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(71) Applicant: **Systema Polska Sp. zo. o**
98 220 Zdunska Wola (PL)

(72) Inventors:
- **Pallaro, Oscar**
  I-35012 Camposampiero (PD) (IT)
- **Cortelazzo, Federico**
  I-35045 Ospedaletto Euganeo (PD) (IT)

(74) Representative: **Gallo, Luca**
Gallo & Partners S.r.l.
Via Rezzonico, 6
35131 Padova (IT)

(54) **Gas combustion head for premixed burners and burner provided with the aforesaid combustion head**

(57) Gas combustion head (10) for premixed burners, which has a main body (11) adapted to receive a fuel gas - air mixture (15), and on such main body (11) a conical surface (12) is obtained having a series of openings (13), through which the fuel gas - air mixture (15) flows from an internal distribution chamber (14) of said main body (11) to a combustion area (16) outside said main body (11), in a manner so as to develop a longitudinal flame (17).

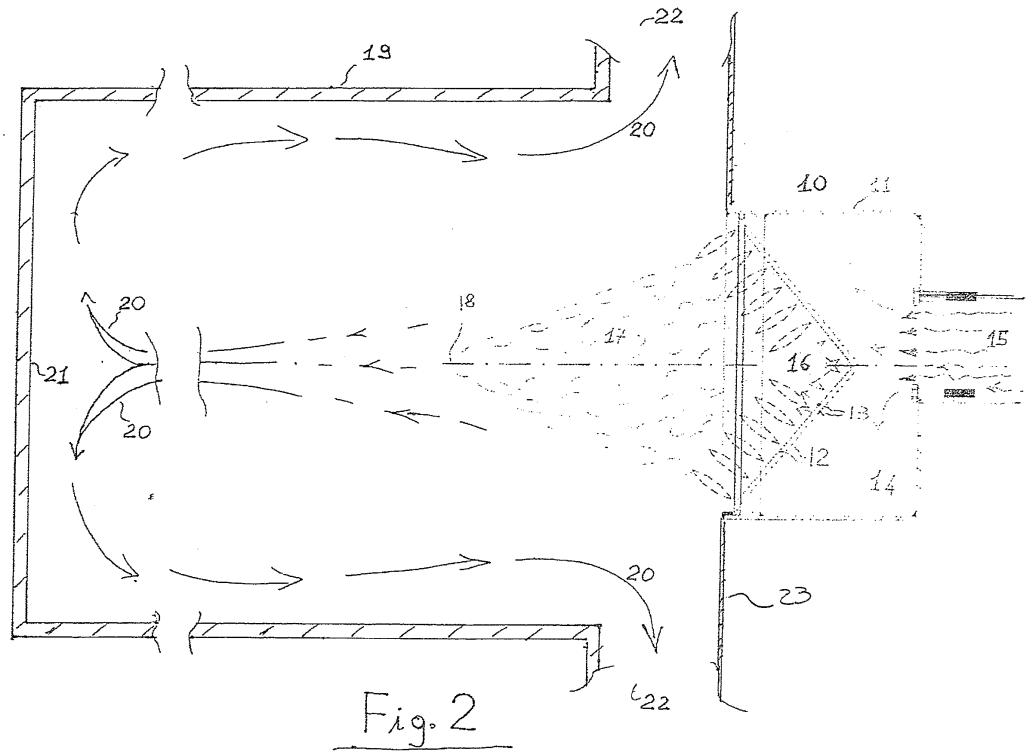

Fig. 2

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Description

Field of application

[0001] The present invention regards a gas combustion head for premixed burners and a burner provided with the aforesaid combustion head, according to the preamble of the respective independent claims.

[0002] The present combustion head and the burner are of the type adapted to be advantageously employed for obtaining thermodynamic appliances, in particular for heating, adapted to generate heat through a flow of burnt gases to be employed in exchangers for the production of athermal energy.

