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(54) BOILER FOR PRODUCING HOT WATER OR STEAM

(57) A boiler for producing hot water or steam, comprising a containment enclosure (2), which forms a heating chamber (3) that contains the water to be heated, and accommodating a firebox body (4), which forms internally a combustion chamber (5) with a burner (6) associated therewith which has a combustion head (7), accommodated in the combustion chamber (5), and a device (8) for premixing air and gas which is connected to the combustion head (7). According to the invention, the premixing device (8) comprises an air supply duct (14), which is connected to the combustion head (7), and a mixing tubular body (15), which is extended coaxially to the supply duct (14) in order to create, between the internal lateral wall of the supply duct (14) and the external surface of the sidewall of the mixing tubular body (15), an intake region (16) which has a transverse air passage section that is narrower than the air passage section formed by the supply duct (14) upstream of the mixing tubular body (15), along the air flow direction.

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Description

[0001] The present invention relates to a boiler for producing hot water or steam.

[0002] Boilers for producing hot water or steam are known which have an external enclosure in which there is a water heating chamber, inside which a firebox body is arranged, which is in a heat exchange relationship with the water to be heated and is provided internally with a combustion chamber, at one end of which a burner is arranged, which normally passes through a door for access to the combustion chamber and is capable of producing, by means of a combustion head, a flame formed in the combustion chamber.

[0003] The water heating chamber is crossed by a plurality of heat exchange tubes in which the hot combustion gases generated in the combustion chamber are made to flow so that they can exchange heat with the water contained in the heating chamber, before they collect in a combustion gas chamber, from which they are evacuated externally by means of a stack.

[0004] The burners used in boilers of this type can be premix burners, which have, upstream of the combustion head, a device for premixing air and gas which is typically constituted by a Venturi tube, which is provided with a converging portion followed by a diverging portion and has an axial intake, connected to an air supply duct, a lateral intake, arranged at the maximum narrowing of its passage section and connected to a gas chamber located around the converging and diverging portions and connected to a gas supply duct, controlled by an adjustable intake valve, and an axial outlet, which is arranged at the end of the Venturi tube that is opposite with respect to its axial intake.

[0005] In particular, between the outlet of the Venturi tube and the combustion head there is an interposed fan, which has the function of aspirating the mixture of air and gas from the outlet of the Venturi tube, of promoting its further mixing and of sending it under pressure to the combustion head, thus placing the combustion chamber in overpressure with respect to the ambient pressure.

[0006] One drawback of the boilers described above resides in that they require the provision of multiple types of different Venturi tubes in order to achieve the mixing of combustible gas and air that is suitable for a wide range of burners of different power ratings, which can vary from 20 to 20,000 kW, which can be installed on boilers.

[0007] Another drawback arises from the need for perfect manufacturing of the Venturi tube in order to ensure correct and complete mixing between the gas and the air in order to avoid the excessive emission of NO_x at the stack.

[0008] A further drawback is the emission of unpleasant hisses in the regions of mixing between the air and the gas, which increase the noisiness of the boiler.

[0009] Another drawback of boilers of the described type resides in the large space occupation at the door, which is caused by the presence of the premix burner and more particularly of its fan and of its Venturi tube.

[0010] Other drawbacks of these boilers are due to the overpressure to which the combustion chamber is subjected, such as the accumulation of unburnt substances in the combustion chamber during ignition, in case of obstructions at the stack, backfires toward the outside environment or leaks of smoke through the gaskets of the door or the propagation of pressure waves toward the outside environment during the ignition steps.

[0011] The aim of the present invention is to provide a boiler for generating hot water or steam that is capable of improving the background art in one or more of the aspects indicated above.

[0012] Within this aim, an object of the present invention is to provide a boiler for producing hot water or steam that has an air and gas premixing device that can be obtained easily for a wide range of burners of different power ratings.

[0013] Another object of the present invention is to provide a boiler for producing hot water or steam that has, at the region of the burner, considerably smaller space occupations than boilers of the background art.

[0014] Another object of the present invention is to provide a boiler for producing hot water or steam that is capable of ensuring for the stack a considerable reduction of NO_x with respect to currently known boilers.

