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(54) **Pulverized fuel burner**

(57) A pulverized fuel burner comprises a fuel feed pipe (4, 4a) for injecting a mixture of pulverized fuel and combustion air into a furnace (3) through a burner throat (2), a core air duct (5) concentrically arranged within the fuel feed pipe (4, 4a) and a secondary air passage (13, 14) arranged externally of and coaxially with the fuel feed pipe (4, 4a). A flame stabilizing ring (20) is disposed on the outlet of the fuel feed pipe (4, 4a), said flame stabilizing ring (20) comprising a flared section (21) protruding toward the secondary air passage (13) and a number of teeth (22) protruding toward the inside of the fuel feed pipe (4, 4a). The flared section (21) of has a smoothly curved cross section with a thickness that reduces smoothly toward the rim of the flared section (21).

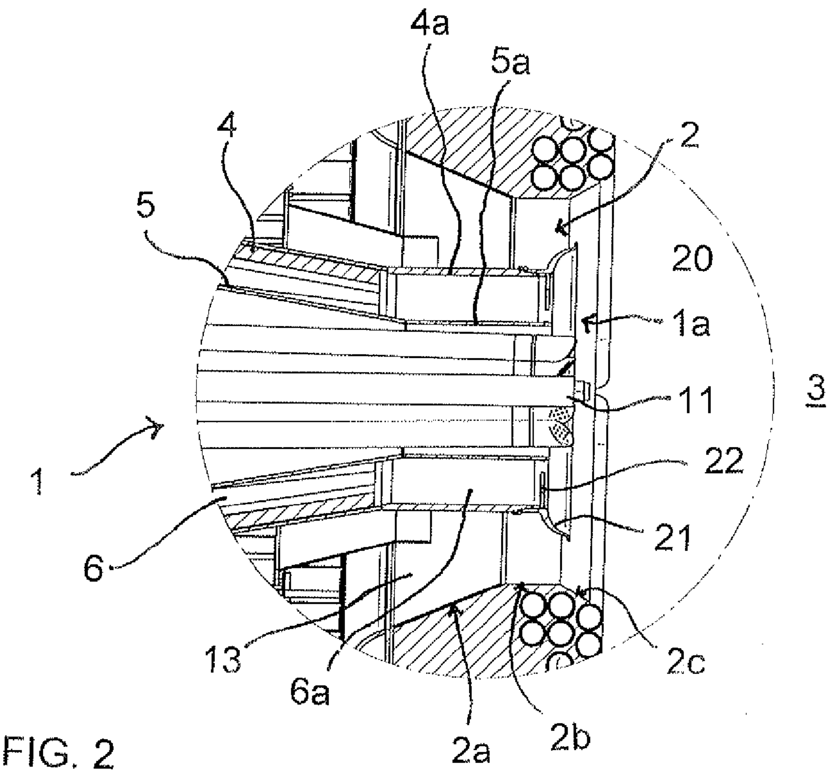

FIG. 2

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to a pulverized fuel burner that comprises a fuel feed pipe for injecting a mixture of pulverized fuel and combustion air into a furnace through a burner throat, a core air duct concentrically arranged within the fuel feed pipe, and a secondary air passage arranged externally of and coaxially with the fuel feed pipe. Furthermore, there is a flame stabilizing ring disposed on the outlet of the fuel feed pipe, said flame stabilizing ring comprising a flared section protruding toward the secondary air passage and a number of teeth protruding toward the inside of the fuel feed pipe.

BACKGROUND OF THE INVENTION

[0002] Pulverized fuel burners are used in large coal-fired boilers for injecting a mixture of pulverized coal and combustion air into the furnace of the boiler. The coal-air mixture ignites after the outlet of the fuel feed pipe so as to form a flame in the furnace.

[0003] US-20100058961-A1 discloses an example of a pulverized coal burner comprising a nozzle body through which pulverized coal is injected into a furnace together with combustion air. The nozzle body comprises an outer sleeve and an inner sleeve arranged in and coaxially of the outer sleeve whereby a fuel flow space is formed between the outer and inner sleeves. Combustion air is injected into the fuel flow discharging from the nozzle body, on the one hand axially from the inner sleeve as tertiary air and on the other hand tangentially from the secondary air channel surrounding the outlet of the fuel feed nozzle. The outlet of the nozzle body is located quite deep in the burner throat. In this burner, pulverized coal and combustion air are made to mix up vigorously already in the burner throat. To ensure good ignition and combustion, secondary air is injected into the fuel flow with an intensive tangential acceleration, which creates a recirculation flow close to the discharge area of the nozzle body. Further, the tertiary air pipe arranged centrally in the fuel flow space creates a recirculation flow in the center of the outlet of the nozzle body, thus stabilizing the flame. In other words, the burner forms an internal recirculating flow downstream of the burner by means of rotated combustion air (secondary air), and it also forms a stable flame by blowing the pulverized fuel in the recirculating flow.

