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(54) Burner assembly and burner head for burning fuel/comburent gaseous mixtures

Brennerbaueinheit und Brennerkopf zur Gasmischungsverbrennung

Assemblage de brûleurs et tête ascociée pour la combustion de mélanges gazeux

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- **PATENT ABSTRACTS OF JAPAN vol. 009, no. 149 (M-390), 25 June 1985 (1985-06-25) & JP 60 026210 A (MATSUSHITA DENKI SANGYO KK), 9 February 1985 (1985-02-09)**

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Description

Field of the invention

[0001] The present invention relates to a burner assembly for fuel/comburent gaseous mixtures, and respectively to a combustion module and to a boiler including the aforementioned burner assembly.

[0002] More particularly, the present invention relates to a burner assembly of the complete pre-mixing type for heating systems for civil use, that is, a burner assembly capable of performing the combustion of a gaseous mixture in which fuel and comburent are previously mixed according to a (stoichiometric or with a slight excess of air) ratio adapted to ensure the complete combustion of the combustible gas.

Background Art

[0003] In the field of low-power gas heating systems, such as for example combined boilers or condensation boilers for domestic use, burner assemblies have been known for a long time, which comprise a burner head provided with a plurality of openings for delivering a fuel/comburent gaseous mixture ignited by a lighting electrode. The mixture is sent to said head through suitable feeding means comprising a duct, to which a gaseous comburent - generally air - and a gaseous fuel - generally gas delivered by the civic distribution network - are fed.

[0004] A first type of burner assemblies largely widespread on the market comprises the so-called "aerated" burner assemblies, in which the combustion air is partly pre-mixed with the combustible gas upstream of the burner head (primary air) and partly fed downstream of the latter to complete the combustion (secondary air).

[0005] An example of burner head for aerated assemblies is described in British patent application GB 2 213 924 A. Said burner head comprises a pair of independent sections which are individually fed with a gas/air gaseous mixture including just primary air and, respectively, with a gas/air gaseous mixture including a lower quantity of air, or just with gas without any addition of air. In particular, said burner head is especially suitable to produce a multicoloured variegated flame which is particularly pleasant from the aesthetic point of view.

[0006] Nevertheless, for the purpose of carrying out a combustion as much complete as possible, the aerated burner assemblies must necessarily operate with a considerable excess of air with respect to the stoichiometric ratio; said excess of air causes a series of drawbacks, such as the practical impossibility of reducing the size of the burner head due to the consequent low density of the flame, the emission of quite a large amount of harmful gases, above all nitrogen oxides (NO_x), and a limited combustion efficiency.

[0007] As an alternative to aerated burner assemblies, and in the range of thermal powers over about 50KW, it is also known the use of the so-called "blown" burner assemblies, which do not have a burner head, and by means of which a highly turbulent flame is generated by independently feeding the gaseous fuel and the combustion air to a mixing area which is positioned immediately upstream of the flame. Generally, blown burner assemblies comprise for this purpose a plurality of nozzles for feeding the gaseous fuel, around which air is fed at a high speed by a blower.

[0008] Although blown burner assemblies have long been widespread on the market, they have many undesirable drawbacks, among which the high noise level of the flame and a limited capacity of thermal power modulation (not higher than 3:1) with respect to the actual requirements of the users.

[0009] For the purpose of overcoming the aforementioned drawbacks in some way, it was proposed - especially in low-power heating systems for domestic use (that is for thermal powers nor exceeding 50-60 KW) - to use the so-called complete pre-mixing burner assemblies, comprising a mixing duct mounted downstream or upstream of an air-feeding blower, and of a gas-feeding duct.

[0010] In fact, said burner assemblies, which are fed with gas/air mixtures comprising the whole quantity of air needed for combustion, ensure a substantially complete combustion of the combustible gas also when small-size burner heads are used, and they allow to achieve a greater combustion efficiency, a lower environmental impact, smaller sizes and a lower cost with respect to the aerated assemblies.

[0011] European patent application EP 0 331 037, for example, describes a complete pre-mixing burner assembly capable to ensure the complete combustion of the gaseous fuel, so as to reduce the production of nitric oxides.

[0012] Said burner assembly comprises a plurality of first burner heads for delivering a first fuel/comburent gaseous mixture having a high concentration of fuel, and a plurality of second burner heads, respectively positioned between said first heads, for delivering a second fuel/comburent gaseous mixture having a low concentration of fuel.

[0013] Said first and second burner heads are independently fed by respective delivery and mixing ducts.

[0014] European patent application EP 0 866 270, on the other hand, describes a complete pre-mixing burner assembly in which combustion air is fed by a blower and combustion gas is fed in a regulated fashion via individual conduits to burner zones. For connecting and disconnecting the gas feed to individual burning zones, on/off valves are provided in the corresponding combustion gas individual conduits.

[0015] Nevertheless, also the aforementioned complete pre-mixing burner heads have some drawbacks which have not been overcome so far and which limit their spreading on the market.

[0016] A first drawback is related to their limited capacity of thermal power modulation (which typically is in

the range 5-6:1) with respect to the actual requirements of the users (just think, for example, to combined boilers, wherein the power required for the production of hot sanitary water is ever-increasing, whereas the power required for domestic heating is decreasing due to the high levels of insulation of modern houses).

[0017] A second drawback is related to the fact that the above advantages of smaller sizes and lower costs may be achieved, with the presently available components manufactured on a large scale, only for a relatively limited range of thermal powers (not higher than 50 - 60 KW), the achievement of higher powers remaining a feature of the aforementioned aerated or blown burner assemblies.

[0018] A still different kind of burner assemblies known in the art are the so-called "hybrid burners" which combine the features of an "aerated" burner and of a "catalytic" burner. Japanese patent application JP 60-026210 discloses a burner assembly of this kind which comprises a mixture tube in gas communication with a plate-shaped catalyst. The mixture tube is divided in two passages by a partition wall so that, in operation, the combustible gases injected towards the passages defined within the mixture tube suck primary air from the opening edge thereof, whereupon the gas and air mixture then flows into spaced-apart combustion parts in order to be emitted and combusted from a wire net.

Summary of the invention

[0019] The technical problem underlying the present invention is that of providing an easy-to-make, low-cost burner assembly of the complete pre-mixing type adapted on the one side to attain a high range of thermal power modulation and, on the other side, to deliver a thermal power comparable to that of the aerated or blown burner assemblies.

[0020] According to a first aspect of the invention, said problem is solved by a complete pre-mixing burner assembly as defined in the accompanying claim 1.

[0021] Thanks to the presence of several complete pre-mixing delivery sections, which are reciprocally separated in a fluid-tight manner and which may be independently fed, the burner assembly of the invention advantageously allows to achieve a modulation range of thermal power which is significantly wider than that of the aerated, blown or pre-mixed burner assemblies of the prior art, such range being equal to the sum of the modulation ranges achievable by each delivery section.

[0022] In addition, thanks to the presence of delivery sections which may be independently fed, the burner assembly of the invention advantageously allows to ensure said wide modulation range of thermal power not just for those powers that so far could be achieved only by aerated or blown burners (powers ranging between 100 and 120 KW), but also for reduced thermal powers (ranging between 20-30 KW) by simply selecting the size of the means used to feed the fuel/comburent gaseous mixture to each delivery section.

[0023] In fact, the overall nominal thermal power of the burner assembly of the invention is almost equal to the sum of the single thermal powers which may be delivered by each independent delivery section of the burner head.

[0024] In addition, unlike the burner head for aerated assemblies described in the aforementioned patent application GB 2 213 924, said advantageous features may be achieved without any by-pass of the gaseous mixture from one delivery section to the other, thus substantially avoiding the risk of undesired backfires in the section which is not being fed.

[0025] Furthermore, the burner assembly of the invention allows to carry out the combustion of the fuel/comburent mixture by delivering the latter not only in vertical direction and from the bottom upwards, as in the case of the aerated burner assemblies of the prior art, but also by delivering the fuel/comburent mixture sideways, o from top to bottom, to the advantage of its flexibility of use.

[0026] According to a first embodiment of the burner assembly of the invention, said gas-permeable wall of the burner head is essentially constituted by a wall provided with a plurality of holes for delivering the fuel/comburent gaseous mixture. Advantageously, said perforated wall may be obtained by shaping and drilling a suitable metal material by means of conventional forming operations which may be carried out on a large scale at a low cost.

[0027] According to an alternative embodiment, said gas-permeable wall of the burner head is essentially constituted by a plate made of a suitable porous material permeable to gases.

[0028] The use of a gas-permeable porous plate advantageously allows to confine the combustion phenomena of the fuel/comburent gaseous mixture substantially inside the plate or, at most, immediately above the same with the presence of free flames of reduced height which are evenly distributed on the whole surface of the plate.

[0029] In other words, and unlike the perforated-wall burner head, in which heat is transmitted to the heat exchanger positioned downstream of the burner assembly essentially for convection, in this case the heat is essentially radiative with a minor convective component.

[0030] Therefore, thanks to the use of a gas-permeable porous plate, it is possible to achieve a series of important advantages, among which:

- obtaining a homogeneous delivery of the combustion heat from the entire surface of the plate;
- achieving high temperatures, up to about 1000°C, at the gas-permeable wall of the burner head;
- achieving a reduced pressure drop through the gas-permeable wall;
- reducing the distance between the primary heat exchanger, positioned downstream of the burner as-

sembly, and the burner head, without any danger of reducing the temperature of the flame, if present, to such values so as to make the combustion of gas incomplete with the undesired production of carbon monoxide.

[0031] Said reduction of distance allows, in its turn, to reduce the sizes of the combustion chamber and, thus, of the boiler equipped with the burner assembly, with respect to the prior-art boilers having an equal power.

[0032] Preferably, the gas-permeable porous plate is made of porous ceramics suitable to the purpose, such as for example the ceramic available on the market with the name of "ceramic foam" (ECO CERAMICS, BEVERWIJK, The Netherlands).

[0033] According to the invention, the means for feeding the fuel/comburent gaseous mixture to each delivery section of the burner head comprises at least one duct in fluid communication with a respective blower and a respective duct for feeding a gaseous fuel.