[0015] Another object of the present invention is to provide a boiler for producing hot water or steam that is not affected by unpleasant noisiness in the region of the burner.

[0016] A further object of the present invention is to provide a boiler for the production of hot water or steam that does not have backfires or leaks of gas from the door and does not have problems of accumulation of unburnt substances or of pressure waves that propagate outward.

[0017] A still further object of the present invention is to provide a boiler for producing hot water or steam that is reliable and safe as well as producible at highly competitive costs.

[0018] Another object of the present invention is to overcome the drawbacks of the background art in a manner that is alternative to any existing solutions.

[0019] This aim, as well as these and other objects which will become better apparent hereinafter, are achieved by a boiler for producing hot water and steam according to claim 1, optionally provided with one or more of the characteristics of the dependent claims.

[0020] Further characteristics and advantages of the invention will become better apparent from the description of a preferred but not exclusive embodiment of the boiler according to the invention, illustrated by way of non-limiting example in the accompanying drawings, wherein:

Figure 1 is a schematic longitudinal sectional view of a boiler according to the invention;

Figure 2 is a longitudinal sectional view of a premix-

ing device of the boiler according to the invention;
Figure 3 is an elevation view of a mixing tubular body of the premixing device;
Figure 4 is an enlarged-scale view of a detail of Figure 3;
Figure 5 is a front view of one end of the tubular body of Figure 3;
Figure 6 is a sectional view, taken along the line VI-VI of Figure 3.

[0021] With reference to the cited figures, the boiler for producing hot water or steam according to the invention, designated generally by the reference numeral 1, comprises an external enclosure 2, which preferably has a substantially cylindrical shape, in which there is a heating chamber 3 which contains the water to be heated and is provided with an intake 3a for the cold water and an outlet 3b from which hot water or steam can exit.

[0022] Axially with respect to the heating chamber 3 there is a firebox body 4, inside which a combustion chamber 5 is formed in which the flame generated by a burner 6 develops.

[0023] In particular, the burner 6 comprises a combustion head 7, preferably of the inward firing type, which emits the flame in the combustion chamber 5 and is arranged at one end of said combustion chamber, in which conveniently there is a door 5a for closing the combustion chamber 5, and a premixing device 8 which supplies the combustion head 7 with a mixture of air and gas.

[0024] Multiple heat exchange tubes 9 are connected to the combustion chamber 5, and the hot combustion gases that originate from the flame emitted by the combustion head 7 flow therein and pass longitudinally through the heating chamber 3, so as to heat the water contained therein, until they exit into a combustion gas collection chamber 10, which is connected to a stack 11 for the evacuation of said combustion gases into the atmosphere.

[0025] Preferably, at the end of the combustion chamber 5 that is opposite with respect to the combustion head 7 there is a back wall 12 of the firebox body 4 which allows to redirect the combustion gases toward the door 5a, at which advantageously there is a combustion gas redirection chamber 13 which allows to channel the combustion gases into the heat exchange tubes 9.

[0026] According to the invention, the premixing device 8 comprises an air supply duct 14, which is connected to the outside environment and is connected to the combustion head 7, inside which there is a mixing tubular body 15, which is extended substantially coaxially to the supply duct 14, so as to form inside the supply duct 14 an intake region 16, which is arranged between the internal lateral wall of the supply duct 14 and the outer surface of the sidewall of the mixing tubular body 15 and has a transverse passage section for the air that is narrower than the passage section for the air defined in the supply duct 14 upstream of the mixing tubular body 15, along the direction of the flow of air in the supply duct 14.

[0027] In particular, at a first end thereof 15a, which is directed against the flow of air in the supply duct 14, the mixing tubular body 15 is closed by a head 16, which is substantially ogive-shaped, in order to progressively approach, with its lateral surface, the internal lateral wall of the supply duct 14, proceeding in the direction of the flow of air in the supply duct 14, while at its second end 15b, which is opposite with respect to the first end 15a, it is connected to a gas supply duct 17, which is connected to its internal cavity 18.