State of the art

[0003] In order to increase the performances of heat generators fed with fuel gas, whether they are intended to produce hot air, hot water or vapor, the use of premixed burners has been increasingly employed, characterized by having a premixing between the comburent air and the fuel gas upstream of the combustion area. A particular feature of said burners is that they are able to ensure an optimal combustion over a wide range of thermal power, and they also allow the reduction of the size of the combustion chambers.

[0004] Premixed burners have been on the market for years and mainly have application on hot air generators and on hot water boilers. The thermal power of the single burner usually does not on average exceed several hundred kilowatts; this is linked to the technical characteristics of the combustion heads currently employed on said premixed burners. The continuous adjustment range of the thermal power of the aforesaid burners with current combustion heads is also limited; it is not easy and sometimes impossible to remove or only reduce the frequent noise and vibration phenomena that arise, and the adjustment as well is not simple. Moreover, the current combustion heads employed on premixed burners fully condition the geometry of the combustion chamber, requiring the use of only one specific type thereof. A typical case is that reported in the invention EP 1 538 395 A1, where the combustion head reported herein develops a combustion flame that is totally radial, mainly adapted for hot water boilers, or in any case for apparatuses that do not provide for a combustion chamber "with flame inversion". Also the duration of current combustion heads in high thermal power applications, due to the high surface temperature of the head itself, is limited and much shorter than the average useful lifetime of the apparatus.

[0005] Known from the patents WO 2008/081271 and US 2009/0291402 is a burner provided with a plurality of combustion heads for the air-gas mixture, formed by pairs of walls converging together and flanked to form contiguous channels with longitudinal extension. The walls are provided with a plurality of openings for the passage of the air-gas fluid. Such solution has proven to be spatially bulky given the same power burned and unsuitable for creating a flame conformation capable of obtaining an optimized flow of hot gases, in particular for a combustion chamber of flame inversion type. Indeed, the flame that is formed in these combustion heads has main extension parallel to the longitudinal extension of the channels and is not directed in the extension direction of the hot gases. The patent JP S62196517 describes a burner having a combustion head with a pair of walls entirely similar to those described above.

[0006] Also known, from patents US 2121948 and EP 579315, are burners provided with one or more combustion heads with conical form provided with a main opening centrally obtained on the bottom of the cone, and fed by a main duct with air-gas mixture. The main opening is surrounded by a plurality of secondary openings fed with the same mixture. From the main opening, a main flow exits with high speed and high flow rate, while from the secondary openings a plurality of minor flows exit with smaller flow rate, much less than that of the main opening; the main purpose of such minor flows is to stabilize the flame created by the main duct. The secondary and main feed ducts are made in a body shaped in a distinct manner. The ducts direct the outflow of the fluid with their extension parallel or tilted with respect to the symmetry axis of the cone. The openings at the ends of the ducts are affected by the fall of pressure in the same duct, i.e. in distribution chambers obtained in the same shaped body of the burner. The resulting form of the total flame is very much affected by the pressure of the air/gas mixture. Given that the resulting overall flame is mainly obtained by the main flow of air/gas mixture, it does not have a high combustion surface area, and hence is unsuitable for maintaining the NOx emissions at a low level.

[0007] Further drawback of these conical heads for burners lies in the high construction cost, in particular for arranging a shaped body with the feed ducts obtained.

Presentation of the invention

[0008] In such context, therefore, the main object of the present invention is to overcome the already known drawbacks of the prior art that are mentioned above, by presenting a combustion head for premixed burners which can separately burn even more than 500 kilowatts and which has a continuously variable adjustment range approximately from 5 to 100% of the thermal power, without noise and especially resonance problems. Indeed, due to the particular convexity

of the conical surface for the outflow of the fuel gas - air mixture, one is able to exploit the self-feeding effect and obtain a stable flame in the various burnt thermal flow conditions, with all types of fuel gas.