[0034] Advantageously, the delivery sections of the burner head may be individually fed by using structurally simple components having small sizes and a low cost, which are used both in the manufacture of conventional burner assemblies as well as in other technical fields, such as personal computers, copying machines, electrical household appliances, etc.

[0035] It follows that the burner assembly of the invention is particularly simple from a constructive point of view, and has a reduced cost.

[0036] In a particularly advantageous embodiment of the present invention, the delivery sections of the fuel/comburent gaseous mixture are arranged in series, and may be individually fed from respective coaxial feeding chambers.

[0037] Advantageously, the burner head may have an essentially cylindrical shape, so as to be properly inserted within the annular gas-water heat exchangers used in the water-heating systems for civil use.

[0038] According to an alternative embodiment, the delivery sections of the fuel/comburent gaseous mixture are arranged in parallel, and they may be individually fed by respective feeding chambers positioned in the burner head upstream of said at least one gas-permeable wall.

[0039] Preferably, the feeding chambers are reciprocally separated in a gas-tight manner by at least one partition plate mounted in the burner head essentially along its entire length or width and which may be vertically or horizontally extending.

[0040] According to a further embodiment, the burner head comprises a pair of delivery sections which are substantially semicylindrical and longitudinally tapered, coaxially arranged in parallel one inside the other.

[0041] Advantageously, said embodiment of the burner head may suitably mate with plate-shaped gas-water heat exchangers in the water-heating systems for civil use.

[0042] According to the invention, the burner assembly of the present invention further comprises means for intercepting said at least one feeding duct of the fuel/comburent gaseous mixture, which means is positioned upstream of the delivery sections of the fuel/comburent gaseous mixture.

[0043] Advantageously, this allows to prevent the risk of an undesired return of the combustion flue gases back into the burner assembly through any possibly unfed sections of the burner head in case of clogging of the flue gas-removal ducts provided downstream of the burner assembly.

[0044] In one embodiment of the burner assembly of the invention, the intercepting means comprises a check valve provided with a mechanical actuator including a spring, made of a suitable shape memory metallic material, such as for example special nickel-titanium alloys available on the market.

[0045] Advantageously, it is possible to obtain, in this case, a so-called "fail-safe" intercepting system which automatically shuts in case of failure.

[0046] Preferably, the burner assembly of the invention further comprises an ignition electrode and a flame detector which are both positioned at a predetermined distance from the gas-permeable wall of the burner head, and if necessary, near a respective end of a respective one of the delivery sections.

[0047] In this way, the mixture delivered by one of the sections of the burner head is ignited by the ignition electrode, whereas the mixture delivered by the adjacent section(s) is(are) ignited as a consequence of the flame produced by the first section without the presence of further ignition electrodes.

[0048] In one embodiment of the invention, the delivery sections provided in the burner head are arranged in parallel with one another, and they are essentially arranged side by side and coplanar, while the ignition electrode is operatively positioned so as to generate an ignition spark astride of the sections themselves.

[0049] Advantageously, it is possible in this case to choose at will which delivery section should be switched on, thus allowing to suitably program the operating time and, therefore, the corresponding wear of the blowers designed to feed the fuel/comburent gaseous mixture to the delivery sections.

[0050] In another embodiment of the invention, the blower or blowers are provided with a box-shaped body which is at least partly integral with the supporting body of the burner assembly. In this case, it is advantageously possible not only to reduce the number of components and hence, the cost of the burner assembly, but also to further reduce its size with respect to the prior art assemblies having an equal power.

[0051] Preferably, the burner assembly further comprises means for its removable connection to a boiler.

[0052] In this way, it is advantageously possible to install the burner assembly of the present invention on any type of boiler to replace a pre-existing aerated, blown or complete pre-mixed burner assembly for the purpose of

increasing the capacity of modulation of the boiler itself and/or the range of thermal powers that they may reach.

[0053] In a second aspect thereof, the present invention relates to a combustion module adapted to be mounted in a gas boiler, comprising a burner assembly of the type described above.

[0054] In a third aspect thereof, the present invention relates to a gas boiler comprising a burner assembly of the type described above.

Brief description of the drawings

[0055] Additional features and advantages of the present invention will become more readily apparent by reading the following detailed description of a preferred embodiment, made by way of illustration and not of limitation with reference to the attached drawings. In such drawings:

- Figure 1 shows a perspective view, partly in section, of a first embodiment of the burner assembly of the present invention;
- Figure 2 shows an enlarged perspective view, partly in section, of a second embodiment of the burner head of the burner assembly in figure 1;
- Figure 3 shows an enlarged perspective view, partly in section, of a third embodiment of the burner head of the burner assembly in figure 1;
- Figure 4 shows a perspective view, partly in section, of a fourth embodiment of the burner head of the burner assembly in figure 1;
- Figure 5 shows a perspective view, partly in section, of a combustion module adapted to be mounted on a boiler, incorporating a second embodiment of the burner assembly of the present invention;
- Figure 6 shows an enlarged perspective view, partly in section, of some details of the burner assembly and of the combustion module of figure 5.

Detailed description of preferred embodiments

[0056] With reference to figures 1 - 4, a complete pre-mixing burner assembly according to the invention is generally indicated at 1.

[0057] The burner assembly 1 comprises a substantially parallelepipedic box-shaped supporting body 2, adapted to support - in a manner known per se - an essentially tubular burner head 3, provided with at least one gas-permeable wall, which in this example is formed by a perforated wall 4 comprising a plurality of openings 5, adapted to deliver a fuel/comburent gaseous mixture.

[0058] The burner head 3 comprises a pair of delivery sections 3a, 3b structurally independent from each other and separated upstream and at the perforated wall 4 in a fluid-tight manner.

[0059] Preferably, and for the purpose of improving the required fluid seal between the delivery sections 3a, 3b at the perforated wall 4, the burner head 3 is provided with a non-perforated area 40 adapted to divide the perforated wall 4 into two contiguous portions 4a, 4b, each portion being in fluid communication with said delivery sections 3a and, respectively, 3b.

[0060] The delivery sections 3a, 3b are arranged in series with one another, and they are in fluid communication with suitable means 6 adapted to independently feed each of them with respective fuel/comburent gaseous mixtures.

[0061] The means 6 is supported by the box-shaped body 2, and comprises an outer duct 7 of larger diameter, which is defined by a non-perforated portion of the burner head 3 and an inner duct 8 of smaller diameter, which is coaxially extending within the duct 7.

[0062] The aforementioned coaxial ducts 7 and 8 are in fluid communication with respective blowers 9, 10 adapted to feed a gaseous comburent, for example air A, and with respective ducts 11, 12 adapted to feed a gaseous fuel, for example natural gas G, extending downstream of valves 13, 14 adapted to intercept and adjust the gas flow rate fed to the burner head 3.

[0063] The blowers 9 and 10 are, in turn, provided with essentially box-shaped, suction ducts 16, 17 in fluid communication with a single air inlet opening 18 inside the body 2, and with box-shaped delivery ducts 19, 20 respectively connected to the outer duct 7 and the inner duct 8 of the burner head 3.

[0064] In the example shown in figure 1, the complete pre-mixing of air and combustible gas takes place downstream of blowers 9 and 10 in the delivery ducts 19 and 20 and possibly also in the coaxial ducts 7, 8 of the burner head 3.

[0065] In an alternative embodiment, not shown in the drawings, the gaseous fuel may be fed upstream of blowers 9 and 10 - in this case of the gas-tight type - thus achieving an even more through mixing between the combustible gas and the combustion air.

[0066] According to the invention the box-shaped delivery duct 20 of the blower 10 is provided with suitable means, in this case a cap valve 21, adapted to intercept the inner duct 8 of the burner head 3.

[0067] Thus, in the burner head 3 two coaxial feeding chambers are defined which are respectively constituted by an annular gap 15, extending between the coaxial ducts 7, 8, and by a cylindrical chamber 38. Said feeding chambers are separated from each other in a gas-tight manner by an annular partition plate 39, which is peripherally welded to the non-perforated area 40 of the burner head 3.

[0068] In this way, a first fluid path is defined in the annular gap 15, flown by a first gas/air mixture which feeds the delivery section 3a of the burner head 3.

[0069] A second fluid path flown by a second gas/air

mixture adapted to independently and separately feed the delivery section 3b of the burner head 3 is also defined in the inner duct 8 and in the cylindrical chamber 38.

[0070] The burner assembly 1 is also provided with an ignition electrode 22 and with a flame detector 23 supported at a predetermined distance from the perforated wall 4 of the burner head 3 at one end of the delivery section 3a.

[0071] Advantageously, the burner assembly 1 is provided with a pair of coaxial tubular elements 24, 25, externally supported around the burner head 3, adapted to protect the ignition electrode 22 and the flame detector 23 from accidental impacts during installation.

[0072] Finally, the burner assembly 1 comprises a flange 26 adapted to allow the installation thereof on a conventional boiler, not shown in the figure.

[0073] In the example shown, the flange 26 is provided with a plurality of tapered wings 27 which are, in their turn, provided with respective seats 28 adapted to engage a fastening bolt - not shown - integral with the body of the boiler.

[0074] In use, the burner assembly 1 of the invention allows to carry out the combustion of completely pre-mixed gas/air mixtures by delivering a thermal power which, according to the size and to the deliverable flow rate of the blowers 9, 10 and of the valves 13, 14, may range from 20-30 KW - which is enough to heat a single flat up to 100-120 KW which may provide for the heating of a block of flats.

[0075] In both cases, the thermal power delivered may be very easily and reliably modulated in a range up to 10:1.

[0076] In fact, by feeding the delivery section 3a of the burner head 3 with the first totally pre-mixed gas/air mixture formed in the delivery duct 19 of the blower 9 and flowing in the annular gap 15 defined between the ducts 7 and 8, it is possible to reach about 50% of the maximum nominal power by modulating its value in a range of about 5:1.