[0028] At least one gas dispensing opening 19 is formed in the sidewall of the mixing tubular body 15 and connects the internal cavity 18 of the mixing tubular body 15 to the intake region 16.

[0029] Preferably, in the sidewall of the mixing tubular body 15 there are multiple dispensing openings 19, which are arranged, so that they are mutually spaced, around the axis of the mixing tubular body 15.

[0030] The or each one of the dispensing openings 19 has an elongated shape and is advantageously inclined, with its longitudinal axis of extension, with respect to the axis of the mixing tubular body 15.

[0031] Conveniently, the mixing tubular body 15 has a diametrical space occupation which decreases progressively from the head 16 toward its second end 15b, so as to create a progressive widening of the passage section comprise between its sidewall and the internal wall of the air supply duct 14.

[0032] Advantageously, the dispensing openings 19 are arranged directly downstream of the head 16, along the direction of the air flow, i.e., substantially at the point with the narrowest passage section of the intake region 16.

[0033] Advantageously, the mixing tubular body 15 is made of metallic material, preferably aluminum, and by virtue of its particular shape it can be obtained easily by turning on a lathe a metal bar in the dimensional scale that is suitable for the power rating of the burner 6 for which it is intended, and more preferably it can be provided in two parts which can be mutually assembled, for example by screwing, of which one provides conveniently the head 16, said parts being obtained starting from an aluminum rod which is drilled and shaped with cutting tools on a numeric control lathe.

[0034] At its end 15b, which is opposite with respect to the head 16, the mixing tubular body 15 is conveniently closed by a wall 20 in which a coupling opening 21 is provided for the insertion of the output end of the gas supply duct 17 in the internal cavity 18 of the mixing tubular body 15. A slot 22 is advantageously provided around the coupling opening 20 and has a polygonal cross-section for the engagement of a locking element, not shown, which allows to lock the supply duct 17 to the mixing tubular body 15.

[0035] Preferably, the air flow inside the supply duct 14 is produced by virtue of suction means which are adapted to place in partial vacuum the combustion chamber 5 with respect to the external ambient pressure.

[0036] Conveniently, the suction means comprise at least one fan 23, which is actuated by a motor 24, provided with an inverter. In particular, the fan 23 is accommodated in the combustion gas collection chamber 10 and more particularly is connected with its intake to the combustion gas collection chamber 10 and therefore, through the heat exchange tubes 9, to the combustion chamber 5, while it is connected to the stack 11 with its delivery.

[0037] The operation of the boiler according to the invention is as follows.

[0038] The heating chamber 3 is supplied with water at its intake 3a.

[0039] The activation of the fan 23 allows to place the combustion chamber 5 in partial vacuum, so as to produce in the supply duct 14 a flow of air that is drawn from the outside environment.

[0040] The air that flows in the supply duct 14 undergoes, at the intake region 16 created by the presence of the mixing tubular body 15, an increase in speed and a consequent reduction in pressure, due to the Venturi effect, which allows to draw, from the internal cavity 18 of the mixing tubular body 15, the combustible gas supplied by the supply duct 17, through the dispensing openings 19 of the mixing tubular body 15, so as to introduce it in the air flow so that it can mix with it.

[0041] The elongated shape of the dispensing openings 19 and their inclined arrangement with respect to the axis of the mixing tubular body 15 in the point of maximum partial vacuum allows to avoid the occurrence of air threads which do not mix with the gas and at the same time reduces the risk of noisiness during normal operation in a wide air/gas flow rate modulation range.

[0042] The gas mixture thus obtained supplies the combustion head 7, which is thus ignited so as to generate a flame inside the combustion chamber 5.

[0043] The hot combustion gases, once they have reached the back wall 12 of the firebox body 4, are redirected toward the door 10 and channeled inside the heat exchange tubes 9, so as to heat the water contained in the heating chamber 3, until they reach the combustion gas collection chamber 10, from which they are propelled into the stack 11 by the fan 23, while the steam or hot water that are produced exit from the heating chamber 3 through the outlet 3b.

