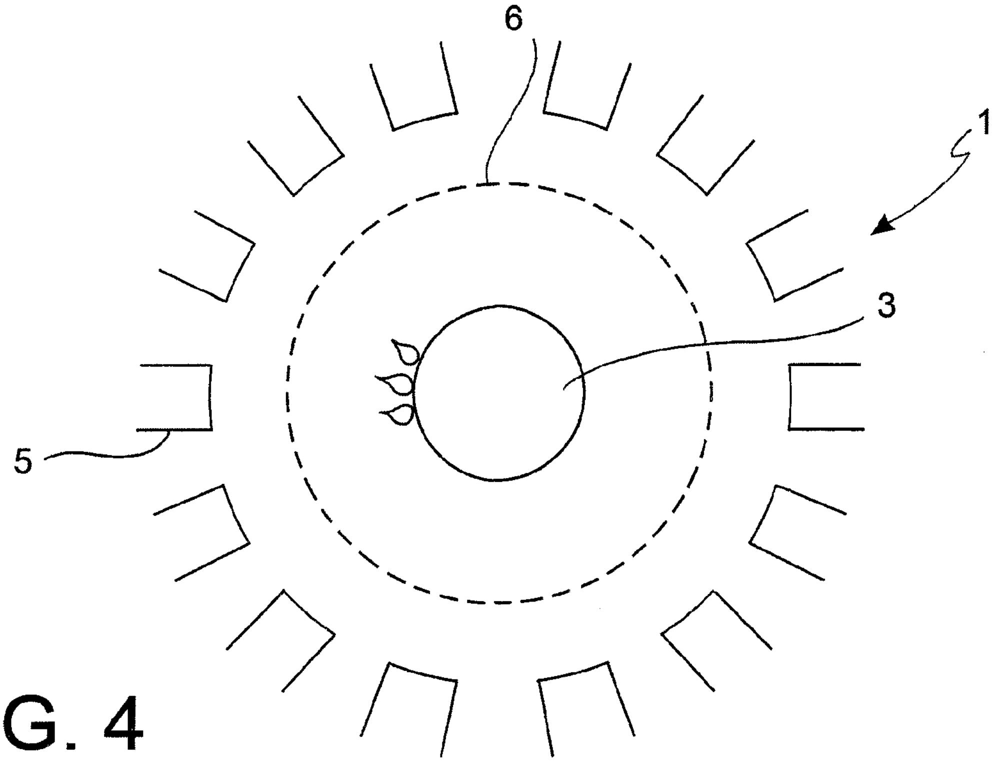

FIG. 4

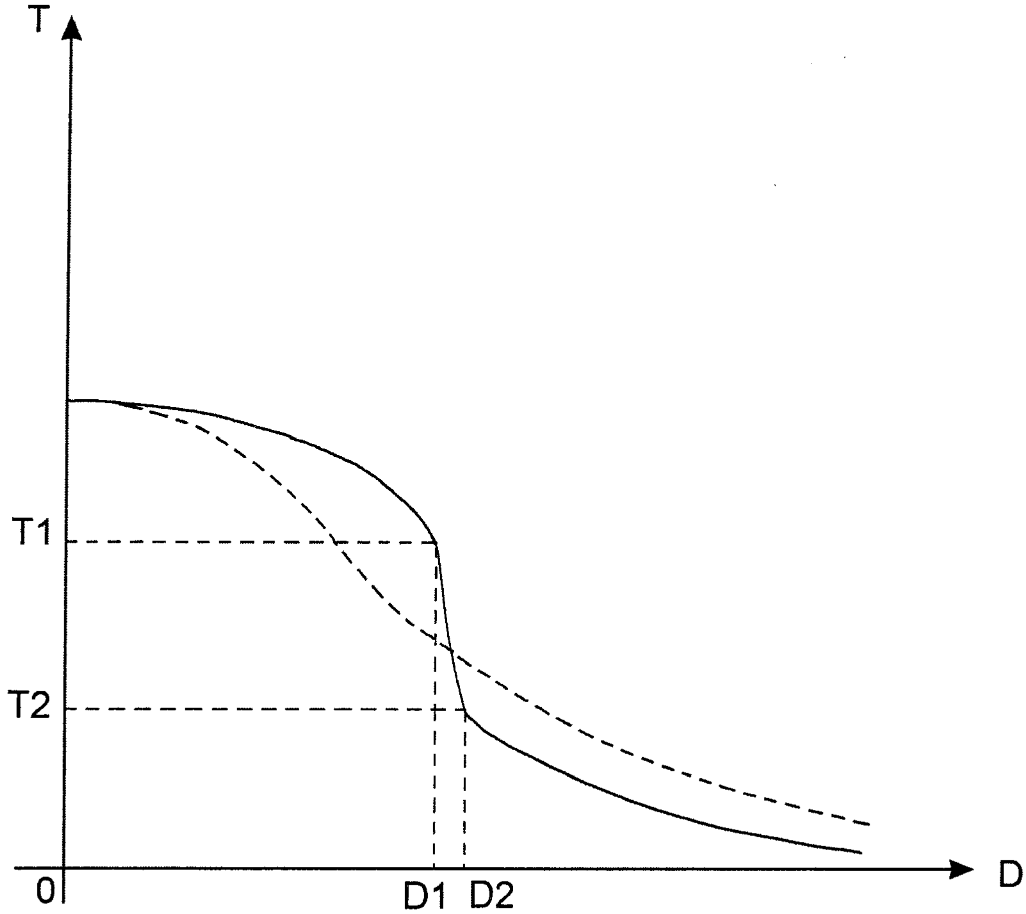

FIG. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 11 16 4787

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	DE 296 11 061 U1 (VIESSMANN WERKE KG [DE]) 29 August 1996 (1996-08-29) * page 1, lines 1-5 * * page 2, line 12 - page 6, line 7 * * figures 1-5 *	1-10	INV. F24H1/26
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The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	27 September 2011	Schwaller, Vincent

CATEGORY OF CITED DOCUMENTS

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