[0077] Conveniently, the mixture radially delivered by section 3a of the burner head 3 is ignited by electrode 22, whereas the flame detector 23 signals the actual presence of the combustion to the electronic control board.

[0078] Advantageously, in this operating condition the fluid-tight separation between the delivery sections 3a and 3b of the burner head 3, which is ensured upstream and at the perforated wall 4 by the annular partition plate 39 and, respectively, by the non-perforated area 40, prevents undesired by-passes of the first gas/air mixture from section 3a to the adjacent section 3b which is temporarily not in operation, thus reducing substantially to zero the risk of dangerous backfires.

[0079] Advantageously, furthermore, the cap valve 21 intercepts the inner duct 8 of the burner head 3 so as to prevent undesired returns of the combustion flue gases through the adjacent section 3b, temporarily in operation, in case of any accidental clogging of the flue gas-removal duct of the boiler.

[0080] If the thermal power required to the burner assembly 1 is higher than 50% of the maximum nominal power, the second totally pre-mixed gas/air mixture formed in the delivery duct 20 of the second blower 10 and flowing in the inner duct 8 and in the cylindrical chamber 38 is fed to the delivery section 3b of the burner head 3 so as to reach 100% of the maximum nominal power.

[0081] Also in this case, it is possible to carry out a power modulation in a similar 5:1 additional range with respect to the adjustment range which may be carried out by feeding the delivery section 3a, so as to reach the aforementioned total modulation range of 10:1.

[0082] Conveniently, the mixture radially delivered by section 3b from the burner head 3 is ignited by the flame already present near the adjacent delivery section 3a, and no further ignition electrodes are needed.

[0083] Figures 2-6 schematically show further embodiments of the burner head 3 of the burner assembly 1 according to the invention.

[0084] In the following description and in said figures, the elements of the burner assembly 1 structurally or functionally equivalent to those previously illustrated with reference to figure 1 will be referred with the same reference numerals, and will not be described further.

[0085] In the embodiment shown in figure 2, the delivery sections 3a, 3b of the burner head 3 are arranged in parallel with one another and may be individually fed by respective feeding chambers 42, 43 defined upstream of the perforated wall 4 inside two essentially semicylindrical ducts 29, 30, arranged side by side and separated from one another in a gas-tight manner by a partition plate 31.

[0086] Conveniently, said partition plate is vertically mounted in a seal-tight manner, for example welded, in the burner head 3 at one non-perforated area 40 and substantially along the entire length of the same.

[0087] The semicylindrical ducts 29, 30 are each provided with a perforated side wall which defines the portions 4a and, respectively, 4b of the perforated wall 4 so that the delivery sections 3a, 3b may radially and outwardly deliver the first and, respectively, the second gas/air mixtures.

[0088] In this case, the desired fluid-tight separation between the delivery sections 3a and 3b of the burner head 3 is ensured upstream and at the perforated wall 4 by the partition plate 31 and, respectively, by the non-perforated area 40, thus preventing undesired by-passes of the first gas/air mixture from section 3a to the adjacent section 3b when the latter is temporarily not in operation.

[0089] Similarly to what has been disclosed with reference to the first embodiment of the burner assembly 1, the gas/air mixture delivered by section 3a is ignited by electrode 22 (not shown), whereas the gas/air mixture delivered by section 3b is ignited by the flame already present externally to the adjacent delivery section.

[0090] In the embodiment shown in figure 3, the delivery sections 3a, 3b are arranged in parallel with one another, and they may be individually fed by respective

feeding chambers 44, 45 which are defined upstream of the perforated wall 4 inside two essentially semicylindrical ducts 32, 33, respectively upper and lower, arranged side by side and separated in a gas tight manner by a partition plate 34.

[0091] Conveniently, said partition plate is horizontally mounted in a seal-tight manner, for example welded, in the burner head 3 at the non-perforated area 40 and substantially for the entire length of the same.

[0092] The semicylindrical ducts 32, 33 are each provided with a perforated side wall which defines the portions 4a and, respectively, 4b of the perforated wall 4.

[0093] In this case, the desired fluid-tight separation between the delivery sections 3a and 3b of the burner head 3 is ensured upstream and at the perforated wall 4 by the partition plate 34 and, respectively, by the non-perforated area 40, thus preventing undesired by-passes of the first gas/air mixture from section 3a to the adjacent section 3b when the latter is temporarily not in operation.

[0094] In this case, the gas/air mixture delivered by the lower section 3a is ignited by electrode 22 (not shown), whereas the gas/air mixture delivered by the upper section 3b is ignited by the flame already present externally to the delivery section lying below, which tends to burn upwards.

[0095] In the embodiment shown in figure 4, the burner head 3 comprises a radially inner delivery section 3a, and a radially outer delivery section 3b which are longitudinally tapered and coaxially arranged one inside the other.

[0096] The delivery sections 3a, 3b have respective perforated portions 4a-4b and 4c, substantially coplanar and arranged in parallel with one another, constituting an equal number of portions of the perforated wall 4 of the burner head 3.

[0097] The delivery sections 3a, 3b may be individually fed by respective coaxial ducts 35, 36 which are longitudinally tapered and have an essentially semicircular cross section which increasingly decreases as it nears the free end of the burner head 3.

[0098] Thus, two coaxial feeding chambers are defined in the burner head 3, which are respectively formed by a semiannular gap 37 adapted to feed the radially outer delivery section 3b, and by a chamber 46 which is essentially shaped as a cone sector and which is defined within the duct 36.

[0099] As may be seen in figure 4, both the semiannular gap 37 and the chamber 46 have an increasingly reduced cross section as they come closer to the free end of the burner head 3.

[0100] Advantageously, and for the purpose of improving the required fluid-tight seal between the delivery sections 3a and 3b of the burner head 3, the radially inner perforated portion 4a of the wall 4 is separated from the radially outer perforated portions 4b and 4c by a pair of non-perforated areas 40a and 40b, at which the opposite side edges of the inner duct 36 are welded.

[0101] In this case, the desired fluid-tight separation between the delivery sections 3a and 3b of the burner head 3 is ensured upstream and at the perforated wall 4 by the inner duct 36 and, respectively, by the non-perforated areas 40a, 40b, thus preventing undesired by-passes of the first gas/air mixture from section 3a to the adjacent section 3b when the latter is temporarily not in operation.

[0102] According to this embodiment and as shown in figure 4, the ignition electrode 22 and the flame detector 23 are supported at a predetermined distance from the perforated wall 4 close to a first end of the perforated portion 4a of the radially inner delivery section 3a.

[0103] Thus, during operation, the gas/air mixture delivered by the radially inner delivery section 3a will be ignited first, while the gas/air mixture delivered by the radially outer delivery section 3b will be ignited by the flame which is present externally to the adjacent delivery section 3a.

[0104] In an alternative embodiment, and depending on specific application requirements, the ignition electrode 22 and the flame detector 23 may be supported close to a first end of the perforated portions 4b, 4c of the radially outer delivery section 3b.

[0105] In this case, therefore, the gas/air mixture delivered by the radially outer delivery section 3b will be ignited first, while the gas/air mixture delivered by the radially inner delivery section 3a will be ignited by the flame which is present at the adjacent delivery section 3b.

[0106] With reference to the accompanying figures 5 and 6, a combustion module 73 according to the invention, adapted to equip a boiler of which only the outer casing 74 is schematically shown in the figures, will now be described.

[0107] Conventionally, said boiler also comprises a plurality of known components, not shown in the figures (hydraulic circuitry, circulation pump, control board, etc.) which are supported inside the casing 74 below the combustion module 73.

[0108] The combustion module 73 shown in figure 5 is particularly compact, and it advantageously allows to reduce the size of the boiler in which the module is to be mounted.

[0109] In this embodiment, the combustion module 73 comprises a substantially parallelepipedic box-shaped casing 75 inside which a combustion chamber or flue gas chamber 76 is defined, which is laterally insulated by panels 77 made of a suitable thermoinsulating material, for example ceramic fibres, and which is provided with an upper hood 78 for the withdrawal of combustion flue gases.

[0110] In addition, in this embodiment the outer casing 74 of the boiler is provided with an annular opening 85 coaxially extending around the hood 78, and which is adapted to allow the inlet of air inside the casing 74. Thus, the combustion air A flows into a gap which is defined between the box-shaped casing 75 of the combustion module 73 and the outer casing 74 of the boiler, before entering into an air inlet opening 56 - which is laterally

formed in the supporting body 102 of the burner assembly 101 - and being sucked inside the burner assembly 101.

[0111] Advantageously, and for the purpose of preventing the introduction of foreign bodies into the burner assembly 101, the air inlet opening 56 is provided with a suitably shaped protective wire gauze 58.

[0112] The combustion module 73 also comprises a gas-water heat exchanger 79, or primary exchanger, adapted to produce primary hot water or water for space heating, which comprises in turn an array of parallel tubes 80, which are supported in a known manner not shown in the figures, in the flue gas chamber 76 downstream of a burner assembly 101 which will be further described hereinbelow.

[0113] The primary heat exchanger 79 is in fluid communication with a pair of ducts 81, 82 which respectively deliver and withdraw the primary water to and from the exchanger itself. Said ducts are jointed in a conventional way to opposed tubes 80 at the end of said array.

[0114] In addition, the tubes 80 of the primary heat exchanger 79 are in fluid communication with each other by means of a pair of headers 91, 83 internally divided into a plurality of chambers for the distribution of liquid by means of a pair of baffles of which, in figure 5, only baffle labelled 87, which divides the header 83, may be seen. Thanks to this arrangement, the primary water delivered to the primary heat exchanger 79 from the feeding duct 81 flows in succession through the tubes 80 according to a zigzag path before reaching the withdrawal duct 82 and leaving the exchanger 79.

[0115] Advantageously, the primary heat exchanger 79 has in this case a very compact size although it has a tube-side liquid path suitable for the thermal exchange requirements to be met.

