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(54) BURNER MODULE

(57) A burner module for a gaseous mixture, comprising:
a plurality of nozzles (20), each of which has an outlet opening (21) with a diameter (D);
an emission plane (P), on which the outlet openings (21) of the nozzles (12) lie;
a connection plane (S), at which the attachment of the burner module to a support structure is located;
wherein the nozzles (20) are spaced apart from one another by a constant pitch (P);
wherein the connection plane (S) and the emission plane (P) are parallel to each other and are spaced apart by a main height (H).

A dimensional parameter (R), given by the product between said main height (H), said pitch (P) and the diameter (D) of the outlet openings (21) of the nozzles (20), measured in millimetres, is comprised between 71 and 84, i.e.:

$$R=H*P*D;$$

$$71 < R < 84.$$

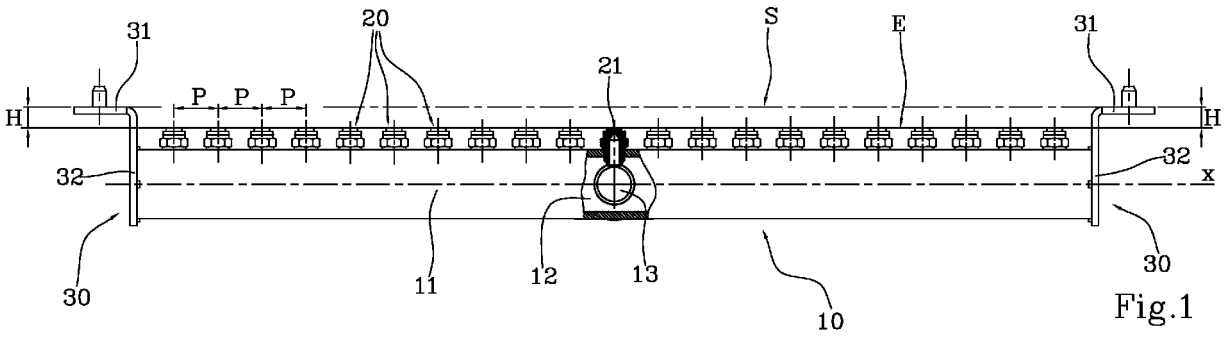

Fig.1

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Description

[0001] The present invention relates to a burner module, usable for example in a wall boiler.

[0002] A burner module normally comprises a manifold for combustible gas. Such a manifold is typically tubular in shape and essentially comprises a cylindrical conduit closed at the ends.

[0003] The manifold is provided with a plurality of nozzles, i.e. calibrated openings that put the inside of the manifold in communication with the external environment. The nozzles are placed side by side with each other and are aligned along a generatrix of the outer surface of the manifold.

[0004] A plurality of burner modules are juxtaposed one another to define a modular burner.

[0005] The nozzles are intended to allow the emission of combustible gas outside the manifold, so that combustion can take place. In particular, the combustible gas, which flows out of the collector through the nozzles, feeds the burner and the flame develops above the burner module. Additional comburent air, called secondary air, is fed to the flame from the surrounding environment.

[0006] Combustion products comprise, among other compounds, carbon monoxide (CO) and nitrogen oxides (NOx). These two compounds, as known, should be reduced as much as possible.

[0007] The amount of CO and NOx produced by combustion depends on various parameters, including the ratio of fuel to primary air, as well as the amount of secondary air in relation to the flow rate emitted by the nozzles. For example, a limited primary air supply results in a significant lowering of the lamba of the combustible air mixture. This means that the flame temperature, in the sections closest to the flame diffuser, is above the critical value for the formation of nitrogen oxides (NOx). This phenomenon is particularly accentuated towards low power regimes of the boiler and is certainly undesirable for obvious reasons tied to the containment of harmful emissions.

[0008] The design of the burner module is therefore very important to achieve optimal combustion conditions, with low emissions of harmful compounds. In particular, the diameter of the nozzles, their number and the pitch of separation between them, the collector section, must be chosen with extreme care in order to contain the emissions of harmful compounds. Currently, the design of the burner modules is substantially done in an empirical manner, developing a model and testing the behaviour thereof during operation. In case of unsatisfactory behaviour, it is necessary to modify the model in one or more geometric parameters, for subsequent tests, until a satisfactory configuration is obtained.

