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(54) **Premixed burner provided with gas combustion head**

Vormischbrenner mit Gasverbrennungskopf

Brûleur à prémélange équipe d'une tête de combustion à gaz

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(56) References cited:
EP-A1- 0 579 315
JP-A- S62 196 517
US-A- 6 129 545
US-A1- 2009 291 402
WO-A2-2008/081271
US-A- 2 121 948
US-A1- 2004 096 794

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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 a thermal 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 burner having the features specified in the preamble of claim 1 is known from US 2004/096794. Another 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 of the burner for air-gas mixtures according to the present invention;

Fig. 2 illustrates a preferred non-limiting embodiment of the burner for air-gas mixtures having 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 two sheet-shaped metal plates with the aforesaid plurality of openings (13) obtained in their thickness. The latter (13) have size substantially equal to each other, and are traversed, orthogonally to the conical surface of said sheet-like plates 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 a combustion area (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 the 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 plates 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.

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

(continued)

14	Distribution chamber for the fuel gas - air mixture
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

[0018] 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.

[0019] According to the present invention, 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).

[0020] 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 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.

[0021] 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. Burner for air-gas mixtures which comprises:

- a gas combustion head (10), 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),
  - a combustion chamber (19), to which said combustion head (10) is coupled, and which 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 (15),
    - an opposite base wall (23) on which said combustion head (10) is provided, and toward which said

burnt gases (20) are susceptible of being directed by said bottom wall (21); at such base wall (23) exhaust sections (22) for the burnt gases being obtained, outside said distribution wall (12);

characterized in that the main body (11) is 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 area (16) outside said main body (11); the distribution wall (12) of said main body (11) of said combustion head (10) 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 two sheet-shaped plates with said plurality of openings (13) obtained in their thickness, such openings (13) have size substantially equal to each other, and are arranged such that they are susceptible of being traversed, orthogonally to the conical surface of said sheet-like plates in directions (Y) tilted towards the central axis (Z) of said cone, by flows of said air-gas mixture (15) with substantially equal flow speeds generating flames inside said combustion area (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);
wherein said two conical plates are each provided with a plurality of openings, parallel and spaced from each other along the extension of the longitudinal axis (18) of said combustion chamber (19) coinciding with the central axis (Z) of the cone of said combustion head (10);
wherein the two conical plates of said conical distribution wall (12) are placed between said internal distribution chamber (14) and said combustion area (16);
wherein said combustion chamber (19) is provided with axial symmetry centered on the axis (Z) of the cone of said combustion head (10).

2. Burner according to claim 1, wherein the conical wall (12) defines a frustoconical shape.

3. Burner 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 (18).

4. Burner according to any one of the preceding claims, wherein said combustion chamber (19) has cylindrical shape.

5. Burner according to any one of the preceding claims, wherein the sheet-shaped plates of the distribution wall (12) of said combustion head (10) are made in net form.

Patentansprüche

1. Vormischbrenner für Luft-Gas-Gemische, der Folgendes umfasst:

- einen Gasverbrennungskopf (10) umfassend:

einen eine innere Verteilerkammer (14) begrenzenden Hauptkörper (11), der an mindestens einen Zuführungskanal zur Einleitung eines Brenngas-Luft-Gemisches (15) in die genannte innere Verteilerkammer (14) angeschlossen ist

- eine mit dem genannten Gasverbrennungskopf (10) gekoppelte Brennkammer (19), die Folgendes umfasst:

- eine zu der genannten Verteilerwand (12) gerichtete untere Wand (21), die geeignet ist, die Flussrichtung der Verbrennungsgase (20) des genannten Luft-Gas-Gemisches (15) um 180 Grad umzukehren,
- eine gegenüberliegende Basiswand (23), auf der sich der genannte Gasverbrennungskopf (10) befindet und zu der die genannten Verbrennungsgase (20) mittels der genannten unteren Wand (21) geleitet werden können; wobei an dieser Basiswand (23) Auslassabschnitte (22) für die Verbrennungsgase außerhalb der genannten Verteilerwand (12) eingerichtet sind;

dadurch gekennzeichnet, dass der Hauptkörper (11) mit mindestens einer Verteilerwand (12) mit einer Vielzahl von Öffnungen (13) ausgestattet ist, durch die das Brenngas-Luft-Gemisch (15) von der genannten inneren Verteilerkammer (14) des genannten Hauptkörpers (11) in einen Verbrennungsbereich (16) außerhalb des genannten Hauptkörpers (11) fließt; wobei die Verteilerwand (12) des genannten Gasverbrennungskopfs (10) eine konische