[0116] In this embodiment of the invention, the burner assembly 101 is supported at the base of the flue gas chamber 76, and features an extreme compactness. In fact, in this case part of the burner head 3 is essentially integral with the supporting body 102 of the burner assembly 101, with a substantial reduction both of the sizes and of the number of components of the burner assembly itself. To this end, the supporting body 102 which in this case is substantially parallelepipedic, is suitably shaped, and possesses a plurality of inner cavities and fluid passages, as will be further described hereinbelow.

[0117] The burner head 3 is provided with a pair of gas-permeable walls 4a, 4b, which are preferably constituted by respective porous plates 104a, 104b, having a parallelepipedic shape with a square base, made of ceramic having a predetermined permeability to gases.

[0118] In an alternative embodiment, not shown in the figures and similarly to what has been illustrated above, the gas-permeable walls of the burner head 3 may be constituted by suitably perforated metal plates having a predetermined thickness and a shape similar to that of the aforementioned porous plates.

[0119] Also in this case, the burner head 3 comprises a pair of delivery sections 3a, 3b, structurally independent and separated in a fluid-tight manner from each other upstream and at the aforementioned porous plates 104a, 104b.

[0120] In this case, the delivery sections 3a, 3b of the burner head 3 are arranged in parallel with one another, and may be individually fed by respective feeding chambers 48, 49, structurally independent and defined upstream of the gas-permeable walls 104a, 104b.

[0121] The feeding chambers 48, 49 are integral with the supporting body 102 of the burner assembly 101, and are separated from one another in a gas-tight manner by a partition plate 50 which is vertically extending inside a cavity 51 centrally formed in the body 102.

[0122] Preferably, the partition plate 50 is integral with the supporting body 102 of the burner assembly 101, and extends within the cavity 51 substantially along the entire length of the burner head 3.

[0123] In this embodiment, the desired fluid-tight separation between the delivery sections 3a and 3b of the burner head 3 is ensured upstream and at the porous plates 104a, 104b by the partition plate 50 and, respectively, by a baffle 105, essentially shaped as a down-turned T, vertically extending from the partition plate 50 and interposed between said porous plates.

[0124] In this way, undesired by-passes of the gas/air mixture from one of the sections 3a, 3b to the adjacent section when the latter is temporarily not in operation are advantageously prevented.

[0125] Conveniently, and for the purpose of obtaining the required gas-tight seal upstream and at the porous plates 104a, 104b, a gasket 89 made of a suitable material, for example silicone, is interposed between the baffle 105 and the partition plate 50, wherein it is partly housed in a corresponding mating seat 90.

[0126] With particular reference to figure 6, the construction details of the means 6 adapted to independently feed the respective fuel/comburent gaseous mixtures to each delivery section 3a, 3b will now be described. For the sole purpose of simplifying the description, reference will be made in the following description and in said figure only to those parts of the means 6 adapted to feed section 3a, being understood that the corresponding parts intended for feeding section 3b are entirely similar.

[0127] In this embodiment and for the purpose of minimising both the number of the various components and the size of the burner assembly 1, the suction duct of the blower 9 shown in figure 6 is essentially constituted by a passage 116, which is integral with the supporting body 102 of the burner assembly 101.

[0128] Preferably, the suction duct 116 is in fluid communication with the air inlet opening 56.

[0129] Preferably, the duct 11 for feeding combustible gas to the delivery section 3a is mounted in a respective wall 60, coaxially provided with a through hole which houses the duct 11. The wall 60 is also provided with a plurality of slots 61 for allowing the air flow.

[0130] Advantageously, the perforated wall 60 imparts a predetermined pressure drop to the air flowing through

the same and allows - in co-operation with a device which detects said pressure drop (not shown) - to control the flow rate of the fed gas G according to the pressure drop and, thus, as a function of the flow rate of air A sucked by the blower 9.

[0131] Advantageously, the complete pre-mixing of air and of the combustible gas takes place in this case upstream of the blower 9 - which in this case is of the gas-tight type - thus producing a more through mixing between the combustible gas and the combustion air.

[0132] Advantageously, furthermore, and for the purpose of minimising both the number of the various components and the size of the burner assembly 1, the blower 9 is provided with a respective box-shaped body 109a, which is at least partly integral with the supporting body 102 of the burner assembly 101, and which is sealed by a respective cover 110a.

[0133] In a conventional way, an electric motor 52 for driving the blower 9 is supported outside of the cover 110a, and is in turn provided with a respective protecting casing 54.

[0134] In this embodiment, and always for the purpose of minimising both the number of the various components and the size of the burner assembly 1, the delivery duct 119 of the blower 9 is essentially constituted by a suitably shaped duct integral with the supporting body 102 of the burner assembly 101.

[0135] According to the invention, the delivery duct 119 of the blower 9 is provided with suitable intercepting means, in this case constituted by a check valve 62.

[0136] More in particular, the valve 62 is adapted to intercept the duct 119 downstream of the blower 9 at one of its inlet openings 121 which constitutes, at the same time, a valve seat against which a shutter 64 of the valve 62 abuts.

[0137] As shown in greater detail in figure 6, the valve 62 comprises a valve body 63 which is at least partly integral with the supporting body 102 of the burner assembly 101, inside which body the shutter 64 is mounted, which in this case is of the cap type and is peripherally provided with a sealing O-ring 65.

[0138] In this embodiment, the valve body 63 of the valve 62 is defined between the supporting body 102 of the burner assembly 101 and the closing cover 110a of the box-shaped body 109a of the blower 9. Also in this case, said cover operates as removable cover adapted to seal the aforesaid valve body 63. To this end, the cover 110a is peripherally provided with a gasket 86 housed in a respective seat formed in the body 102.

[0139] For the purpose of driving the shutter 64, the valve 62 is provided with a mechanical actuator, generally indicated at 66, which includes a stem 67 which is mounted in a gas-tight manner through the cover 110a.

[0140] The stem 67 is rotatably mounted on the shutter 64 at a first of its ends provided with a spherical head 67a, the shutter 64 also having a matching washer 68 at its opposite end.

[0141] The mechanical actuator 66 further comprises a pair of counteracting springs 69a, 69 which are acting to close and, respectively, to open the opening 121, which springs are made of suitable metal materials. To this end, the springs 69a and 69 are respectively interposed between the shutter 64 and an inner wall of cover 110a, and between an outer wall of the cover 110a and the washer 68.

[0142] Advantageously, the pressure drop which the fuel/comburent gaseous mixture undergoes during its flow through the valves 62 may be suitably reduced thanks to the presence of a peg 72, having a predetermined height, extending from the cover 110a and being adapted to act as a stop means for the shutter 64 at the opening of the delivery duct 119.

[0143] In this case and as shown in figure 6, the shutter 64 performs at the opening a translation movement and then a rotation movement as soon as it abuts against the peg 72, thanks to its pivotal connection to the stem 67.

[0144] At the end of the stroke of the stem 67, and as shown at full line in figure 6, the shutter 64 will then be sloped in such a way as to interfere as little as possible with the flow of the fuel/comburent gaseous mixture which is directed towards opening 121.

[0145] According to a preferred embodiment of the invention, the closing spring 69a is made of conventional spring steel, and it is adapted to exert a first predetermined force, whereas the spring 69 is made of a suitable shape memory metallic material, such as for example a nickel-titanium alloy.

[0146] Thanks to the inherent characteristics of this shape memory material, the spring 69 is advantageously adapted to exert a greater force than the spring 69a only above a predetermined temperature (or transition temperature), known in advance, and achievable by providing suitable heating means for the spring 69.

[0147] In the embodiment shown in figure 6, said heating means of the spring 69 is advantageously constituted by a pair of electric wires 70, 71 adapted to allow the circulation of a current having a predetermined value in the spring itself and, thus, to achieve its heating due to the Joule effect.

[0148] Advantageously, the opening and closing operations of the valve 62 may be easily controlled by the control board of the boiler in which the burner assembly 1 is mounted, without any intervention of moving parts.

[0149] Finally, in this embodiment of the burner assembly 1 the gas/air mixture delivered by sections 3a and/or 3b may be ignited - choosing which section must be started first - thanks to an ignition/flame-detection assembly 123 substantially positioned astride of said sections.

[0150] This advantageously allows to extend the working life of the blowers 9, 10 by suitably programming the operating cycles of the delivery sections 3a, 3b.

[0151] In the embodiment shown in figure 5, the assembly 123 comprises:

- a first insulated ignition electrode 124, having a free

end close to the edge of plate 104a;

- a not insulated, central electrode 125 or earth electrode, having a free end close to the edge of plate 104b and positioned opposite to the free end of the insulated electrode 124 with respect to the baffle 105, intended for dividing plates 104a, 104b, and

- a second insulated ionisation electrode 126, which is substantially L-shaped and provided with an end arm 126a extending at a predetermined distance from the plates 104a, 104b, astride of baffle 105.

[0152] Conveniently, said electrodes are suitably shaped so as to have an end portion thereof at a predetermined distance from the free surface of the plates 104a, 104b.

[0153] In this way, in operation, the assembly 123 is advantageously capable to:

- produce a spark between the insulated ignition electrode 124 and the earth electrode 125, astride of the plates 104a, 104b, thus causing the ignition of the gaseous mixture coming from the plate which is actually fed, and, at the same time, to

- detect the presence of combustion by means of the insulated ionisation electrode 126 having its end arm 126a extending astride of the plates 104a, 104b, and thus, capable to detect the presence of combustion whichever plate is actually in operation.

[0154] The several advantages ensuing from the present invention are immediately evident from what has been disclosed above.

[0155] In the first place, the burner assembly of the invention possesses all the advantages of efficiency, environmental impact, size and cost which are typical of the complete pre-mixing burner assemblies.

[0156] In the second place, the burner assembly of the invention allows to achieve a modulation range of thermal power which is significantly higher than that of the aerated, blown or pre-mixed burner assemblies of the prior art, and equal to the sum of the modulation ranges which may be achieved by each delivery section of its burner head.

[0157] In addition, the burner assembly of the invention allows to ensure the above modulation range of thermal power not only for powers which could have been reached so far only by the aerated or blown burners (power in the order of 100-120 KW), but also for reduced thermal powers (in the order of 20-30 KW) by simply selecting the size of the means adapted to deliver the fuel/comburent gaseous mixture to each delivery section.