[0044] It should be noted that it is possible to vary the air/gas power range simply by replacing the mixing tubular body 15 with another one having a different diameter inside the same supply duct 14, which is not possible with the classic Venturi tube, which instead requires the entire assembly constituted by the tube composed of a converging element and a diverging element and the gas chamber to be replaced.

[0045] In practice it has been found that the invention is capable of achieving fully the intended aim and objects and in particular it is stressed that the premixing device that has the mixing tubular body configured as described above allows, in addition to considerable cost reductions for an equal performance, an easy sizing thereof in relation to any burner size.

[0046] It should also be noted that the premixing device provided with the mixing tubular body described above allows optimum mixing of air and gas, with consequent reduction of NO_x, while the particular shape and arrangement of the gas dispensing openings in the mixing tubular body allows to reduce noisiness considerably.

[0047] Another advantage of the boiler according to the invention is the absence of leaks of smoke through the gaskets arranged in the door and in the combustion gas collection chamber, since the combustion chamber and the combustion gas collection chamber are in partial vacuum.

[0048] Another advantage of the boiler according to the invention is that it has an extremely reduced space occupation in front of the door, since the premixing device has the space occupation of the air supply duct and the intake fan is arranged inside the combustion gas collection chamber and therefore inside the boiler itself.

[0049] All the characteristics of the invention indicated above as advantageous, convenient or the like may also be omitted or be replaced with equivalents.

[0050] The individual characteristics described with reference to general teachings or to particular embodiments may all be present in other embodiments or may replace characteristics in these embodiments.

[0051] The invention thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the appended claims.

[0052] In practice, the materials used, so long as they are compatible with the specific use, as well as the shapes and dimensions, may be any according to the requirements.

[0053] All the details may further be replaced with other technically equivalent elements.

[0054] The disclosures in Italian Patent Application No. 102017000106688 from which this application claims priority are incorporated herein by reference.

[0055] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. A boiler for producing hot water or steam, comprising a containment enclosure (2), which forms a heating chamber (3) that contains the water to be heated, and accommodating a firebox body (4), which forms internally a combustion chamber (5) with a burner (6) associated therewith which has a combustion head (7), accommodated in said combustion chamber (5), and a device (8) for premixing air and gas

which is connected to said combustion head (7), **characterized in that** said premixing device (8) comprises an air supply duct (14), which is connected to said combustion head (7), and a mixing tubular body (15), which is extended coaxially to said supply duct (14) in order to create, between the internal lateral wall of said supply duct (14) and the external surface of the sidewall of said mixing tubular body (15), an intake region (16) which has a transverse air passage section that is narrower than the air passage section formed by said supply duct (14) upstream of said mixing tubular body (15), along the air flow direction, said mixing tubular body (15) having an internal cavity (18) and being closed, at a first end (15a) that is directed against the air flow that arrives from said supply duct (14), by an ogive-shaped head (16) and connected, at a second end (15b), which lies opposite said first end (15a), to a duct (17) for supplying combustible gas, in the sidewall of said mixing tubular body (15) there being at least one dispensing opening (19) that is connected to said internal cavity (18) of said mixing tubular body (15) and to said intake region (16).

2. The boiler according to claim 1, **characterized in that** in the sidewall of said mixing tubular body (15) there is a plurality of dispensing openings (19) distributed around the axis of said mixing tubular body (15).

3. The boiler according to one or more of the preceding claims, **characterized in that** said dispensing openings (19) have an elongated extension and are arranged so as to be inclined with the corresponding extension axis with respect to the axis of said mixing tubular body (15).

4. The boiler according to one or more of the preceding claims, **characterized in that** said mixing tubular body (15) has a diametrical space occupation that decreases progressively from said head (16) toward said second end (15b).

5. The boiler according to one or more of the preceding claims, **characterized in that** said dispensing openings (19) are arranged substantially in the point of said intake region (16) that has an air passage section that is smaller than the remaining part of said intake region (16).

6. The boiler according to one or more of the preceding claims, **characterized in that** it comprises means adapted to place said combustion chamber (5) in partial vacuum with respect to the external ambient pressure.