Form mit im Wesentlichen kreisförmigen Abschnitten im Verhältnis zu der Mittelachse (Z) des Konus rechtwinkligen Ebenen und Konvexität zu der genannten inneren Verteilerkammer (14) aufweist; wobei die genannte Verteilerwand (12) aus zwei blechförmigen Platten mit der genannten Vielzahl an in ihrer Stärke erzielten Öffnungen (13) gebildet wird und diese Öffnungen (13) eine im Wesentlichen gleiche Größe aufweisen und so angeordnet sind, dass sie geeignet sind, rechtwinklig zu der konischen Fläche der genannten blechförmigen Platten in Richtungen (Y) mit Neigung zu der Mittelachse (Z) des genannten Konus von Flüssen des genannten Luft-Gas-Gemisches (15) bei im Wesentlichen gleichbleibenden Fließgeschwindigkeiten überquert zu werden und Flammen in dem genannten Verbrennungsbereich (16) zu erzeugen, die im Wesentlichen gleich und symmetrisch um die mittlere Achse (Z) des genannten Konus angeordnet sind und in Richtung dieser Mittelachse (Z) konvergieren und geeignet sind, zusammen einen Fluss aus heißen Verbrennungsgasen mit der höchsten Fließgeschwindigkeit an der genannten Mittelachse (Z) zu bilden (Z);
wobei die genannten beiden konischen Platten jeweils mit einer Vielzahl an parallelen und voneinander entfernten Öffnungen entlang des Verlaufs der Längsachse (18) der genannten Verbrennungskammer (19) ausgestattet sind und mit der Mittelachse (Z) des Konus des genannten Gasverbrennungskopfs (10) übereinstimmen;
wobei die genannten konischen Platten der genannten konischen Verteilerwand (12) zwischen der genannten inneren Verbrennungskammer (14) und dem genannten Verbrennungsbereich (16) positioniert sind;
wobei die genannte Verbrennungskammer (19) eine axiale, auf der Achse (Z) des Konus des genannten Gasverbrennungskopfes (10) zentrierte Symmetrie aufweisen.

2. Brenner nach Anspruch 1, bei dem die konische Wand (12) eine Kegelstumpfform definiert.

3. Brenner nach einem beliebigen der vorangegangenen Ansprüche, bei dem die Öffnungen der Vielzahl an Öffnungen (13) der konischen Wand zum Durchgang des Brenngas-Luft-Gemisches auf Umfängen der konischen Wand angeordnet sind, die voneinander mit variabler Steigung entlang der Richtung der Längsachse (18) entfernt sind.

4. Brenner nach einem beliebigen der vorangegangenen Ansprüche, bei dem die genannte Verbrennungskammer (19) zylindrische Form aufweist.

5. Brenner nach einem beliebigen der vorangegangenen Ansprüche, bei dem die blechförmigen Platten der Verteilerwand (12) des genannten Gasverbrennungskopfs (10) netzförmig sind.

Revendications

1. Brûleur à pré-mélange comportant :

- une tête de combustion à gaz (10) comportant :

un corps principal (11) délimitant une chambre de distribution interne (14), connecté à au moins un conduit d'alimentation pour l'introduction d'un mélange de gaz-air (15) à l'intérieur de ladite chambre de distribution (14),

- une chambre de combustion (19) à laquelle est accouplée ladite tête de combustion (10) et qui est munie de :

- une paroi de fond (21) faisant face à ladite paroi de distribution (12) et susceptible d'inverser de 180 degrés la direction d'avance des gaz brûlés (20) dudit mélange air/gaz (15),
- une paroi de base opposée (23) sur laquelle est fournie ladite tête de combustion (10) et vers laquelle lesdits gaz brûlés (20) sont susceptibles d'être dirigés par ladite paroi de fond (21) ; sur ladite paroi de base (23) étant obtenues des sections d'échappement (22) des gaz brûlés à l'extérieur de ladite paroi de distribution (12) ;

caractérisé en ce que le corps principal (11) est pourvu d'au moins une paroi de distribution (12), ayant une pluralité d'ouvertures (13) à travers lesquelles le mélange de gaz-air (15) s'écoule de ladite chambre de distribution interne (14) dudit corps principal (11) vers une zone de combustion (16) à l'extérieur dudit corps principal (11) ;
la paroi de distribution (12) dudit corps principal (11) de ladite tête de combustion (10) a une forme conique avec des sections substantiellement circulaires par rapport aux plans orthogonaux à l'axe central (Z) du cône et avec convexité dirigée vers ladite chambre de distribution interne (14) ; ladite paroi de distribution (12) étant formée de deux plaques en feuille avec ladite pluralité d'ouvertures (13) obtenues dans leur épaisseur, ces ouvertures (13)