[0158] Lastly, the burner assembly of the invention allows to carry out the combustion of the fuel/comburent mixture by delivering the latter not only in vertical direction and from the bottom upwards, as in the case of the aerated burner assemblies of the prior art, but also delivering the fuel/camburent mixture sideways or top-down, all to the advantage of its flexibility of operation.

Claims

1. Burner assembly (1, 101) comprising:

- a supporting body (2, 102);
- a burner head (3) supported by said body (2), comprising at least one gas-permeable wall (4, 104a,b) and a plurality of delivery sections (3a, 3b) structurally independent and separated from one another in fluid-tight manner upstream and at said at least one gas-permeable wall (4, 104a,b);
- means (6) supported by said body (2, 102) for independently feeding a fuel/comburent gaseous mixture to each of the delivery sections (3a, 3b) of the burner head (3);

characterised in that the burner assembly (1, 101) is of the complete pre-mixing type,
in that the means (6) for feeding the fuel/comburent gaseous mixture to each of the delivery sections (3a, 3b) of the burner head (3) comprises at least one duct (7, 8, 29, 30, 32, 33, 35, 36, 119) in fluid communication with a respective blower (9, 10) and a respective duct (11, 12) for feeding a gaseous fuel, and **in that** it further comprises intercepting means (21, 62) of said at least one duct (7, 8, 29, 30, 32, 33, 35, 36, 119) for feeding the fuel/comburent gaseous mixture, said intercepting means (21, 62) being mounted upstream of at least one of said delivery sections (3a, 3b) and being adapted to prevent a return of combustion flue gases back into the burner assembly (1, 101).

2. Burner assembly (1, 101) according to claim 1, wherein said at least one gas-permeable wall (4, 104a,b) is essentially constituted by a wall (4) provided with a plurality of holes for delivering the fuel/comburent gaseous mixture.

3. Burner assembly (1, 101) according to claim 1, wherein said at least one gas-permeable wall (4, 104a,b) is essentially constituted by a plate (104a,b) made of a suitable gas-permeable porous material.

4. Burner assembly (1, 101) according to claim 1, wherein the delivery sections (3a, 3b) of the fuel/comburent gaseous mixture are arranged in series and may be individually fed by respective coaxial feeding chambers (15, 38).

5. Burner assembly (1, 101) according to claim 1, wherein the delivery sections (3a, 3b) of the fu-

el/comburent gaseous mixture are arranged in parallel and may be individually fed by respective feeding chambers (42, 43, 44, 45, 37, 46, 48, 49) defined in the burner head (3) upstream of said at least one gas-permeable wall (4, 104a,b).

6. Burner assembly (1, 101) according to claim 5, wherein the feeding chambers (42, 43, 44, 45, 37, 46, 48, 49) are reciprocally separated in a gas-tight manner by at least one partition plate (31, 34, 50).

7. Burner assembly (1, 101) according to claim 6, wherein said at least one partition plate (31, 50) is vertically mounted in said burner head (3) substantially for the entire length or width thereof.

8. Burner assembly (1, 101) according to claim 6, wherein said at least one partition plate (34) is horizontally mounted in said burner head (3) substantially for the entire length thereof.

9. Burner assembly (1, 101) according to claim 1, comprising a pair of substantially semicylindrical and longitudinally tapered delivery sections (3a, 3b) coaxially arranged in parallel one inside the other.

10. Burner assembly (1, 101) according to claim 1, wherein the intercepting means (21, 62) comprises a check valve provided with a mechanical actuator (66) including a spring (69) made of a suitable metal material of the so-called shape memory type.

11. Burner assembly (1, 101) according to claim 1, further comprising an ignition electrode (22, 124) positioned at a predetermined distance from said at least one gas-permeable wall (4, 104a,b) of the burner head (3).

12. Burner assembly (1, 101) according to claims 5 and 11, wherein the delivery sections (3a, 3b) arranged in parallel with one another, are essentially arranged side by side and coplanar, and wherein the ignition electrode (22, 124) is operatively positioned so as to generate a spark astride of said sections (3a, 3b) arranged side by side.

13. Burner assembly (1, 101) according to any one of the preceding claims, further comprising a flame detector (23, 126) positioned at a predetermined distance from said at least one gas-permeable wall (4, 104a,b) of the burner head (3).

14. Burner assembly (1, 101) according to claim 1, wherein the blower (9, 10) is provided with a box-shaped body (109a) which is at least partly integral with the supporting body (102) of the burner assembly (1, 101).

15. Burner assembly (1, 101) according to claim 1, further comprising means (26) for a removable connection to a boiler.

16. Combustion module (73) for a gas boiler, comprising a box-shaped case (75) in which a flue gas chamber (76) is defined and a gas-water heat exchanger (79) mounted in said chamber (76), **characterised in that** it comprises, upstream of said gas-water heat exchanger (79), a burner assembly (1, 101) according to any one of claims 1-3, 5-7, or 10-15.

17. Gas boiler comprising a burner assembly (1, 101) according to any one of claims from 1 to 15.

Revendications

1. Assemblage de brûleurs (1, 101) comprenant :

- un corps de support (2, 102) ;
- une tête de brûleur (3) supportée par ledit corps (2), comprenant au moins une paroi perméable au gaz (4, 104a, b) et une pluralité de sections de distribution (3a, 3b) structurellement indépendantes et séparées les unes des autres d'une manière étanche au fluide en amont et au niveau de ladite au moins une paroi perméable au gaz (4, 104a, b) ;
- des moyens (6) supportés par ledit corps (2, 102) destinés à alimenter indépendamment en mélange gazeux carburant/comburant chacune des sections de distribution (3a, 3b) de la tête de brûleur (3) ;

caractérisé en ce que l'assemblage de brûleurs (1, 101) est du type à mélange préalable total,
en ce que les moyens (6) destinés à alimenter en mélange gazeux carburant/comburant chacune des sections de distribution (3a, 3b) de la tête de brûleur (3) comprend au moins un conduit (7, 8, 29, 30, 32, 33, 35, 36, 119) en communication fluidique avec un ventilateur (9, 10) respectif et un conduit (11, 12) respectif destiné à l'alimentation en carburant gazeux,
et **en ce qu'**ils comprennent en outre des moyens d'interception (21, 62) dudit au moins un conduit (7, 8, 29, 30, 32, 33, 35, 36, 119) destinés à l'alimentation en mélange gazeux carburant/comburant, lesdits moyens d'interception (21, 62) étant montés en amont d'au moins une desdites sections de distribution (3a, 3b) et étant adaptés pour empêcher un retour des gaz de combustion à l'intérieur de l'assemblage de brûleurs (1, 101).

2. Assemblage de brûleurs (1, 101) selon la revendication 1, dans lequel ladite au moins une paroi perméable au gaz (4, 104a, b) est essentiellement cons-

tituée par une paroi (4) pourvue d'une pluralité de trous destinés à distribuer le mélange gazeux carburant/comburant.

3. Assemblage de brûleurs (1, 101) selon la revendication 1, dans lequel ladite au moins une paroi perméable au gaz (4, 104a, b) est constituée essentiellement par une plaque (104a, b) fabriquée dans un matériau poreux perméable au gaz approprié.

4. Assemblage de brûleurs (1, 101) selon la revendication 1, dans lequel les sections de distribution (3a, 3b) du mélange gazeux carburant/comburant sont agencées en série et peuvent être alimentées individuellement par des chambres d'alimentation (15, 38) coaxiales respectives.

5. Assemblage de brûleurs (1, 101) selon la revendication 1, dans lequel les sections de distribution (3a, 3b) du mélange gazeux carburant/comburant sont agencées en parallèle et peuvent être alimentées individuellement par les chambres d'alimentation (42, 43, 44, 45, 37, 46, 48, 49) respectives définies dans la tête de brûleur (3) en amont de ladite au moins une paroi perméable au gaz (4, 104a, b).

6. Assemblage de brûleurs (1, 101) selon la revendication 5, dans lequel les chambres d'alimentation (42, 43, 44, 45, 37, 46, 48, 49) sont séparées réciproquement d'une manière étanche au gaz par au moins une cloison (31, 34, 50).

7. Assemblage de brûleurs (1, 101) selon la revendication 6 dans lequel ladite au moins une cloison (31, 50) est montée verticalement dans ladite tête de brûleur (3) sensiblement sur l'ensemble de la longueur ou de la largeur de celle-ci.

8. Assemblage de brûleurs (1, 101) selon la revendication 6, dans lequel ladite au moins une cloison (34) est montée horizontalement dans ladite tête de brûleur (3) sensiblement sur l'ensemble de la longueur de celle-ci.

9. Assemblage de brûleurs (1, 101) selon la revendication 1, comprenant une paire de sections de distribution (3a, 3b) sensiblement semi-cylindriques et biseautées dans le sens longitudinal, agencées de manière coaxiale parallèlement l'une à l'intérieur de l'autre.

10. Assemblage de brûleurs (1, 101) selon la revendication 1, dans lequel les moyens d'interception (21, 62) comprennent une soupape d'arrêt pourvue d'un actionneur mécanique (66) comportant un ressort (69) fabriqué dans un matériau métallique approprié du type de ce qu'on appelle à mémoire de forme.

11. Assemblage de brûleurs (1, 101) selon la revendication 1, comprenant en outre une électrode d'amorçage (22, 124) positionnée à une distance prédéterminée de ladite au moins une paroi perméable au gaz (4, 104a, b) de la tête de brûleur (3).

12. Assemblage de brûleurs (1, 101) selon l'une quelconque des revendications 5 et 11, dans lequel les sections de distribution (3a, 3b) agencées parallèlement l'une à l'autre sont agencées essentiellement côte à côte et de façon coplanaire, et dans lequel l'électrode d'amorçage (22, 124) est positionnée de façon opérationnelle, de manière à générer une étincelle à califourchon sur lesdites sections (3a, 3b) agencées côte à côte.