7. The boiler according to one or more of the preceding claims, **characterized in that** said combustion chamber (5) is connected to a plurality of heat exchange tubes (9), which are designed to be crossed by the combustion gases and lead into a combustion gas collection chamber (10), connected to a stack (11), said means adapted to place said combustion chamber (5) in partial vacuum comprise at least one fan (23) accommodated in said combustion gas collection chamber (10).

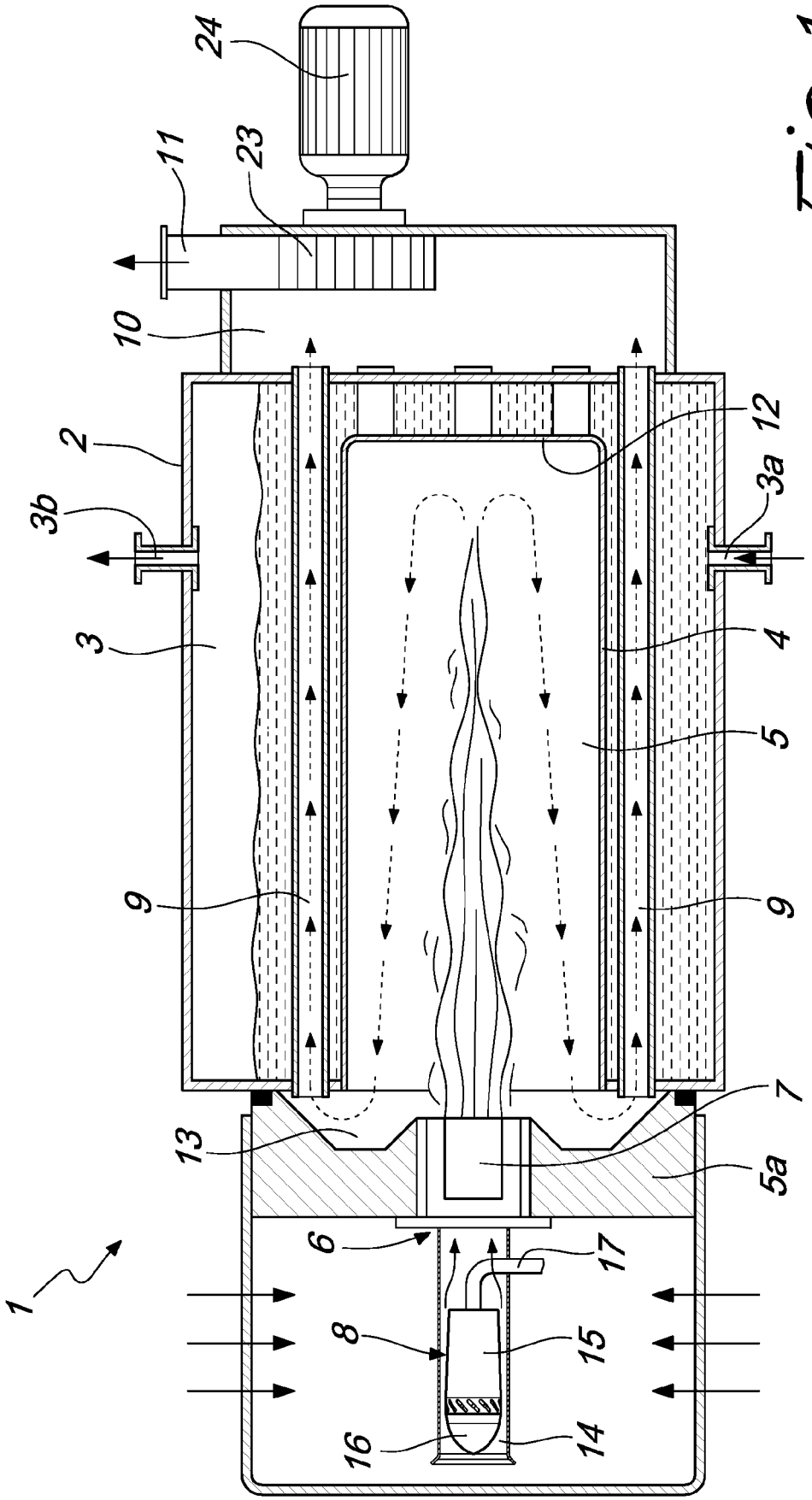

Fig. 1

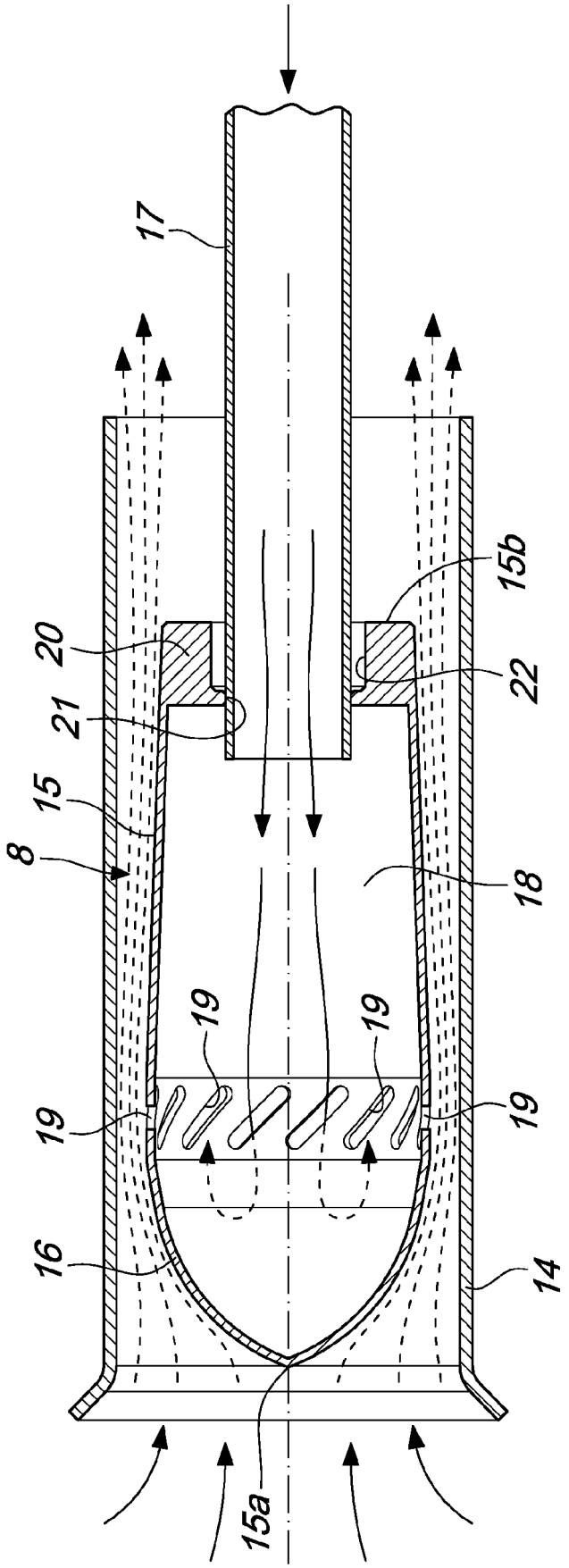

Fig. 2

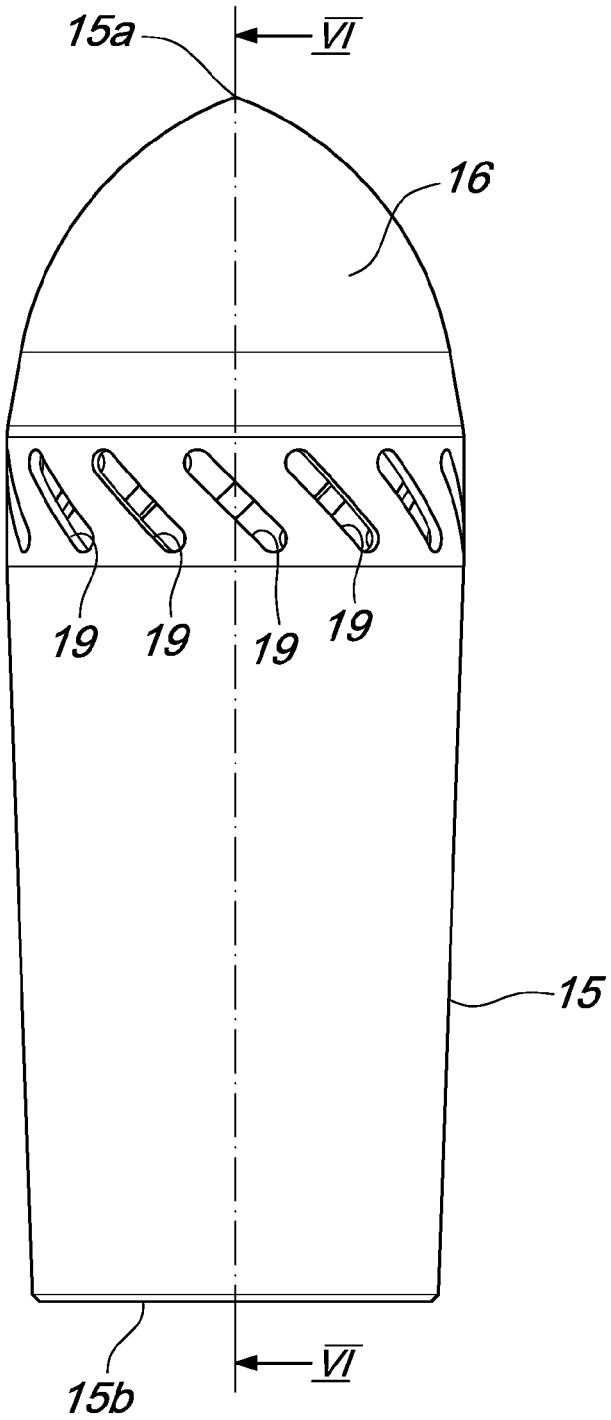

Fig. 3