[0004] However, as there is no actual bluff body in the above-mentioned burner, ignition takes place quite far from the burner outlet, in practice about one to two meters from the outlet of the fuel feed nozzle. Furthermore, as the nozzle body is located quite deep in the burner throat, pulverized coal tends to spread, promoted by the rotational movement of the combustion air, onto the furnace walls around the burner throat, thereby causing slagging of the furnace walls.

[0005] As all the combustion air is mixed with the fuel in connection with the burner outlet, no effective NO_x reduction zones are created in the vicinity of the burner, and reduction of nitrogen oxides has to be carried out by staging the whole boiler, that is to say by using two-stage combustion in the middle part of the boiler. Then, the total stoichiometric ratio SR in the burner zone will be kept around 0.8 and the NO_x reduction will be carried out in the center of the furnace. Due to good mixing, the nitrogen oxide reduction is quite efficient.

[0006] When using the above burners in a coal-fired boiler, local hot spots tend to develop inside the furnace. Consequently, flue gases arriving the upper parts of the boiler may be so hot that they are likely to cause damage in the heat transfer surfaces of superheaters.

[0007] EP-0314928-B1 discloses another type of pulverized coal burner, comprising a fuel tube through which pulverized coal and combustion air are passed to a furnace and a flame retainer disposed at the end of the fuel tube. The flame retainer includes a flared tube and an annular plate, having a plurality of radial inwards projecting parts equiangularly spaced from each other. The flame retainer produces eddy flows inside the retainer so that the pulverized coal is entrained into the eddy flows and secondary air is also entrained from the outside to ensure flame ignition.

[0008] The above flame retainer is composed of a plurality of ceramic pieces and a plurality of metal fastener elements. The structure is complicated and the assembly comprises bolted joints. Flame retainers are usually made of metal. In general, the flame temperatures may be as high as 1200 to 1400 °C, and the mixture of pulverized coal and combustion air may flow at a rate of 15 m/s inside the fuel pipe. Burning of the flame retainer may appear due to the high flame temperature, and remarkable wear of the inwards projecting parts may appear due to collision with pulverized coal particles. Therefore, it is necessary to frequently replace the flame retainer with a fresh one.

[0009] When starting up a burner, high thermal stresses are developed in the flame retainer, and they are likely to lead to plastic deformations of the flame retainer. Attempts have been made to reduce such thermal stresses by adding cuts to the flame retainer or by splitting the flame retainer into smaller segments. Modifications like that cannot, however, fully remove the risk of plastic deformations, which after several load cycles are likely to lead to formation and build-up of fissure.

[0010] EP-1741977-B1 discloses a pulverized coal burner that comprises a core air pipe, a primary air and pulverized coal feeding pipe, and a secondary air pipe arranged concentrically to each other. The mouth region of the primary air pipe comprises on the outside thereof an air deflection groove and on the inside thereof a flame stabilizing ring, which are formed as a one-piece component. The one-piece component further comprises a part of the primary air pipe. The component is fixed to the primary air pipe by welding. A flame retainer like this is subject to the above discussed problems, such as plastic deformations caused by thermal stress.

SUMMARY OF THE INVENTION

[0011] The object of the invention is to solve, or at least to reduce, the problems of prior art. In particular, an object is to provide a burner that improves the stability of the flame, the uniformity of the temperature distribution and the efficiency of combustion in a coal-fired boiler. A further object is to provide a burner with an heat and wear resistant and long lasting flame stabilizing ring.

[0012] The pulverized fuel burner of the present invention comprises a fuel feed pipe for injecting a mixture of pulverized fuel and combustion air into a furnace through a burner throat, a core air duct concentrically arranged within the fuel feed pipe, and a secondary air passage arranged externally of and coaxially with the fuel feed pipe. A flame stabilizing ring is disposed on the outlet of the fuel feed pipe, said flame stabilizing ring comprising a flared section protruding toward the secondary air passage and a number of teeth protruding toward the inside of the fuel feed pipe. The flared section of the flame stabilizing ring has a smoothly curved cross section, or profile, with a thickness that reduces smoothly toward the rim of the flared section.

[0013] It has been found that smoothly curved cross section of the flared section reduces thermal stresses induced in the flame stabilizing ring during the start-up and during regular operation of the burner. The flame-facing frontal surface of flame stabilizing ring is likely to heat up to a higher temperature than the rear surface of the flame stabilizing ring facing the secondary air passage. Calculations have proved that thermal stresses induced in the new structure are remarkably lower than those induced in conventional flame retainer structures. Decrease of thermal stresses will lead to better durability and longer lifetime of flame stabilizing ring. The new structure also allows heat expansion of the flame stabilizing ring without risk of damage.