[0009] The current design is therefore relatively slow and laborious. Furthermore, in case of modifications required for one or more parameters of the burner module, it does not allow to readily adapt the other parameters for optimal operation.

[0010] The object of the present invention is to offer a burner module that allows to obtain optimal operating conditions, with low emissions of harmful compounds, and that can be quickly designed according to different construction and/or installation needs.

[0011] Features and advantages of the present invention will more fully emerge from the following detailed description of an embodiment of the present invention, as illustrated in a non-limiting example in the accompanying figures, in which:

- figure 1 shows a schematic view of the burner module according to the present invention, in vertical elevation;
- figure 2 shows a top view of the burner module of figure 1;
- figure 3 shows a sectional view on plane A-A of figure 2.

[0012] The burner module according to the present invention comprises a manifold (10), provided with a tubular body (11) that delimits an internal cavity (12). The manifold (10) is provided with an inlet opening (13), through which a combustible gas can be introduced into the tubular body (11).

[0013] A plurality of nozzles (20) are arranged so as to pass through the tubular body (11). In a manner known in the art, each nozzle comprises a threaded body (22), through which a calibrated through opening is obtained, at one end of which an outlet opening (21) of the nozzle (20) is arranged. The threaded body (22) is screwed into a corresponding through opening obtained through the wall of the tubular body (11). The outlet openings (21) have the same diameter (D).

[0014] The outlet openings (21) of the nozzles (20) lie on a common emission plane (P). In particular, the nozzles (20) are aligned along a direction parallel to a longitudinal axis (X) of the tubular body (11). Furthermore, the nozzles (20) are space apart from one another by a constant pitch (P). This step (P) is substantially the distance separating the outlet openings (21) from each other. In practice, each outlet opening (21) is separated from the two adjacent openings by the pitch (P).

[0015] The burner module also comprises a pair of brackets (30), provided to enable the attachment of the manifold (10) to a support structure, not shown. Such a support structure, for example, is a suitable attachment element provided in a wall boiler or in a water heater or, in general, an attachment element provided in the device in which the burner module is installed. Preferably, but not necessarily, the brackets (30) are positioned at the ends of the tubular body (11). In the embodiment depicted, the brackets (30) have a joint portion (32), at which they are connected to the tubular body (11), closing the ends thereof.

[0016] The brackets (30) also have an attachment portion (31), provided to enable the connection to said support structure of the device in which the installation of the burner module is envisaged. The attachment portions lie on the same connection plane (S), parallel to the emission plane (E). The attachment to said support structure is located on said connection plane. The connection plane (S) and the emission plane (E) are spaced apart by a main height (H). In other words, the main height (H) is the distance separating the connection plane (S) and the emission plane (P).

[0017] Following extensive research, the Applicant has identified a dimensional parameter (R) that is extremely relevant for the correct design of the burner module, i.e. for the containment of the compounds emitted by the combustion of the mixture.

[0018] The dimensional parameter (R) is given by the product between said main height (H), said pitch (P) and the diameter (D) of the outlet openings (21) of the nozzles (20). The dimensional parameter (R) is therefore a volume. If the dimensions (H,P,D) whose product defines the dimensional parameter (R) are measured in millimetres, the Applicant has found that a value of (R) comprised between 71 and 84 mm^3 allows NOx emissions to be contained well below 90 mg/kWh, and CO emissions to be contained well below 1000 ppm.

[0019] In practice, if:

$$R=H*P*D;$$

$$71 < R < 84\ mm^3,$$

nOx emissions remain well below 90 mg/kWh, and CO emissions remain well below 1000 ppm.

[0020] Thanks to the identification of the dimensional parameter (R), the design of a burner module is considerably simplified.