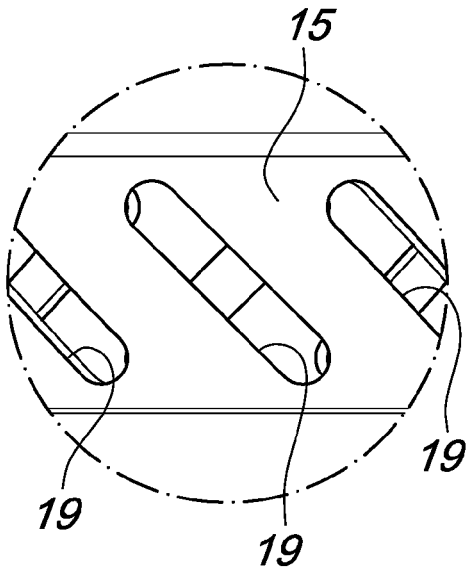

Fig. 4

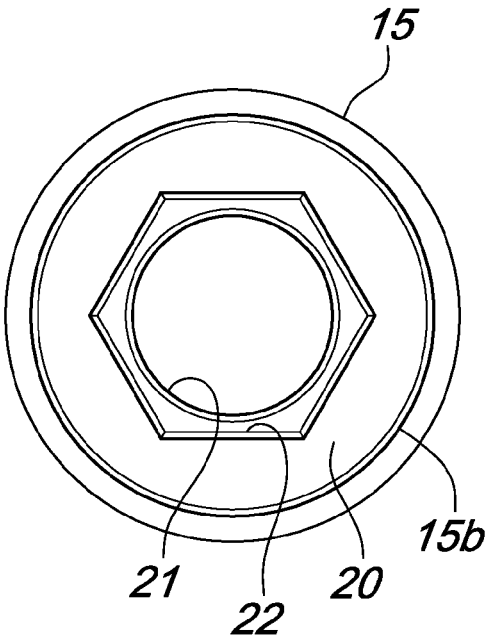

Fig. 5

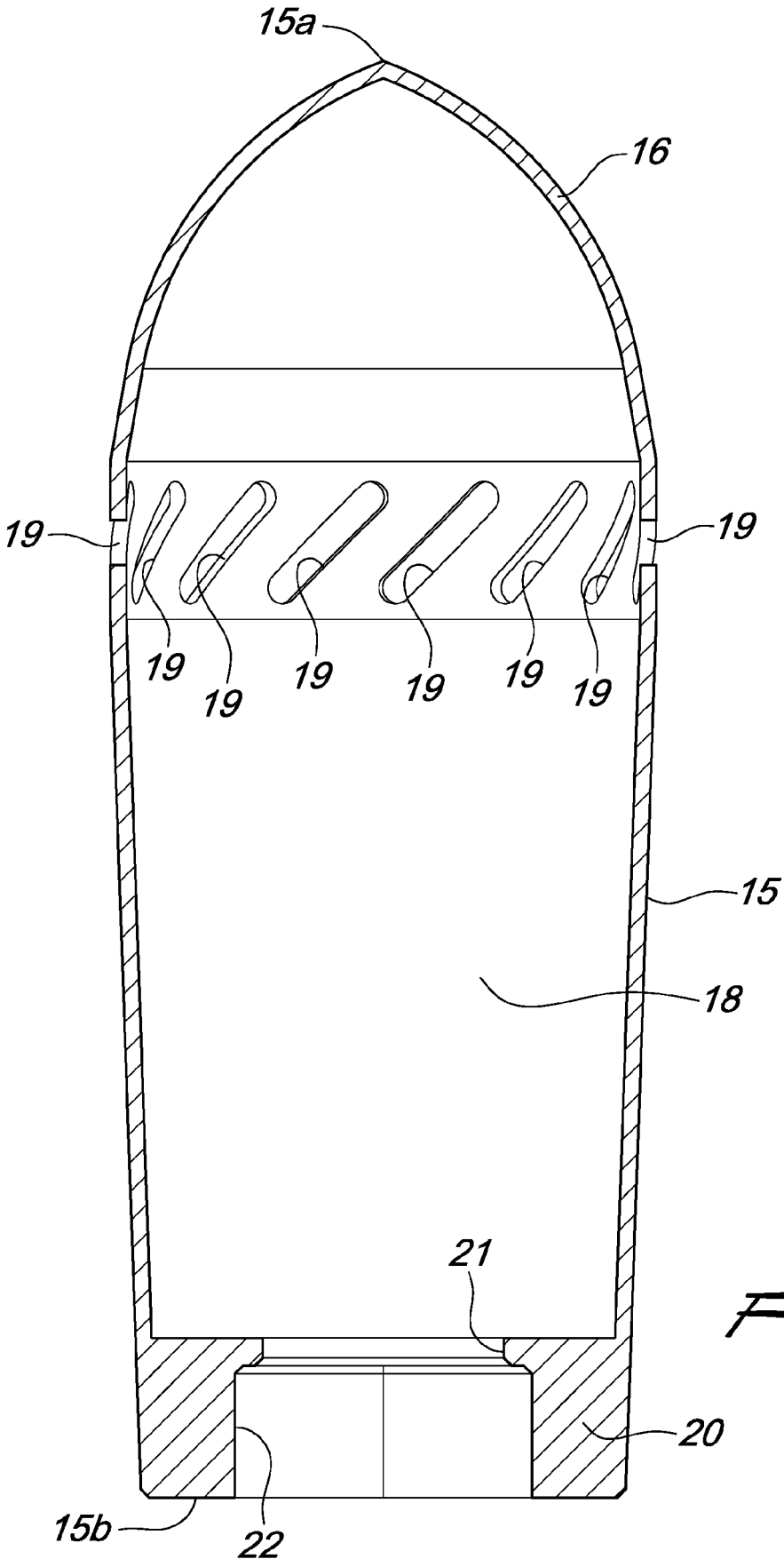

Fig. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 18 19 4991

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	22 January 2019	Riesen, Jörg

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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L : document cited for other reasons

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22-01-2019

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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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