13. Assemblage de brûleurs (1, 101) selon l'une quelconque des revendications précédentes, comprenant en outre un détecteur de flamme (23, 126) positionné à une distance prédéterminée de ladite au moins une paroi perméable au gaz (4, 104a, b) de la tête de brûleur (3).

14. Assemblage de brûleurs (1, 101) selon la revendication 1, dans lequel le ventilateur (9, 10) est pourvu d'un corps en forme de boîte (109a) qui est au moins en partie solide du corps de support (102) de l'assemblage de brûleurs (1, 101).

15. Assemblage de brûleurs (1, 101) selon la revendication 1, comprenant en outre des moyens (26) destinés à un raccordement amovible à une chaudière.

16. Module de combustion (73) pour chaudière à gaz, comprenant un carter en forme de boîte (75) dans lequel une chambre de gaz de combustion (76) est définie et un échangeur de chaleur gaz-eau (79) est monté dans ladite chambre (76), **caractérisé en ce qu'**il comprend, en amont dudit échangeur de chaleur gaz-eau (79), un assemblage de brûleurs (1, 101) selon l'une quelconque des revendications 1 à 3, 5 à 7, ou 10 à 15.

17. Chaudière à gaz comprenant un assemblage de brûleurs (1, 101) selon l'une quelconque des revendications 1 à 15.

Patentansprüche

1. Brennerbaueinheit (1, 101) mit:

- einem Tragekörper (2, 102);
- einem Brennerkopf (3), der von dem Körper (2) getragen wird und wenigstens eine gasdurchlässige Wand (4, 104a, b) und eine Mehrzahl von Abgabeabschnitten (3a, 3b) aufweist, die strukturell unabhängig sind und voneinander

in flüssigkeitsdichter Weise stromaufwärts und bei der wenigstens einen gasdurchlässigen Wand (4, 104a, b) getrennt sind;
- einem Mittel (6), das vom Körper (2, 102) getragen wird, zum unabhängigen Zuführen einer gasförmigen Brennstoff-/Verbrennungsunterhaltungsstoff-Mischung zu jedem der Abgabeabschnitte (3a, 3b) des Brennerkopfes (3);

dadurch gekennzeichnet,
dass die Brennerbaueinheit (1, 101) vom Typ der vollständigen Vormischung ist,
dass das Mittel (6) zum Zuführen der gasförmigen Brennstoff-/ Verbrennungsunterhaltungsstoff-Mischung zu jedem der Abgabeabschnitte (3a, 3b) des Brennerkopfes (3) wenigstens einen Kanal (7, 8, 29, 30, 32, 33, 35, 36, 119) in Flüssigkeitsverbindung mit einem entsprechenden Gebläse (9, 109) und einer entsprechenden Leitung (11, 12) zum Zuführen eines gasförmigen Brennstoffes aufweist,
und **dass** sie außerdem ein Unterbrechungsmittel (21, 62) des wenigstens einen Kanals (7, 8, 29, 30, 32, 33, 35, 36, 119) zum Zuführen der gasförmigen Brennstoff-/Verbrennungsunterhaltungsstoff-Mischung aufweist, das stromaufwärts von dem wenigstens einen Abgabeabschnitt (3a, 3b) befestigt ist und darauf ausgerichtet ist, eine Rückkehr von Verbrennungsabzugsgasen in die Brennerbaueinheit (1, 101) zu verhindern.

2. Brennerbaueinheit (1, 101) nach Anspruch 1, wobei die wenigstens eine gasdurchlässige Wand (4, 104a, b) im Wesentlichen aus einer Wand (4) gebildet ist, die mit einer Mehrzahl von Löchern zum Abgeben der gasförmigen Brennstoff-/ Verbrennungsunterhaltungsstoff-Mischung ausgestattet ist.

3. Brennerbaueinheit (1, 101) nach Anspruch 1, wobei die wenigstens eine gasdurchlässige Wand (4, 104a, b) im Wesentlichen durch eine Platte (104a, b) gebildet ist, die aus einem geeigneten gasdurchlässigen porösen Material besteht.

4. Brennerbaueinheit (1, 101) nach Anspruch 1, wobei die Abgabeabschnitte (3a, 3b) der gasförmigen Brennstoff-/ Verbrennungsunterhaltungsstoff-Mischung in Reihe angeordnet sind und individuell durch entsprechende koaxiale Zuführkammern (15, 38) gespeist werden können.

5. Brennerbaueinheit (1, 101) nach Anspruch 1, wobei die Abgabeabschnitte (3a, 3b) der gasförmigen Brennstoff-/ Verbrennungsunterhaltungsstoff-Mischung parallel angeordnet sind und individuell durch entsprechende Zuführkammem (42, 43, 44, 45, 37, 46, 48, 49) gespeist werden können, die im Brennerkopf (3) stromaufwärts von der wenigstens einen gasdurchlässigen Wand (4, 104a, b) definiert sind.

6. Brennerbaueinheit (1, 101) nach Anspruch 5, wobei die Zuführkammem (42, 43, 44, 45, 37, 46, 48, 49) wechselseitig auf gasdichte Weise mittels wenigstens einer Teilungsplatte (31, 34, 50) getrennt sind.

7. Brennerbaueinheit (1, 101) nach Anspruch 6, wobei die wenigstens eine Teilungsplatte (31, 50) im Wesentlichen über die gesamte Länge oder Breite des Brennerkopfes (3) senkrecht in diesem befestigt ist.

8. Brennerbaueinheit (1, 101) nach Anspruch 6, wobei die wenigstens eine Teilungsplatte (34) im Wesentlichen über die gesamte Länge des Brennerkopfes (3) horizontal in diesem befestigt ist.

9. Brennerbaueinheit (1, 101) nach Anspruch 1, mit einem Paar von im Wesentlichen halbzylinderförmigen und in Längsrichtung verjüngten Abgabeabschnitten (3a, 3b), die einer innerhalb des anderen parallel zueinander und koaxial angeordnet sind.

10. Brennerbaueinheit (1, 101) nach Anspruch 1, wobei das Unterbrechungsmittel (21, 62) ein Verschlussventil aufweist, das mit einem mechanischen Betätigungselement (66) ausgestattet ist, das eine Feder (69) des so genannten Formerinnerungs-Typs aus einem geeigneten metallischen Material beinhaltet.

11. Brennerbaueinheit (1, 101) nach Anspruch 1, des Weiteren mit einer Zündelektrode (22, 124), die in einem vorbestimmten Abstand von der wenigstens einen gasdurchlässigen Wand (4, 104a, b) des Brennerkopfes (3) angeordnet ist.

12. Brennerbaueinheit (1, 101) nach den Ansprüchen 5 und 11, wobei die Abgabeabschnitte (3a, 3b), die parallel zueinander angeordnet sind, im Wesentlichen Seite an Seite und koplanar angeordnet sind, und wobei die Zündelektrode (22, 124) operativ derart angeordnet ist, dass sie einen Funken rittlings von den Abschnitten (3a, 3b), die Seite an Seite angeordnet sind, erzeugt.

13. Brennerbaueinheit (1, 101) nach einem der vorangehenden Ansprüche, des Weiteren mit einem Flammendetektor (23, 126), der in einem vorbestimmten Abstand von der wenigstens einen gasdurchlässigen Wand (4, 104a, b) des Brennerkopfes (3) angeordnet ist.

14. Brennerbaueinheit (1, 101) nach Anspruch 1, wobei das Gebläse (9, 10) mit einem kastenförmigen Körper (109a) ausgestattet ist, der zumindest teilweise integral mit dem Tragekörper (102) der Brennerbaueinheit (1, 101) ist.

15. Brennerbaueinheit (1, 101) nach Anspruch 1, des Weiteren mit einem Mittel (26) für die lösbare Verbindung mit einem Boiler.

16. Verbrennungsmodul (73) für einen Gasboiler, mit einem kastenförmigen Behälter (75), in dem eine Abzugsgaskammer (76) definiert ist, und mit einem Gas-Wasser-Wärmetauscher (79), der in der Kammer (76) befestigt ist, **dadurch gekennzeichnet, dass** es stromaufwärts von dem Gas-Wasser-Wärmetauscher (79) eine Brennerbaueinheit (1, 101) gemäß einem der Ansprüche 1-3, 5-7 oder 10-15 aufweist.