ont une dimension substantiellement égale l'une à l'autre et sont placées de façon à ce qu'elle soient susceptibles d'être traversées, en mode orthogonal à la surface conique desdites plaques en feuille dans les directions (Y) inclinées vers l'axe central (Z) dudit cône, par l'écoulement dudit mélange d'air-gaz (15) avec substantiellement des vitesses d'écoulement égales générant des flammes à l'intérieur de ladite zone de combustion (16) qui sont substantiellement égales et symétriquement disposées autour de l'axe central (Z) dudit cône, convergeant vers ledit axe central (Z) et susceptible de former ensemble un écoulement de gaz brûlés chauds avec débit maximum sur ledit axe central (Z) ;
dans lequel lesdites deux plaques coniques sont chacune pourvue d'une pluralité d'ouvertures, parallèles et espacées l'une de l'autre le long de l'extension de l'axe longitudinal (18) de ladite chambre de combustion (19) coïncidant avec l'axe central (Z) du cône de ladite tête de combustion (10) ;
dans lequel les deux plaques coniques de ladite paroi de distribution conique (12) sont placées entre ladite chambre de distribution interne (14) et ladite zone de combustion (16) ;
dans lequel ladite chambre de combustion (19) est pourvue d'une symétrie axiale centrée sur l'axe (Z) du cône de ladite tête de combustion (10).

2. Brûleur selon la revendication 1, dans lequel la paroi conique (12) définit une forme de tronc de cône.

3. Brûleur selon l'une quelconque des revendications précédentes, dans lequel les ouvertures de la pluralité d'ouvertures (13) de la paroi conique, pour le passage du mélange gaz-air, sont disposées sur les circonférences de la paroi conique qui sont espacées l'une de l'autre avec pas variable le long de la direction de l'axe longitudinal (18).

4. Brûleur selon l'une quelconque des revendications précédentes, dans lequel ladite chambre de combustion (19) a forme cylindrique.

5. Brûleur selon l'une quelconque des revendications précédentes, dans lequel les plaques en feuille de la paroi de distribution (12) de ladite tête de combustion (10) sont réalisées en forme de filet.