[0009] Further object of the present invention is to present a burner whose combustion head is particularly adapted for its combustion chamber of "flame inversion" type. The longitudinal stability of the flame, due to the particular convexity of the conical surface for the distribution of the fuel gas - air mixture, in fact allows the possibility of also using cylindrical combustion chambers in which the flame inversion is obtained in the combustion chamber itself, overall optimizing the heat exchange surfaces and the exhaust of the combustion products.

[0010] Further object of the present invention is to present a combustion head for premixed burners which has a long duration and which diverges from the classical so-called "radiating heads" more or less coated with metallic or ceramic materials. Indeed, due to the particular convexity of the conical surface for feeding the fuel gas - air mixture present in the combustion head of the invention, the development and the conformation of the flame are such to not heat the body of the combustion head itself, ensuring greater stability and duration over time.

Description of the drawings

Brief description of the drawings

[0011] The technical characteristics of the finding, according to the task and the proposed objects, can be clearly found in the contents of the below-reported claims and the advantages thereof will be clearer in the detailed description of one embodiment, according to the finding, illustrated as a non-limiting example in the enclosed set of drawings in which:

Fig. 1 illustrates a preferred non-limiting embodiment of the gas combustion head for premixed burners.
Fig. 2 illustrates a preferred non-limiting embodiment of the gas combustion head for premixed burners, applied to a combustion chamber with "flame inversion".

Detailed description of a preferred embodiment

[0012] With reference to the set of drawings, reference number (10) indicates the gas combustion head for premixed burners in its entirety.

[0013] It comprises a main body (11) adapted to receive a fuel gas - air mixture (15), which is provided with an internal distribution chamber (14) for the fuel gas - air mixture (15) and with at least one distribution wall (12). The latter is provided with a series of openings (13), through which the fuel gas - air mixture (15) coming from the distribution chamber (14) flows. The distribution wall (12) of the main body (11) has conical shape with sections substantially circular with respect to planes orthogonal to the central axis (Z) of the cone and with convexity directed towards the internal distribution chamber (14).

[0014] Such distribution wall (12) is formed by at least one sheet-shaped metal plate with the aforesaid plurality of openings (13) obtained in its thickness. The latter (13) have size substantially equal to each other, and are traversed, orthogonally to the conical surface of said sheet-like plate in directions (Y) tilted towards the central axis (Z) of the cone, by flows of air-gas mixture with substantially equal flow speeds and susceptible of generating flames inside the combustion chamber (16) that are substantially equal and symmetrically arranged around the central axis (Z) of the cone as well as converging towards such central axis (Z) so as to form together a flow of hot burnt gases with maximum flow rate at the central axis (Z) of the cone.

[0015] The aforesaid combustion head (10) delimits a combustion area (16) outside said main body (11) where the igniting of the fuel gas - air mixture occurs and where the flame (17) is formed, with extension along the longitudinal axis (18) of a combustion chamber (19), in particular coinciding with the central axis of the cone (Z) of the head (12).

[0016] The sheet-shaped plate can be advantageously made in net form.

[0017] In fig. 2, a combustion chamber with "flame inversion" (19) is indicated, the gas combustion head for premixed burners (10) being coupled to such chamber.

[0018] Key for fig.1 and fig.2

10	Gas combustion head for premixed burners
11	Main body
12	Conical surfaces
13	Openings made on the conical surfaces
14	Distribution chamber for the fuel gas - air mixture

(continued)

15	Fuel gas - air mixture
16	Combustion area where the igniting of the fuel gas - air mixture occurs
17	Flame with longitudinal extension
18	Longitudinal axis
19	Combustion chamber
20	Combustion products
21	Bottom wall of the combustion chamber
22	Passage section for the combustion products into the flue gas exchanger

[0019] From fig. 1: the main body (11) receives, in the distribution chamber (14), a fuel gas - air mixture (15) that is premixed in a system upstream of the body itself. The internal distribution chamber (14) thus has a fuel gas - air mixture (15) that is pressurized with respect to the combustion area (16). Through the openings (13) made on the conical surface (12) with convexity directed towards the distribution chamber (14), a flow of air-gas mixture then exits, which is ignited by means of an ignition device (not reported), immediately in the area enclosed by the conical surface (12) identified as the combustion area (16). The single flows that exit from the openings (13) are extended in directions (Y) that are tilted with respect to the central symmetry axis (Z) of the cone. In other embodiments not represented herein, in order to be able to vary the range of thermal power that can be developed by the combustion head (10), the shape of the surface (12) can assume various configurations, advantageously including a frustoconical shape.