17. Gasboiler mit einer Brennerbaueinheit (1, 101) nach einem der Ansprüche 1 bis 15.

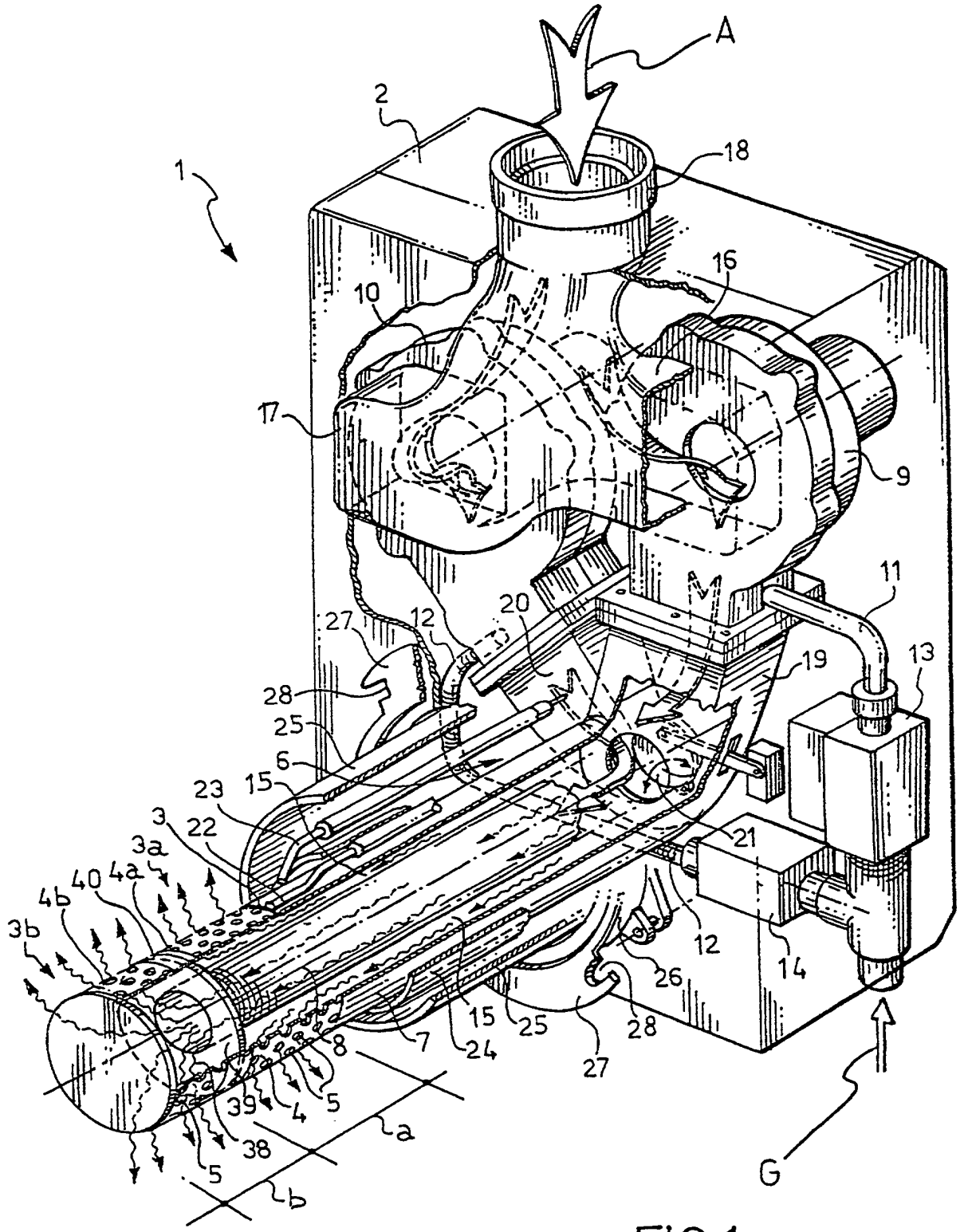

A
2
18
1
16
10
17
9
11
20
27
12
19
13
28
25
6
23
15
3
22
21
3a
4a
40
4b
3b
12
14
26
15
25
28
27
24
7
8
5
39
4
38
5
a
b
G