[0014] Advantageously, the burner nozzle should be dimensioned so that the velocity of the secondary air at the narrowest point of the secondary air flow passage is in the range of 50 to 70 m/s, preferably about 60 m/s. High-velocity secondary air creates a strong turbulent recirculation flow downstream of the flame stabilizing ring, which leads to quick ignition and a hot flame. Thus the properties of the new burner comprise quick fuel ignition near the flame stabilizing ring and quick mixing of the secondary air with the already ignited flame. Together these two features lead to an extremely hot and efficiently burning flame. Quick mixing of secondary air with the coal-air mixture can be further secured by setting the conical angle of the burner throat to a value of about 10° - 15°, preferably about 10° - 12°. Furthermore, the secondary air flow should have a strong swirl, i.e. the swirl number S of the tangentially flowing air should be in the range of 1.0 to 2.0. Swirl number S characterizes the ratio of tangential to axial momentum of the air flow.

[0015] The flame stabilizing ring ignites the fuel right in the vicinity of the burner nozzle; to be more precise, the fuel is ignited within the recirculation flow generated inside the flame stabilizing ring. As a result of improved ignition, the burning degree of coal increases and, consequently, flue gas temperatures in the furnace upper parts decrease by about 40 - 80 °C, which increases boiler efficiency. Due to enhanced burning in the burner zone, flue gases are at lower temperature when entering the superheaters and also the temperature distribution within flue gases is more uniform. Consequently, the material temperatures of the superheater and reheaters will be kept lower and more uniform. Experiences show that this will result in remarkable reduction of material damages in the heating surfaces.

[0016] Furthermore, improved flame ignition together with improved burning enable reduction of boiler minimum load from a level of 60% to a level of 20 - 35%. Carbon monoxide emissions will also decrease as a result of improved ignition.

[0017] Especially when using natural gas as fuel, the quicker flame ignition tends to cause exceptionally strong thermal radiation into the flame stabilizing ring. Consequently, conventional flame stabilizing rings would be destroyed quite fast. Due to the smoothly curved profile and smoothly reducing thickness of the flared section, the flame stabilizing ring of the present invention endures heat and thermal stress better than conventional flame stabilizing rings.

[0018] According to one aspect of the invention, the flared section is provided with an elliptically contoured frontal surface and a circularly contoured rear surface.

[0019] Advantageously, the outlet of the fuel feed pipe, or its extension, is flush with the narrowest area of the burner throat.

[0020] Advantageously, the flame stabilizing ring comprises a tubular section and the fuel feed pipe comprises a thinned end section, which tubular section and thinned end section are arranged one within the other and locked to each other by means of a locking ring. The locking ring may comprise a first annular flange fitted in a first annular slot in the flame stabilizing ring and a second annular flange fitted in a second annular slot in the fuel feed pipe.

[0021] The teeth of the flame stabilizing ring may be secured between a collar formed in the flame stabilizing ring and the end of the fuel feed pipe.

[0022] In another embodiment of the invention, the flame stabilizing ring comprises a teeth retaining ring in which the teeth are fastened. The teeth retaining ring is preferably fixed to the end of the fuel feed pipe and at least partly surrounded by the tubular section of the flame stabilizing ring.

[0023] According to a further aspect of the invention, the flared section of the flame stabilizing ring is provided with a number of integral cooling ribs formed on the rear surface of the flared section facing the secondary air passage.

[0024] Optionally, a cooling air guide sleeve may be arranged to surround at least a part of the locking ring, tubular section and cooling ribs to force air to flow over the locking ring, along the surface of the tubular section and through the spaces between the cooling ribs in order to cool the flame stabilizing ring.

[0025] The other objects and the advantages of the present invention will be apparent from the following description concerning the preferred embodiments of the invention

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] Below the invention is explained in detail with references to the enclosed drawings.

FIG. 1 is a partly broken side view of a pulverized fuel burner according to prior art.

FIG. 2 is a cross sectional side view of the nozzle area of a burner according to the present invention.

FIG. 3 is an isometric view of a flame stabilizing ring fixed to the outlet of a fuel feed pipe.

FIG. 4 is a side view of the cross section of the flame stabilizing ring of FIG. 3.

FIG. 5 is an isometric view of a tooth used in the flame stabilizing ring of FIG. 4.

FIG. 6 is a side view of the cross section of a second embodiment of flame stabilizing ring.

FIG. 7 is an isometric view of a tooth used in the flame stabilizing ring of FIG. 6.

FIG. 8 is an isometric view of a third embodiment of a flame stabilizing ring fixed to a fuel feed pipe.

FIG. 9 is a side view of the cross section of the flame stabilizing ring of FIG. 8.

FIG. 10 is a cross sectional side view of an embodiment comprising a cooling air guide sleeve.

DETAILED DESCRIPTION

[0027] FIG. 1 shows, in a partly broken side view, a pulverized fuel burner known of the prior art. The burner comprises a burner nozzle 1 installed in connection with a burner throat 2 arranged in the wall of a furnace 3. In this particular case the burner throat 2 has a conically contracting inlet section 2a, a short cylindrical section 2b, and a conically broadening outlet section 2c which opens into the furnace 3. The outlet 1a of the burner nozzle 1 is located in the conically contracting section 2a so that the fuel-air mixture and the secondary combustion air get into contact with each other in the burner throat 2 before entering the furnace 3.