[0020] In other embodiments not represented herein, the conical wall (12) comprises two conical plates, each provided with a plurality of openings, parallel and spaced from each other along the extension of the longitudinal axis (18).

[0021] The size of the openings (13) is usually the same in the extension of the conical shape along the longitudinal axis. The flow rate of the air-gas mixture through each single opening (13) is proportional to its passage section and to the pressure present in the distribution chamber (14). In other embodiments not shown herein, in order to be able to vary the range of thermal power that can be developed by the combustion head (10), the size of the openings (13) can be varied in the extension of the conical shape along the longitudinal axis. In other embodiments not shown herein, in order to be able to vary the range of thermal power that can be developed by the combustion head (10), the sections of the plurality of openings (13) of the conical wall (12), for the passage of the fuel gas - air mixture (15), are organized on circumferences of the conical wall (12) that are spaced from each other with variable pitch along the direction of the longitudinal axis (18). In other embodiments not shown herein, in order to be able to vary the range of thermal power that can be developed by the combustion head (10), the degree of conicity of the surface (12) can be varied.

[0022] From fig. 2: The gas combustion head (10) for premixed burners is coupled to a combustion chamber with "flame inversion" (19). The flame (17) is developed and propagated in the direction of the bottom wall (21) of the combustion chamber (19), such wall being opposite the base wall (23) where the combustion head (10) is mounted. When the combustion products (20) arrive in proximity to this wall (21), they reverse direction by 180° in order to be introduced downstream in the flue gas exchanger system, through at least one exhaust section (22) placed in proximity to the starting front of the flame (17) i.e. to the base wall (23). More in detail, such exhaust section (22) can be obtained in the advantageously cylindrical lateral wall (24) that joins the bottom wall (21) to the base wall (23), at the latter, or it can be obtained directly with perimeter openings in the base wall (23).

Claims

1. Gas combustion head (10) for premixed burners, which comprises:

a main body (11) delimiting an internal distribution chamber (14), connected to at least one feed duct for introducing a fuel gas - air mixture (15) inside said internal distribution chamber (14), and provided with at least one distribution wall (12), having a plurality of openings (13), through which the fuel gas - air mixture (15) flows from said internal distribution chamber (14) of said main body (11), to a combustion chamber (16) outside said main body (11);

characterized in that the distribution wall (12) of said main body (11) has conical form with sections substantially circular with respect to planes orthogonal to the central axis (Z) of the cone and with convexity directed towards said internal distribution chamber (14);

said distribution wall (12) being formed by at least one sheet-shaped plate with said plurality of openings (13) obtained in its thickness, such openings (13) have size substantially equal to each other, and are traversed, orthogonally to the conical surface of said sheet-like plate in directions (Y) tilted towards the central axis (Z) of said cone, by flows of said air-gas mixture with substantially equal flow speeds generating flames inside said combustion chamber (16) that are substantially equal and symmetrically arranged around the central axis (Z) of said cone, converging towards such central axis (Z) and
susceptible of forming together a flow of hot burnt gases with maximum flow rate at said central axis (Z).

2. Gas combustion head (10) for premixed burners, according to claim 1, wherein the conical wall (12) defines a frustoconical shape.

3. Gas combustion head (10) for premixed burners, according to claim 1 or 2, wherein the conical wall (12) comprises two conical plates, each provided with a plurality of openings, parallel and spaced from each other along the extension of the longitudinal axis (18).