FIG.1

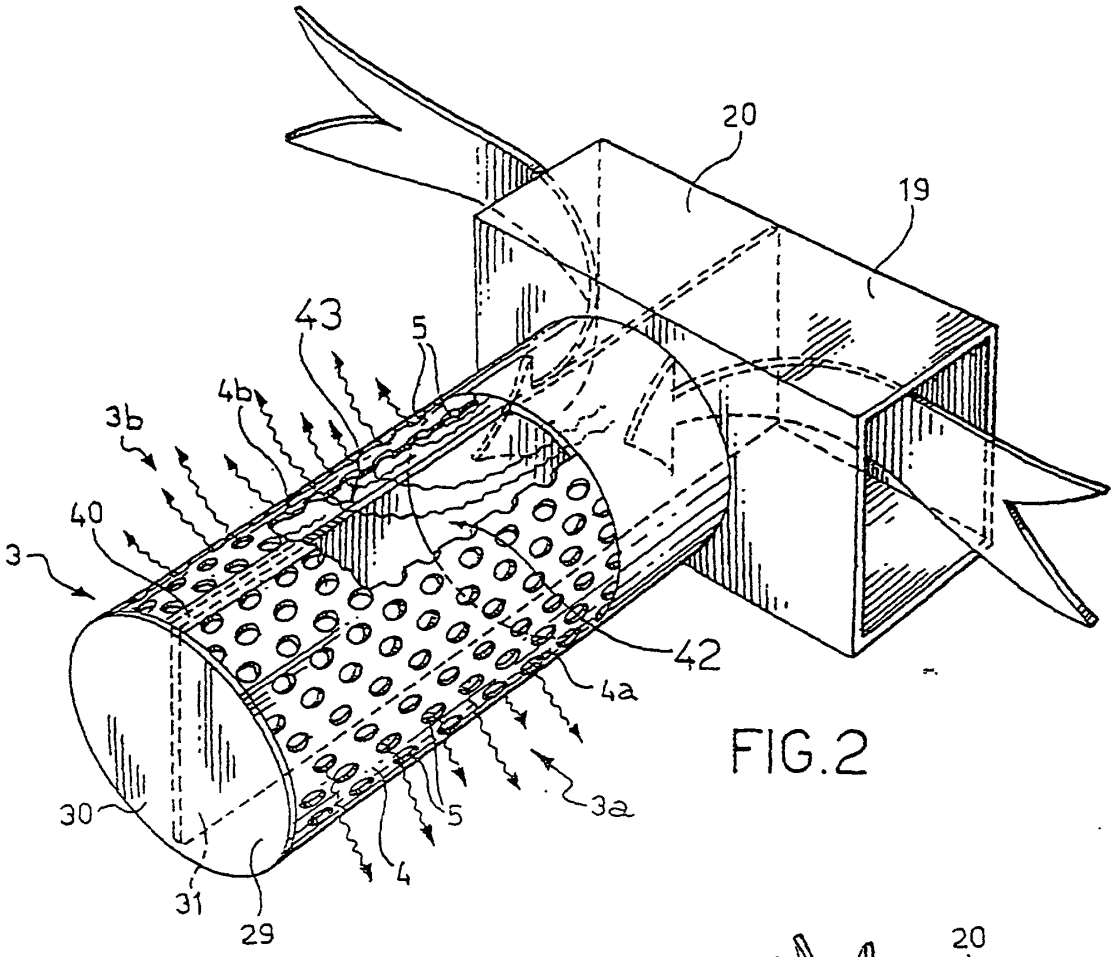

20
19
43
5
4b
3b
40
3
42
4a
3a
5
4
30
31
29

FIG.2

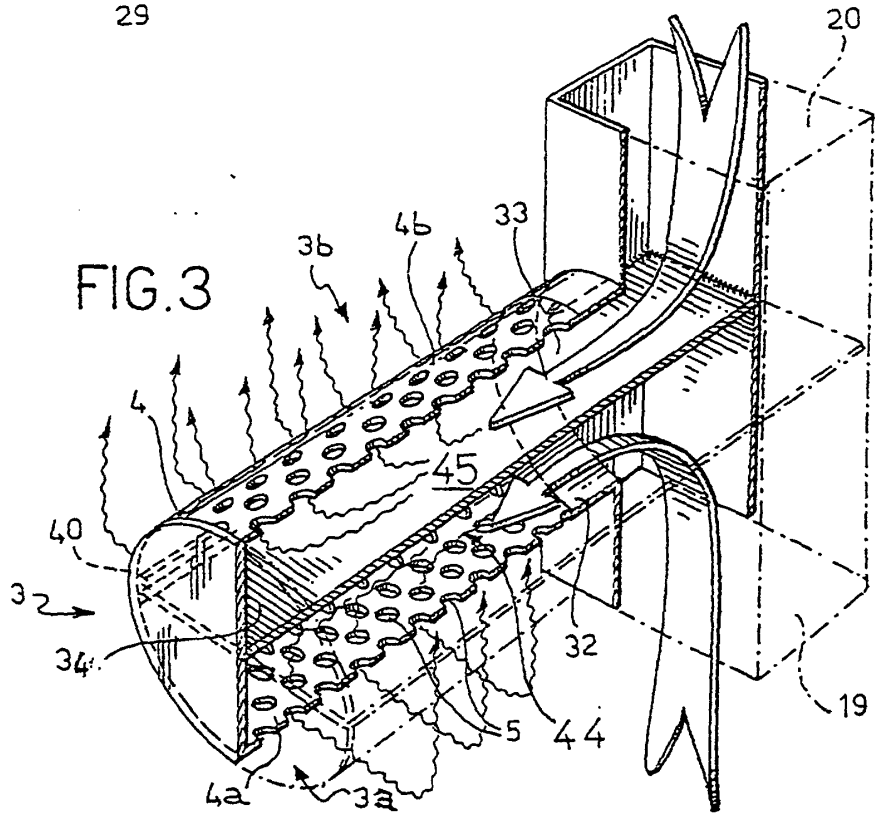

20
33
4b
3b
4
45
40
3
34
32
5
44
4a
3a
19

FIG.3

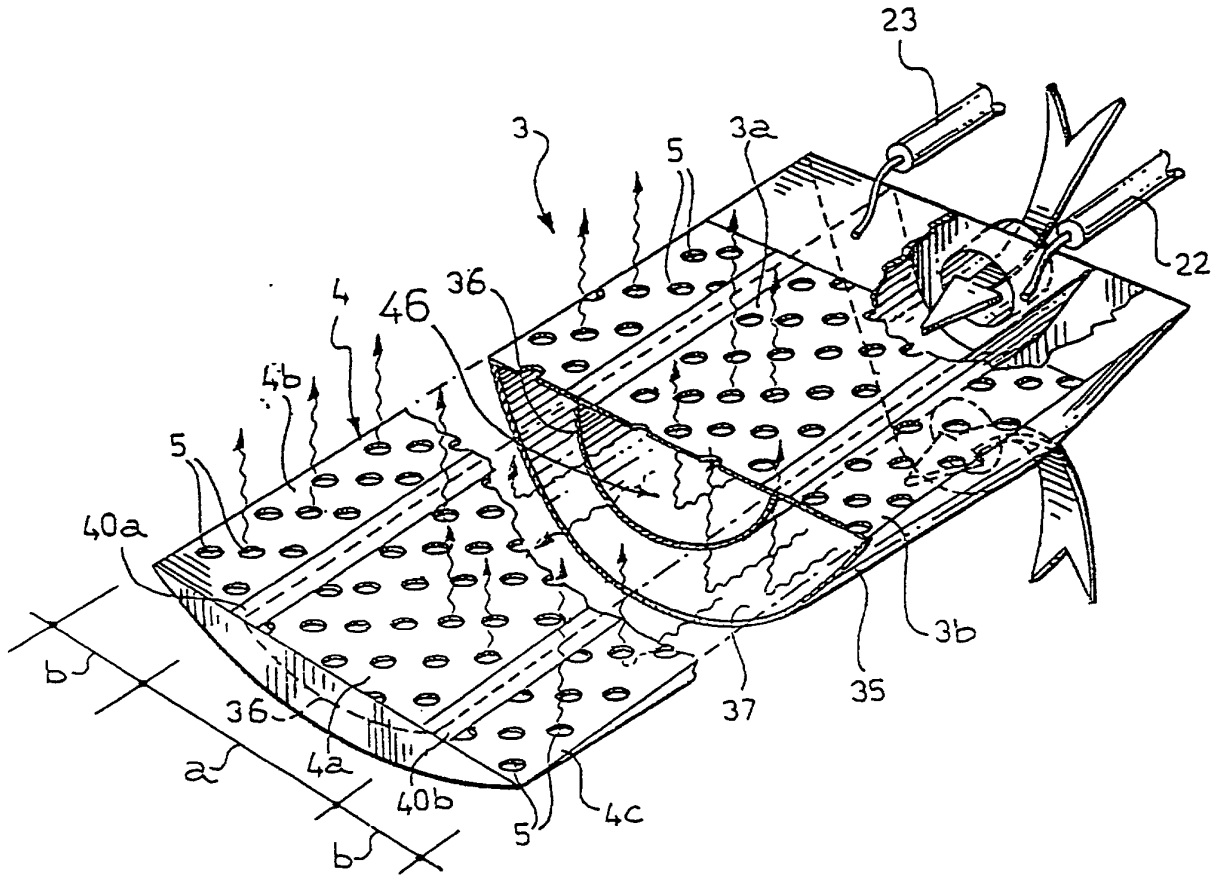


FIG.4

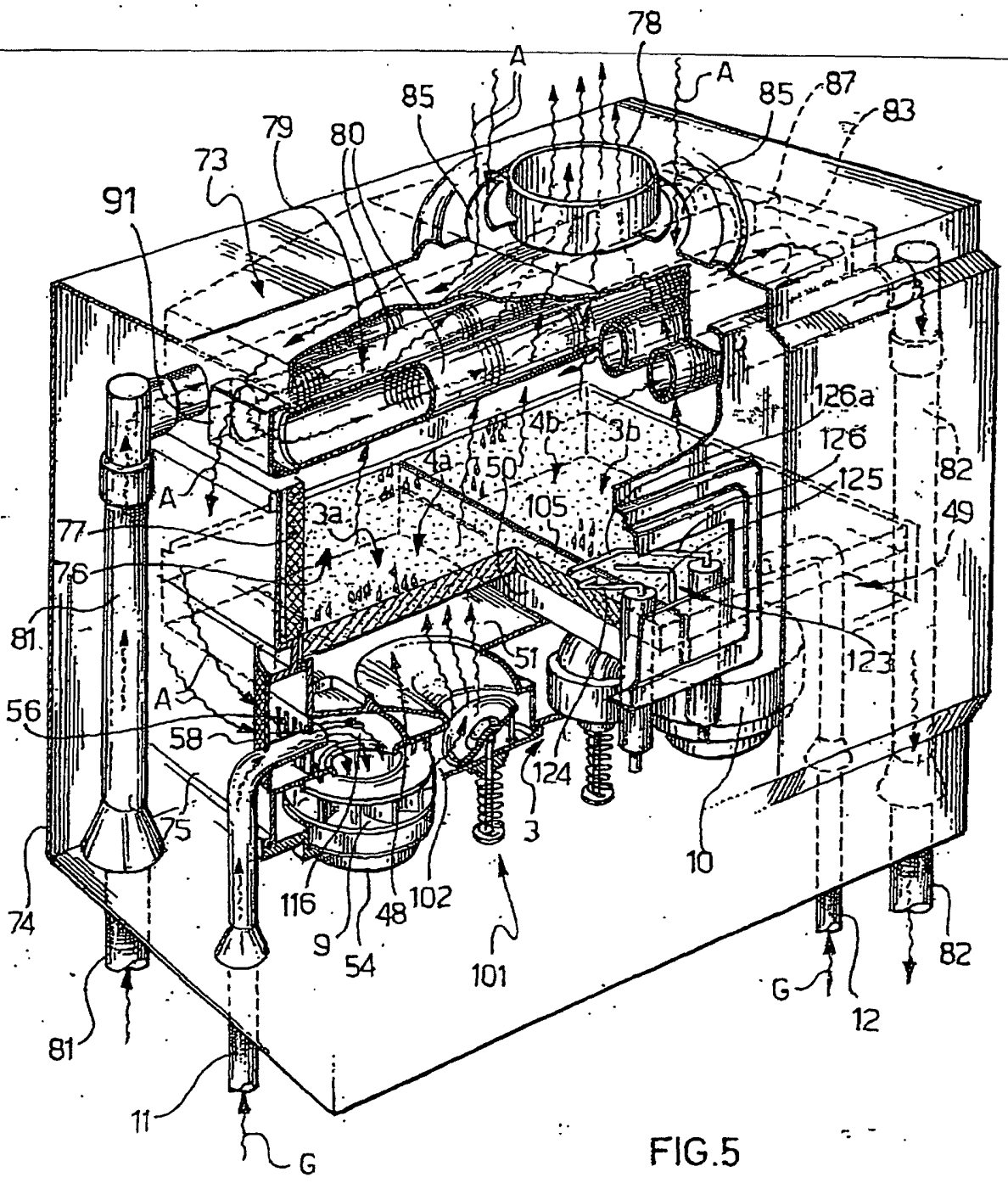

78
A
A
85
85
87
83
79
80
73
91
126a
126
125
82
49
4b
3b
4a
50
105
3a
77
76
81
51
123
A
56
58
124
75
3
10
74
116
48
102
9
54
101
82
G
12
81
11
G

FIG.5

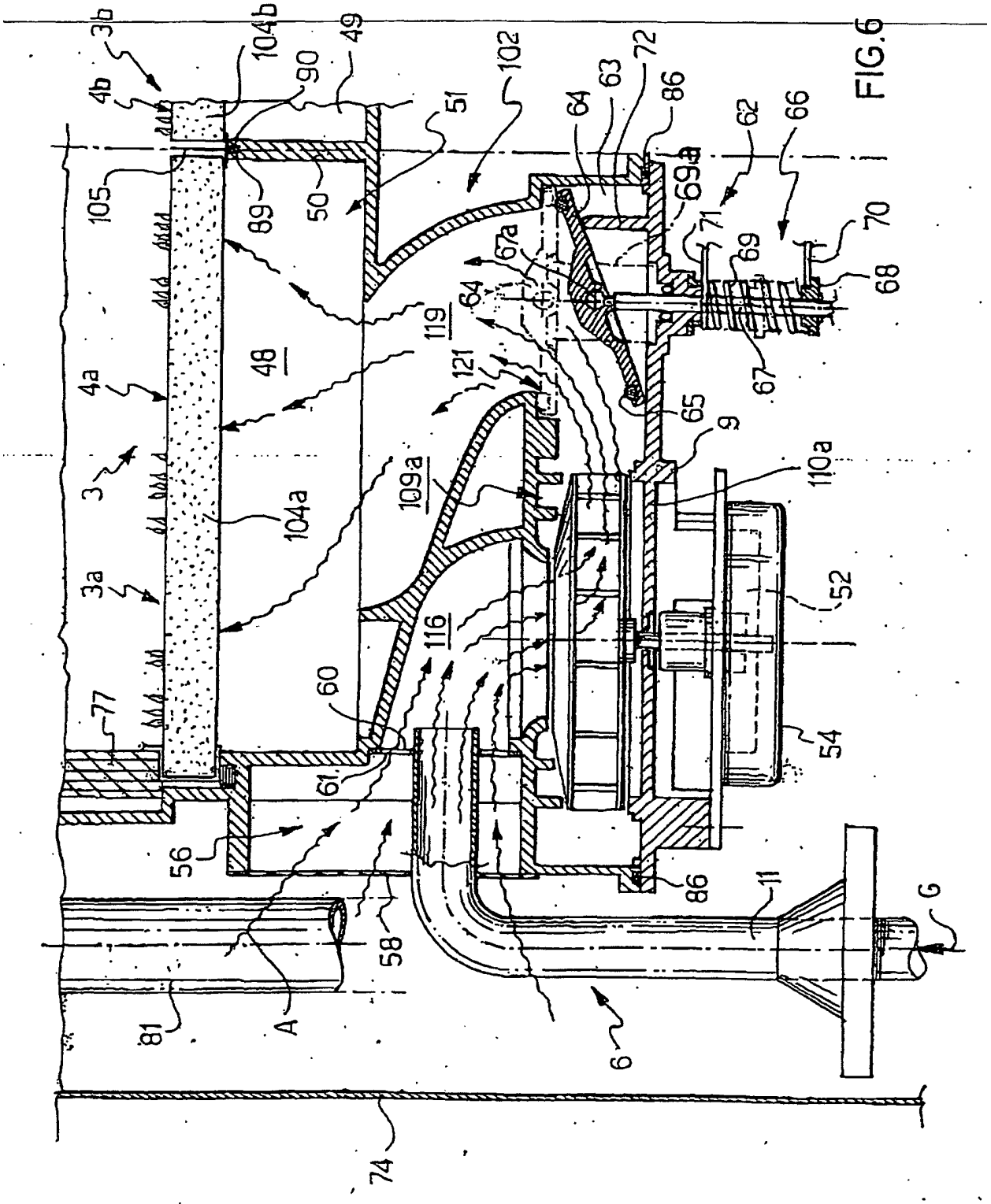

3b
4b
104b
90
49
102
51
64
63
72
86
62
66
105
89
50
69a
71
70
67a
69
68
64
119
121
67
48
4a
65
9
3
109a
110a
104a
3a
52
116
60
77
54
61
56
86
11
G
58
81
A
6
74

FIG.6