[0021] For example, given the diameter of the outlet openings (21), which is typically a function of the type of fuel used and depends on the conformation of the nozzles (20), and the main height (H) being known, which depends on the position and on the installation required for the burner module, obtaining the optimal pitch (P) at which to place the nozzles (20) is immediate. For example, in the case of natural gas, the diameter of the openings (21) is comprised between about 0.9 and 1.5 mm, as a function of the operating pressure.

[0022] Conversely, if the conformation of the nozzles (20) requires a predetermined mounting pitch (P), the dimensional parameter (R) allows the optimal main height (H) to be obtained.

[0023] Preferably, said dimensional parameter (R) is comprised between 75 and 80, i.e.:

$$75 < R < 80.$$

[0024] Within this range comprised between 75 and 80, NOx remains below 85mg/kWh, while CO remains below 800 ppm.

[0025] A plurality of burner modules according to the present invention may be arranged to form a modular burner. The burner modules are arranged side by side with each other with the same emission plane (P) and the same connection plane (S). In a preferred embodiment, the modular burner comprises twenty-one burner modules.

[0026] Examples of further particularly effective configurations for a modular burner, comprising a plurality of burner modules according to the present invention, provide for nineteen or thirty-one burner modules. In all cases, the combustion conditions are optimal, with reduced emissions of harmful compounds.

[0027] The burner module according to the present invention has important advantages over the prior art.

[0028] First of all, the burner module allows to obtain optimal combustion conditions, containing the amount of harmful compounds emitted, in particular NOx and CO.

[0029] In addition, the definition of the dimensional parameter (R) allows to greatly simplify the design of the burner module, ensuring the certainty of containing the amount of harmful compounds emitted, without the need to make prototypes to test the operation thereof.

Claims

1. A burner module for a gaseous mixture, comprising:

a manifold (10), provided with a tubular body (11) that delimits an internal cavity (12);
a plurality of nozzles (20), arranged so as to pass through the tubular body (11), each of which has an outlet opening (21);
an emission plane (P), on which the outlet openings (21) of the nozzles (12) lie;
a pair of brackets (30), provided to enable the attachment of the manifold (10) to a support structure, and which have an attachment portion (31) for attaching to said support structure;
a connection plane (S), on which the attachment portions (31) lie and on which the attachment to said support structure is located;
wherein the outlet openings (21) of the nozzles have an equal diameter (D);
wherein the nozzles (20) are spaced apart from one another by a constant pitch (P);
wherein the connection plane (S) and the emission plane (P) are parallel to each other and are spaced apart by a main height (H);
characterised in that:
a dimensional parameter (R) given by the product between said main height (H), said pitch (P) and the diameter (D) of the outlet openings (21) of the nozzles (20), measured in millimetres, is comprised between 71 and 84, i.e.:

$$R=H*P*D;$$

$$71 < R < 84.$$

2. The burner module according to claim 1, wherein said dimensional parameter (R) is comprised between 75 and 80, i.e.:

$$75 < R < 80.$$

3. A modular burner, comprising a plurality of burner modules according to one of the preceding claims, arranged side by side with a same emission plane (P) and a same connection plane (S).