[0028] The burner nozzle 1 comprises a fuel feed pipe 4, a core air duct 5 concentrically arranged within the fuel feed pipe 4, and a bipartite secondary air passage 13, 14 coaxially surrounding the tapered end of the fuel feed pipe 4. Both the fuel feed pipe 4 and the core air duct 5 taper toward the outlet 1a of the burner nozzle 1. An annular fuel flow space 6 is confined between the fuel feed pipe 4 and the core air duct 5.

[0029] The secondary air passage 13, 14 is provided with an annular partition wall 15 that divides the secondary air passage into an outer secondary air passage 13 and an inner secondary air passage 14. The outer secondary air passage 13 is provided with a first swirl generator 16 and the inner secondary air passage 14 is provided with a second swirl generator 17. These two swirl generators 16, 17 apply a rotational or curling movement to the secondary air flow entering the outer or the inner secondary air passage 13, 14, respectively.

[0030] The fuel feed pipe 4 is in communication with a fuel inlet 7, the core air duct 5 is in communication with a core air inlet 9, and the secondary air passage 13, 14 is in communication with a secondary air inlet 18.

[0031] A mixture of pulverized fuel and primary air is supplied to the fuel feed pipe 4 via the fuel inlet 7, which is located tangentially in relation to the fuel feed pipe 4. The fuel-air mixture is released to the burner throat 2 via the outlet of the fuel feed pipe 4. Two successive secondary air flows are tangentially mixed with the freshly released fuel-air mixture right after the outlet of the fuel feed pipe 4. At the same time, a core air flow is supplied centrally into the outflowing fuel-air mixture. Hence, the burner nozzle 1 induces an internal recirculating flow downstream of the burner nozzle 1 by means of rotated secondary air and creates a stable flame by blowing the pulverized fuel in the recirculating flow.

[0032] The core air duct 5 also accommodates some gas lances 10 and an oil lance 11. Gaseous fuel may be supplied to the gas lances 10 via a gas ring 12 to enable combustion of alternative fuels, such as natural gas. The gas lances 10 or the oil lance 11 are used for flame ignition at start-up.

[0033] As there is no actual flame stabilizing element, or bluff body, at the outlet of the fuel feed pipe 4, flame ignition takes place quite far from the burner nozzle outlet 1a, in practice about 1 to 2 meters from the burner nozzle outlet 1a. In a boiler comprising a plurality of burners like this arranged on the opposite walls of the furnace this may cause uneven burning and uneven temperature distribution. If the flue gases are too hot when entering the upper parts of the boiler, they may cause damages on the heat transfer surfaces of superheaters located in the flow path of flue gases.

[0034] Furthermore, as the burner nozzle 1 is located quite deep inside the burner throat 2, pulverized fuel tends to spread, urged by the tangentially blowing secondary air flows, onto the furnace walls surrounding the burner throat 2, whereby the pulverized fuel may form slag on the inner walls of the furnace.

[0035] In accordance with the present invention, these problems can be solved by modifying the burner nozzle, e.g. by providing the burner with additional structural elements, an example of which is shown in FIG. 2.

[0036] First of all, the fuel feed pipe 4 is provided with a cylindrical extension 4a that brings the outlet of the fuel feed pipe 4 flush with the narrowest area 2b of the burner throat 2. Correspondingly, the core air duct 5 is also provided with a cylindrical extension 5a so that these two extensions 4a and 5a increase the length of the fuel flow space 6 so much that the outlet 1a of the burner nozzle 1 is now located closer to the furnace 3 in the area of the cylindrical section 2b of the burner throat 2. The conical angle of the conically broadening outlet section 2c of the burner throat 2 is preferably in the range of 10° to 12°. The gas lances 10 and the oil lance 11 are also lengthened to extend up to the outlet of the fuel feed pipe 4.

[0037] Secondly, the outlet of the fuel feed pipe 4 is provided with a flame stabilizing ring 20 of a totally novel construction. The flame stabilizing ring 20 comprises a flared section 21 that protrudes toward the secondary air passage 13 and a number of spaced teeth 22 that protrude toward the inside of the extended fuel feed pipe 4a. The secondary air passage may consist of only one passage 13 or of two passages 13, 14 as in FIG. 1. The velocity of the secondary air in the annular space between the burner throat 2 and the flame stabilizing ring 20 should be set in the range of 50 to 70 m/s, preferably about 60 m/s.

[0038] The new burner may be operated without any core air or with a very small flow of core air, the velocity of the core air being in the range of 0 to 10 m/s. The major function of the core air duct 5 is to act as a bluff body that enhances the flame stabilization. Core air is needed during the light-up when the flame is ignited with the aid of gas lances or oil lance but otherwise the core air duct is mainly closed during pulverized coal firing.