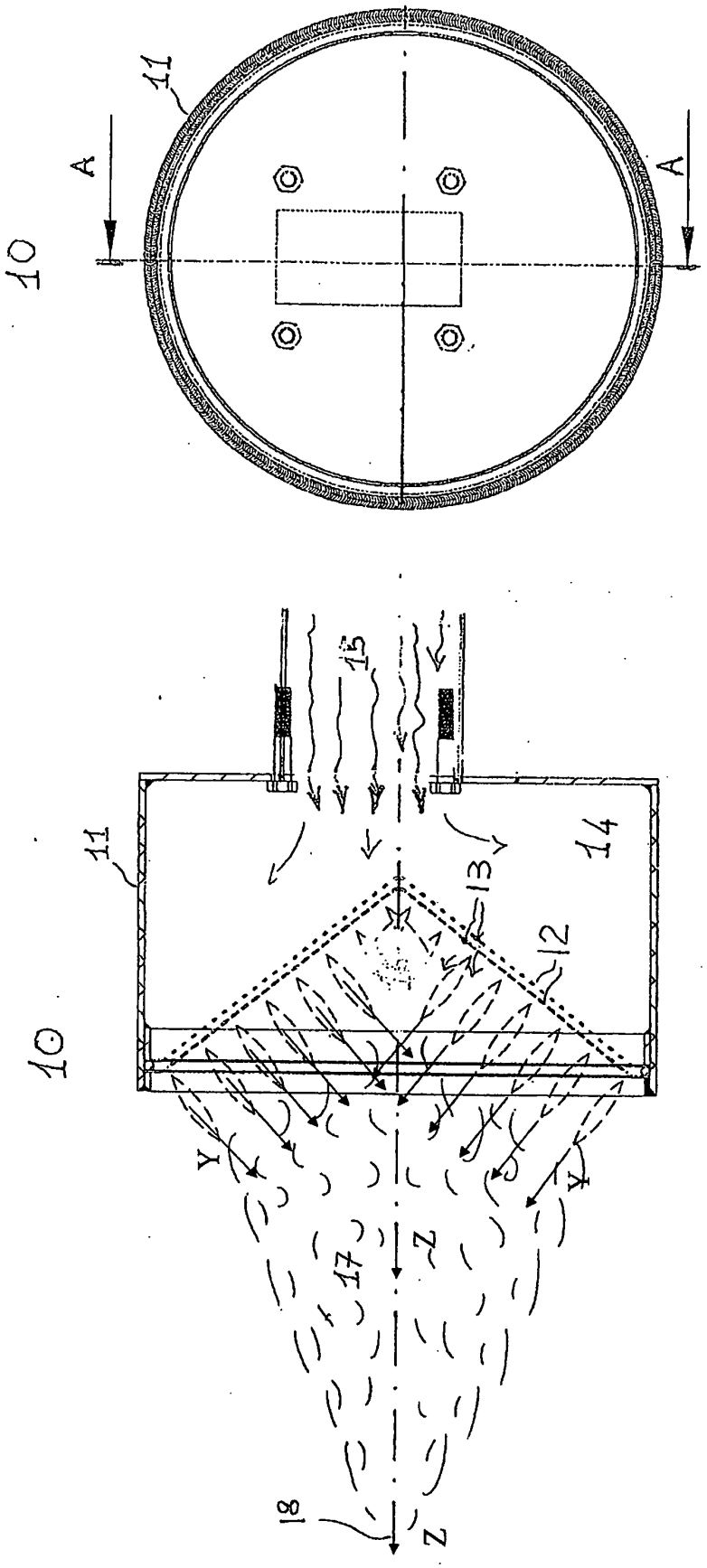

Fig. 1

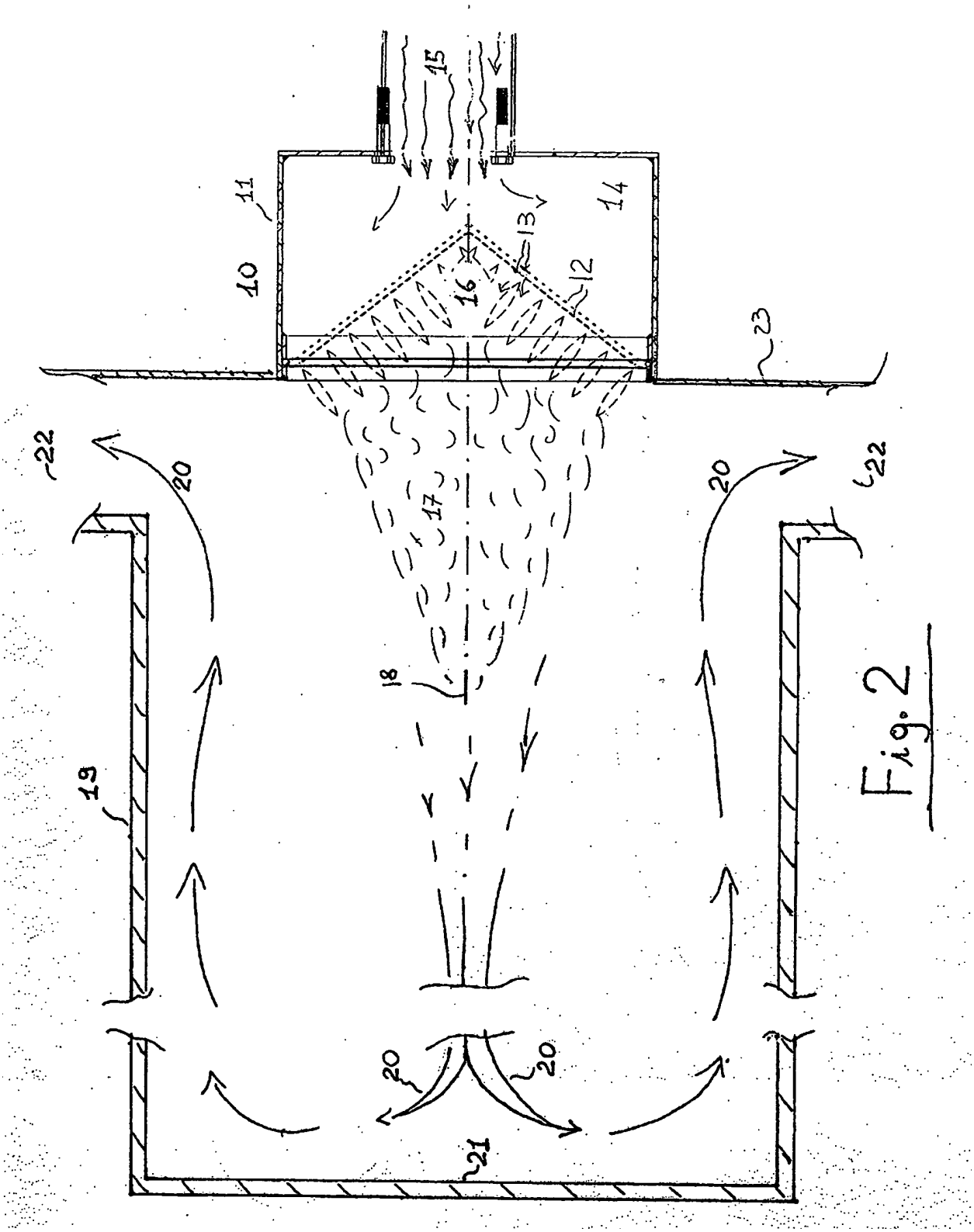

Fig. 2

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 2004096794 A **[0004]**
- EP 1538395 A1 **[0004]**
- WO 2008081271 A **[0005]**
- US 20090291402 A **[0005]**
- JP S62196517 B **[0005]**
- US 2121948 A **[0006]**
- EP 579315 A **[0006]**