4. Gas combustion head (10) for premixed burners, according to any one of the preceding claims, wherein the sections of the plurality of openings (13) of the conical wall, for the passage of the fuel gas - air mixture, have different size in the extension of the conical form along the longitudinal axis.

5. Gas combustion head (10) for premixed burners, according to any one of the preceding claims, wherein the openings of the plurality of openings (13) of the conical wall, for the passage of the fuel gas - air mixture, are organized on circumferences of the conical wall that are spaced from each other with variable pitch along the direction of the longitudinal axis.

6. Burner for air-gas mixtures which comprises a gas combustion head (10) according to claim 1, and a combustion chamber, which houses at its interior said combustion head, **characterized in that** said combustion chamber is provided with axial symmetry centered on the axis of the cone of said combustion head (10), in particular it has cylindrical shape, and is provided with a bottom wall (21) facing said distribution wall (12) and susceptible of reversing by 180 degrees the advancing direction of the burnt gases (20) of said air/gas mixture, directing them towards an opposite base wall (23) on which said combustion head (10) is provided, and at such base wall (23) exhaust sections (22) for the burnt gases are obtained, outside said distribution wall (12).

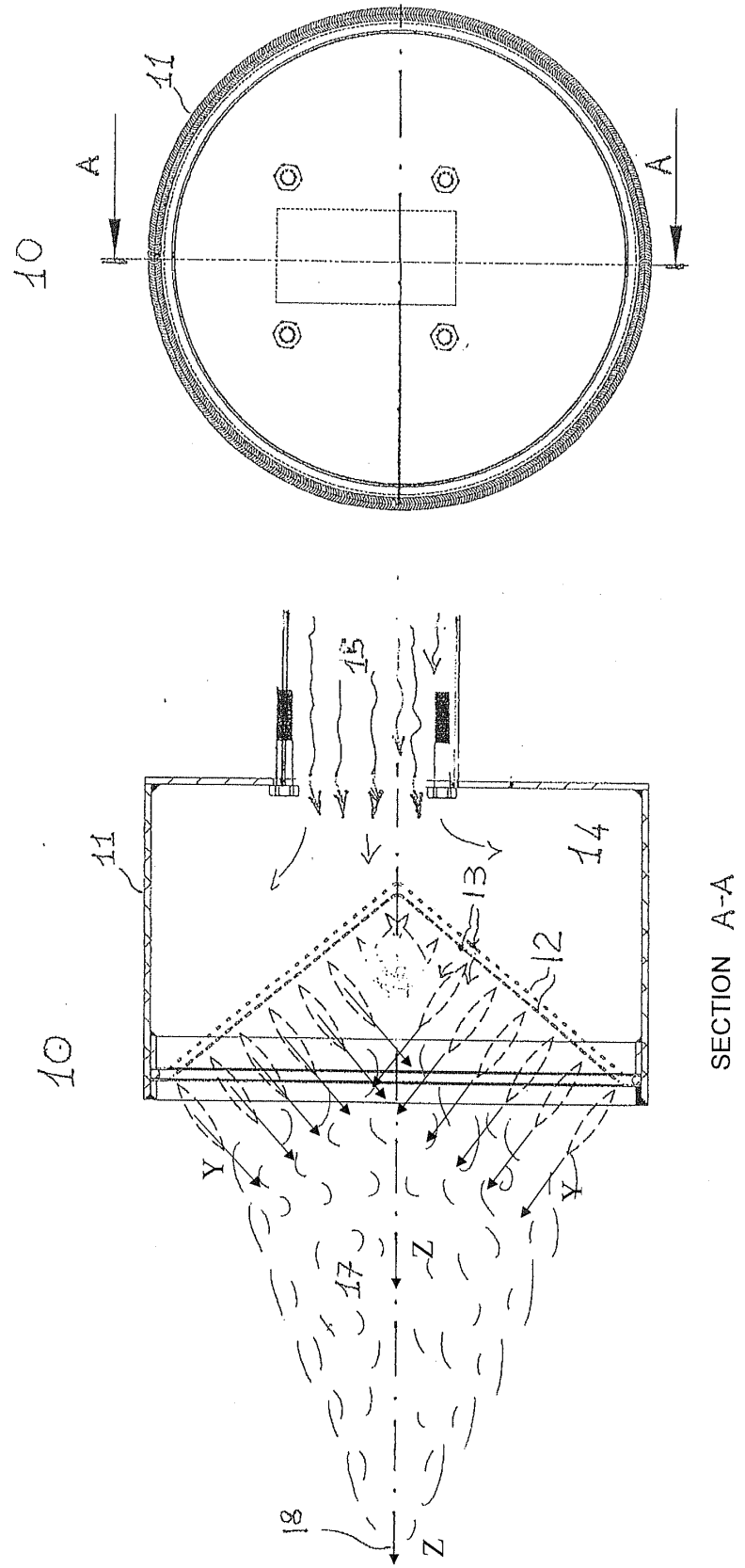

Fig. 1

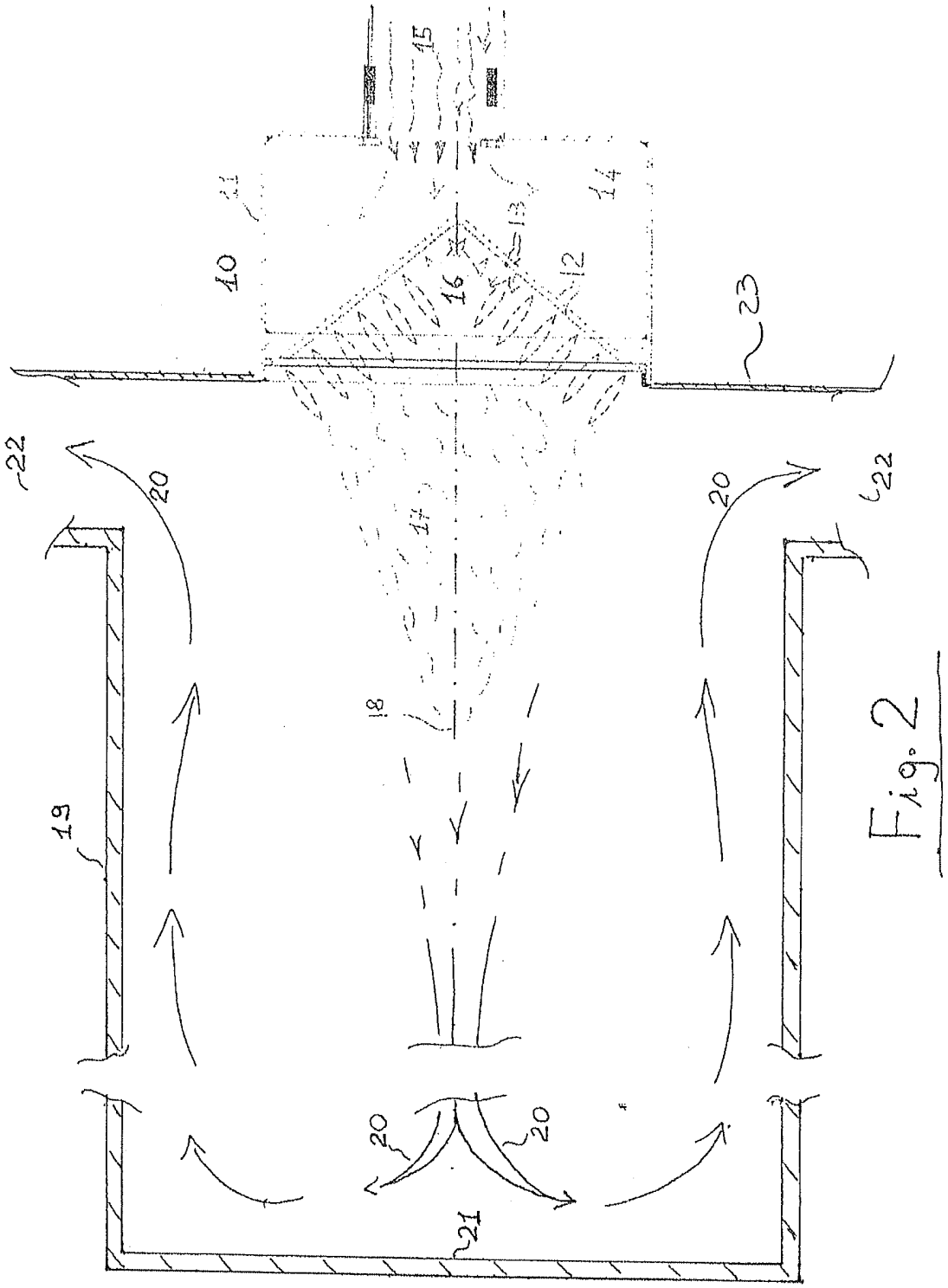

Fig. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 13 18 6354

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,D Y	EP 0 579 315 A1 (INGBUREAUP I PRODUCT INNOVATIE [NL]) 19 January 1994 (1994-01-19) * column 3, line 18 - column 4, line 16 * * figures 4-7 *	1,3,5 2,4,6	INV. F23D14/10
Y,D	US 2 121 948 A (BORLAND CARL A) 28 June 1938 (1938-06-28) * page 1, line 7 - line 46 * * page 2, line 3 - line 10 * * figures 1,2,5,6 *	2,4	
Y	US 2004/096794 A1 (LOEVGREN HANS [US] ET AL) 20 May 2004 (2004-05-20) * page 1, paragraph 13 - paragraph 21 * * figure 1 *	6	
A,D	US 2009/291402 A1 (CHO EUN SEONG [KR] ET AL) 26 November 2009 (2009-11-26) * page 3, paragraphs 34,37 * * figures 5,8 *	1,2	
			TECHNICAL FIELDS SEARCHED (IPC)
A,D	JP S62 196517 A (OSAKA GAS CO LTD) 29 August 1987 (1987-08-29) * abstract; figures 1-3 *	1,2	F23D