[0039] Resulting from the above-mentioned modifications in the burner structure, the overall heat transfer rate of the furnace is enhanced. Increase of heat transfer rate with the new burners reduces the gas temperatures in the upper parts of the boiler. Even though the decrease of gas temperature might be low, e.g. about 40 to 70 °C, it may improve the duration of the heat transfer surfaces in the upper parts of the boiler. Furthermore, combustion is boosted and the flame is ignited closer to the burner outlet than before when using burners of the new type.

[0040] FIG. 3 shows a first embodiment of the new flame stabilizing ring 20 disposed at the end of the fuel feed pipe 4a. The flame stabilizing ring 20 comprises an outwardly flared section 21, a number of equally spaced, inwardly directed teeth 22 of a ceramic material, and a tubular section 23, which is fixed to the fuel feed pipe 4a by a locking ring 27 surrounding the joint between the two components 20, 4a.

[0041] FIG.4 shows enlarged the cross section, or profile, of the flame stabilizing ring 20. The figure also shows how the flame stabilizing ring 20 is fastened onto the end of the fuel feed pipe 4a. The flared section 21 of the flame stabilizing ring 20 has a smoothly curved, outward thinning shape such that the thickness d of the cross section reduces smoothly toward the rim 24 of the flared section 21. Advantageously, the flared section 21 has an elliptically contoured frontal surface 35 and a circularly contoured rear surface 36.

[0042] The fuel feed pipe 4a comprises a thinned end section 26 and the tubular section 23 of the flame stabilizing ring 20 is arranged to surround the thinned end section 26. The outside diameter of the tubular section 23 corresponds to the outer diameter of the fuel feed pipe 4a, and the inner diameter of the tubular section 23 corresponds to the outer diameter of the thinned end section 26. The flame stabilizing ring 20 and the fuel feed pipe 4a are fixed to each other by means of a locking ring 27 that comprises a first annular flange 28 engaging a first annular slot formed on the outer surface of the tubular section 23 and a second angular flange 29 engaging a second annular slot formed on the outer surface of the fuel feed pipe 4a.

[0043] A plurality of ceramic teeth 22 are clamped between a collar 30 formed in the inner wall of the flame stabilizing ring 20 and the end of the fuel feed pipe 4a. FIG. 5 shows an example of a ceramic tooth 22 that can be placed in a hollow formed in the collar 30. The lateral upper ends of the tooth 22 are each provided with a lug 31 to ensure the locking of the tooth 22 in the hollow.

[0044] The flame stabilizing ring 20 can be made of the same heat-resisting steel as the fuel feed pipe 4, 4a. The flame stabilizing ring 20 may be one piece or composed of a number of identical segments, which can be manufactured for instance by die casting. The teeth 22 are preferably made of heat-resisting ceramics, such as silicon carbide, etc.

[0045] The heat of the flame raises the temperature of the flame stabilizing ring 20, especially on the frontal surface 35 of the flared section 21. As the heat-resistant steel of the flame stabilizing ring 20 is of poor thermal conductivity, temperature differences build up between the frontal surface 35 and the rear surface 36 of the flared section 21, as well as between the flared section 21 and the tubular section 23 of the flame stabilizing ring 20. As there are no unrounded angles or bulky stiffening members in the new flame stabilizing ring 20, the structure is more resilient than flame stabilizing rings of prior art. As there are no fastening screws penetrating the flame stabilizing ring 20 and the fuel feed pipe 4a, less thermal stress is induced in the new structure. The smoothly curved, outward thinning cross-section of the flared section 21 as well as fixing the flame stabilizing ring 20 to the fuel feed pipe 4a by a locking ring 27 located at a distance from the flame enable heat expansion and reversible deformation in the flame stabilizing ring 20.

[0046] FIG. 6 shows an alternative way of fixing the teeth 22 to the flame stabilizing ring 20. In this case, the flame stabilizing ring 20 comprises a teeth retaining ring 32 which is fastened to the end of the thinned section 26 of the fuel feed pipe 4a and surrounded by the flared section 21 and the tubular section 23 of the flame stabilizing ring 20. The structure of the teeth 22 used in this construction is shown in FIG. 7. The upper longitudinal sides of the tooth 22 are each provided with a flange 33 to ensure the locking of the tooth 22 in a hollow, or groove, formed in the teeth retaining ring 32.

[0047] FIGS. 8 and 9 show a flame stabilizing ring 20 provided with integral cooling ribs 34 spaced with regular distances on the rear surface 36 of the flared section 21, that is to say, on the surface facing the secondary air passage 13. The secondary air flowing past the rear surface 36 of the flared section 21 flushes the spaces between the ribs 34 and thereby cools the rear surface 36 of the flared section 21. The cooling ribs 34 can be formed in connection with the manufacture of the flared section 21, e.g. by die casting, but also other methods known in the art can be used. As the cooling ribs 34 reinforce the structure, the thickness of the flared section 21 can be reduced.