4. The modular burner according to claim 3, comprising twenty-one burner modules according to claim 1 or 2.

5. The modular burner according to claim 3, comprising nineteen burner modules according to claim 1 or 2.

6. The modular burner according to claim 3, comprising thirty-one burner modules according to claim 1 or 2.

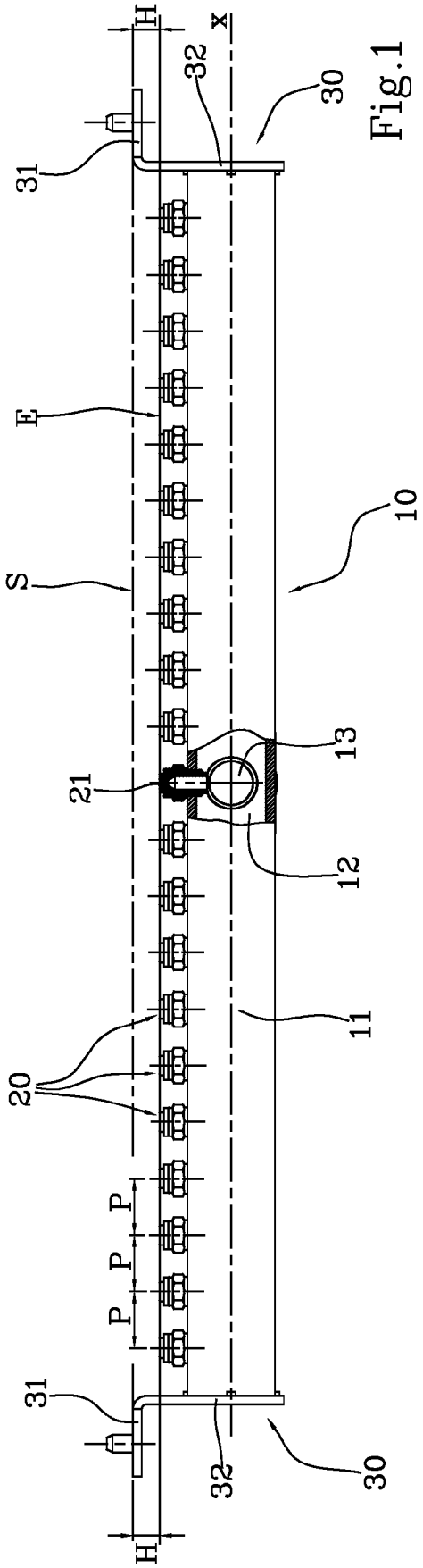

Fig.1

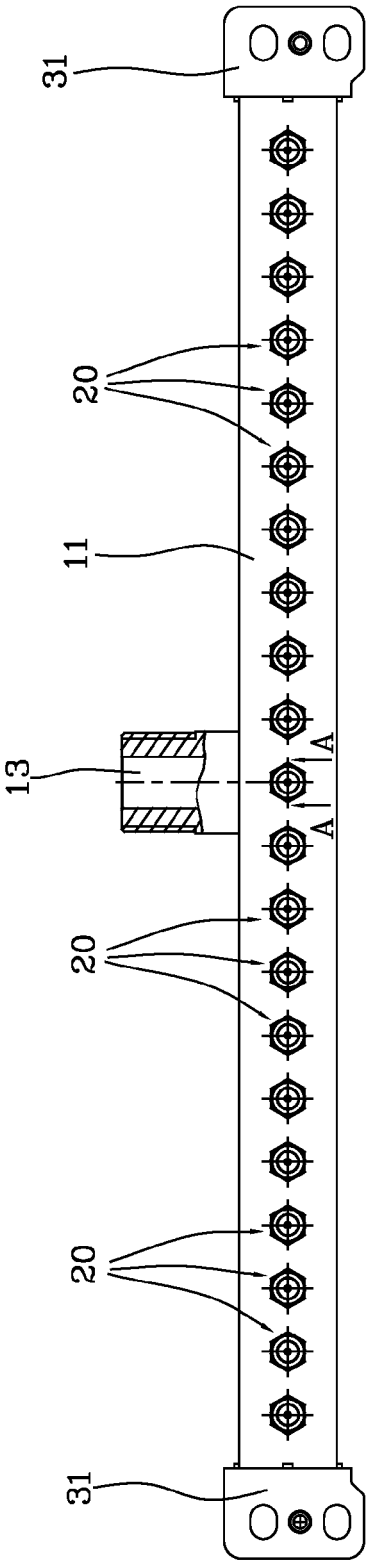

Fig.2

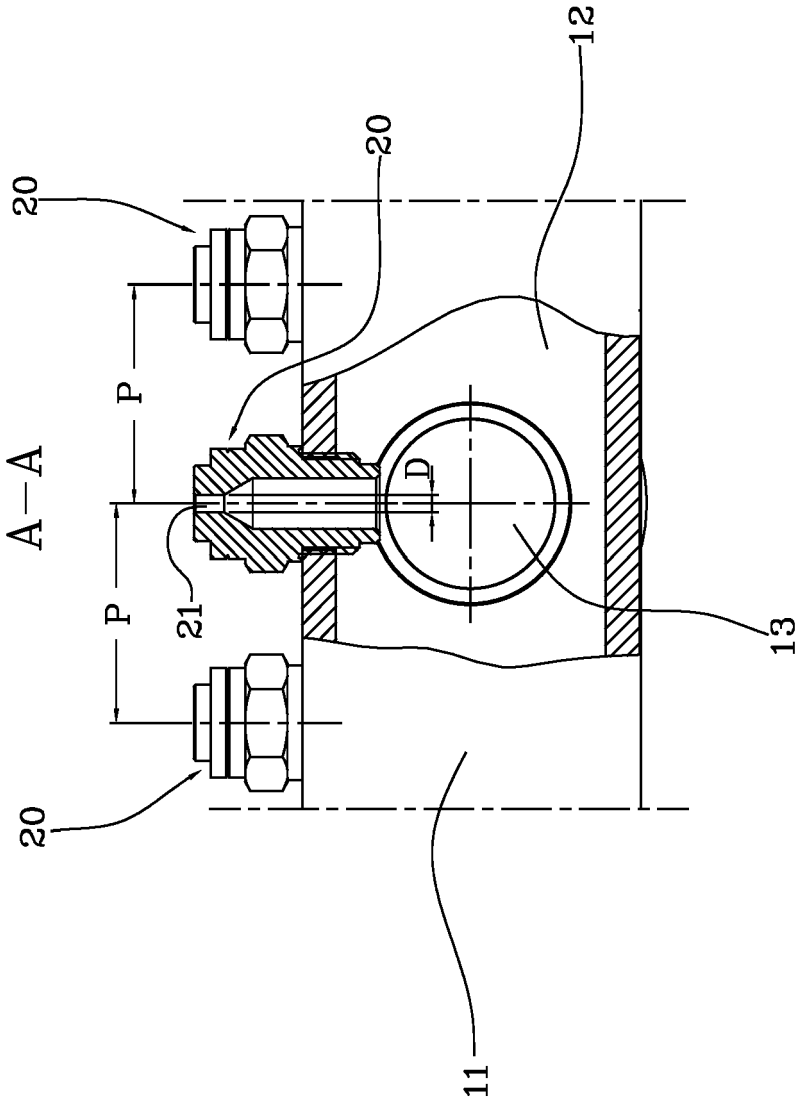

Fig.3

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EUROPEAN SEARCH REPORT

Application Number
EP 22 21 4828

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 1 863 100 A (COLEMAN THOMAS A) 14 June 1932 (1932-06-14) * page 1, line 42 - page 2, line 59; figures 1,2 *	1-6	INV. F23D14/48
A	US 2019/257523 A1 (DUSKY PAUL [US]) 22 August 2019 (2019-08-22) * paragraph [0016] - paragraph [0024] *	1-6	
A	EP 3 795 899 A1 (WUHU MIDEA KITCHEN & BATH APPLIANCES MFG CO LTD [CN] ET AL.) 24 March 2021 (2021-03-24) * paragraph [0020] - paragraph [0039]; figures 1-3 *	1-6	
A	EP 1 028 287 A1 (BOSCH GMBH ROBERT [DE]) 16 August 2000 (2000-08-16) * paragraph [0010] - paragraph [0013]; figures 1,2 *	1-6	
			TECHNICAL FIELDS SEARCHED (IPC) F23D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	17 April 2023	Theis, Gilbert

CATEGORY OF CITED DOCUMENTS

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17-04-2023

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 1863100 A	14-06-1932	NONE	
US 2019257523 A1	22-08-2019	EP 3755948 A2	30-12-2020
		US 2019257523 A1	22-08-2019
		WO 2019164657 A2	29-08-2019
EP 3795899 A1	24-03-2021	CN 108534139 A	14-09-2018
		EP 3795899 A1	24-03-2021
		US 2021215336 A1	15-07-2021
		WO 2019218413 A1	21-11-2019
EP 1028287 A1	16-08-2000	DE 19905789 A1	24-08-2000
		EP 1028287 A1	16-08-2000

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