A,D	WO 2008/081271 A2 (WORGAS BRUCIATORI SRL [IT]; DOTTI MASSIMO [IT]; FOGLIANI GIUSEPPE [IT]) 10 July 2008 (2008-07-10) * page 3, line 14 - page 5, line 2 * * figures 1-5 *	1,3	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	6 November 2013	Gavriliu, Costin

CATEGORY OF CITED DOCUMENTS

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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06-11-2013

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0579315 A1	19-01-1994	NONE	
US 2121948 A	28-06-1938	NONE	
US 2004096794 A1	20-05-2004	CN 1498325 A	19-05-2004
		EP 1370800 A1	17-12-2003
		JP 2004526118 A	26-08-2004
		SE 0100948 A	20-09-2002
		TW 593927 B	21-06-2004
		US 2004096794 A1	20-05-2004
		WO 02075209 A1	26-09-2002
US 2009291402 A1	26-11-2009	CN 101495806 A	29-07-2009
		EP 2041490 A1	01-04-2009
		JP 5200016 B2	15-05-2013
		JP 2010501818 A	21-01-2010
		US 2009291402 A1	26-11-2009
		WO 2008004734 A1	10-01-2008
JP S62196517 A	29-08-1987	JP H0619216 B2	16-03-1994
		JP S62196517 A	29-08-1987
WO 2008081271 A2	10-07-2008	EP 2102551 A2	23-09-2009
		WO 2008081271 A2	10-07-2008

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 1538395 A1 **[0004]**
- WO 2008081271 A **[0005]**
- US 20090291402 A **[0005]**
- JP S62196517 B **[0005]**
- US 2121948 A **[0006]**
- EP 579315 A **[0006]**