[0048] FIG. 10 shows a flame stabilizing ring 20 provided with further improved cooling. A cooling air guide sleeve 37 is fixed above the flame stabilizing ring 20 to cover the cooling ribs 34, the tubular section 23 and the locking ring 27. The cooling air guide sleeve 37 is arranged so that it deflects a part of the secondary air flowing in the secondary air passage 13 to stream over the locking ring 27, along the surface of the tubular section 23 and through the spaces between the cooling ribs 34.

[0049] As the thermal load applied to the cooling air guide sleeve 37 is lower than that applied to the flame stabilizing ring 20, the cooling air guide sleeve 37 may be thinner and made of cheaper material than the fuel feed pipe 4a and the flame stabilizing ring 20. The cooling air guide sleeve 37 can be made e.g. out of sheet metal by spinning.

[0050] While the present invention has been described with reference to the details of the embodiments shown in the drawings, it will be understood that many modifications will be apparent to those of ordinary skill in the art.

Claims

1. A pulverized fuel burner comprising:

- a fuel feed pipe (4, 4a) for injecting a mixture of pulverized fuel and combustion air into a furnace (3) through a burner throat (2);
- a core air duct (5) concentrically arranged within the fuel feed pipe (4, 4a);
- a secondary air passage (13, 14) arranged externally of and coaxially with the fuel feed pipe (4, 4a);
- a flame stabilizing ring (20) disposed on the outlet of the fuel feed pipe (4, 4a), said flame stabilizing ring (20) comprising a flared section (21) protruding toward the secondary air passage (13) and a number of teeth (22) protruding toward the inside of the fuel feed pipe (4, 4a),

characterized in that the flared section (21) of the flame stabilizing ring (20) has a smoothly curved cross section with a thickness (d) that reduces smoothly toward the rim (24) of the flared section (21).

2. A pulverized fuel burner according to claim 1, **characterized in that** the flared section (21) is provided with an elliptically contoured frontal surface (35) and a circularly contoured rear surface (36).

3. A pulverized fuel burner according to claim 1 or 2, **characterized in that** the outlet of the fuel feed pipe (4), or its extension (4a), is flush with the narrowest area (2b) of the burner throat (2).

4. A pulverized fuel burner according to any one of the preceding claims, **characterized in that** the flame stabilizing ring (20) comprises a tubular section (23) and the fuel feed pipe (4a) comprises a thinned end section (26), which tubular section (23) and thinned end section (26) are arranged one within the other and locked to each other by means of a locking ring (27).

5. A pulverized fuel burner according to claim 4, **characterized in that** the locking ring (27) comprises a first annular flange (28) fitted in a first annular slot in the flame stabilizing ring (20) and a second annular flange (29) fitted in a second annular slot in the fuel feed pipe (4a).

6. A pulverized fuel burner according to any one of the preceding claims, **characterized in that** each tooth (22) is secured between a collar (30) formed in the flame stabilizing ring (20) and the end of the fuel feed pipe (4a).

7. A pulverized fuel burner according to any one of claims 1 to 5, **characterized in that** the flame stabilizing ring (20) comprises a teeth retaining ring (32) in which each tooth (22) is fastened.

8. A pulverized fuel burner according to claim 7, **characterized in that** the teeth retaining ring (32) is fixed on the end of the fuel feed pipe (4a) and at least partly surrounded by the tubular section (26) of the flame stabilizing ring (20).

9. A pulverized fuel burner according to any one of the preceding claims, **characterized in that** the flared section (21) of the flame stabilizing ring (20) is provided with a number of integral cooling ribs (34) formed on the rear surface (36) facing the secondary air passage (13).

10. A pulverized fuel burner according to claim 9, **characterized in that** there is a cooling air guide sleeve (37) arranged concentrically above the locking ring (27), the tubular section (23) and the cooling ribs (34) to force secondary air to flow over the locking ring (27), along the surface of the tubular section (23) and through the spaces between the cooling ribs (34) in order to cool the flame stabilizing ring (20).

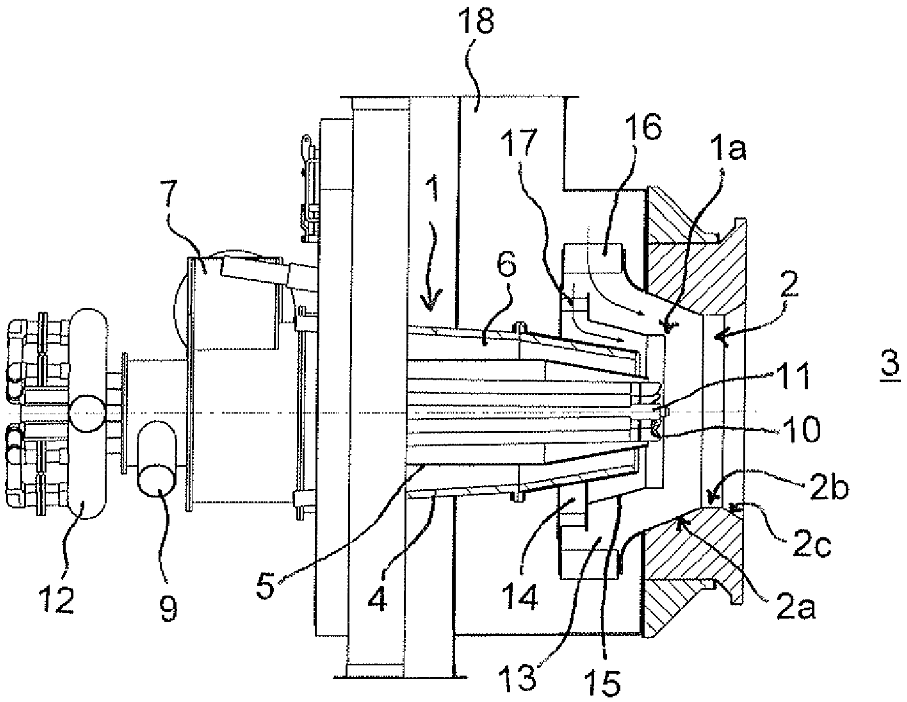

FIG. 1 PRIOR ART

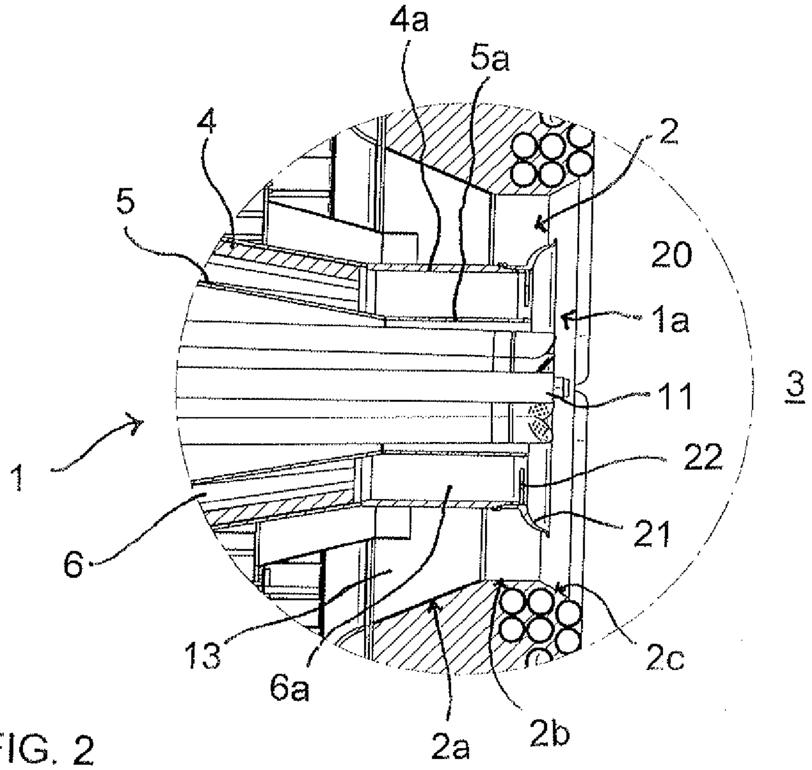

FIG. 2

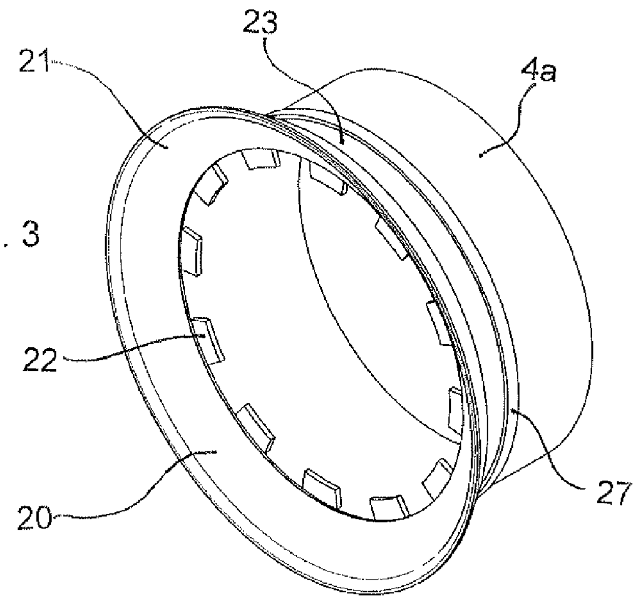

FIG. 3

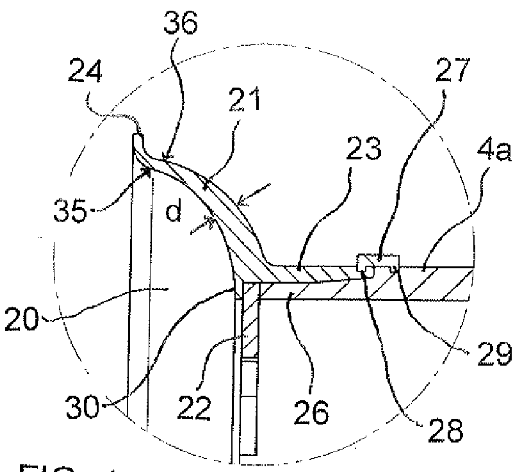

FIG. 4

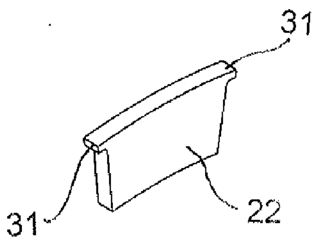

FIG. 5

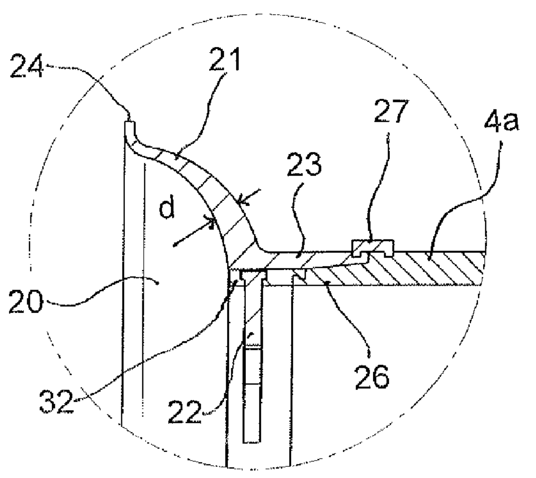

FIG. 6

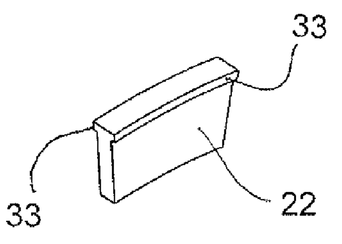

FIG. 7

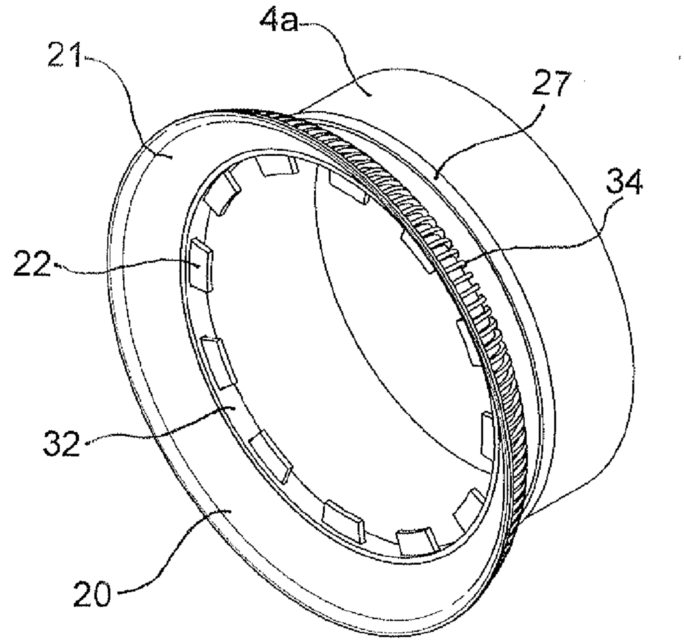

FIG. 8

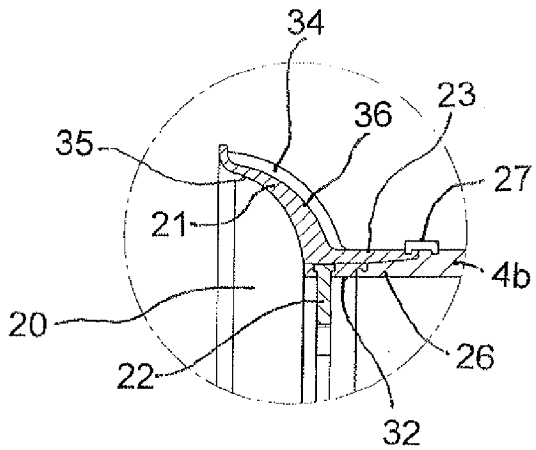

FIG. 9

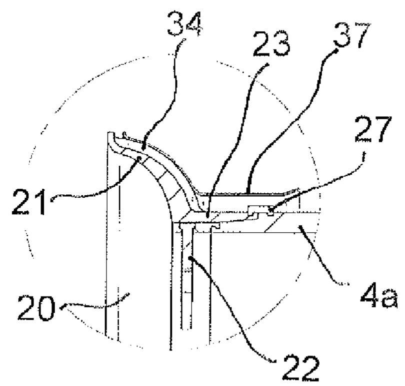

FIG. 10

Europäisches Patentamt
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EUROPEAN SEARCH REPORT

Application Number
EP 11 18 8350

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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F23D

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Place of search	Date of completion of the search	Examiner
The Hague	17 April 2012	Munteh, Louis

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CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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REFERENCES CITED IN THE DESCRIPTION

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