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Remarks:

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(54) **FLUIDIZED BED APPARATUS**

(57) The present invention relates to a fluidized bed combustor, having
- a material inlet (1) through which particulate solid material can be introduced,
- a reaction chamber (2) in which the particulate solid

material is introduced,
- a fluidized bottom (3) below the reaction chamber (2) through which a primary gaseous medium is supplied to the reaction chamber.

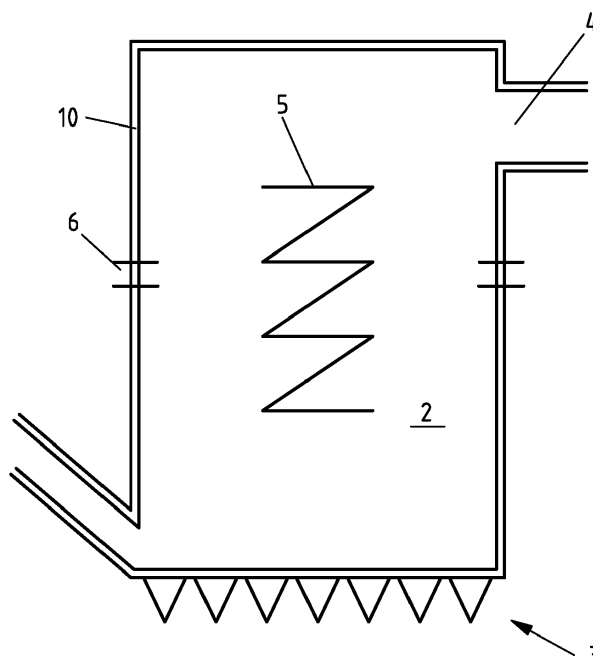


FIG.1

Description

[0001] The present invention relates to fluidized bed apparatus, in particular to a so-called Circulating Fluidized Bed Apparatus (CFBA). Hereinafter terms like "upper", "lower", "horizontal", "vertical", "inner" etc. always refer to a regular use position of the CFBA.

[0002] A CFBA typically comprises a fluidized bed apparatus, designed as a combustor, incineration reactor, boiler, gasifier, steam generator etc., hereinafter called fluidized bed combustor.

[0003] The combustor walls are made of tubes, through which water runs, wherein said tubes are either welded directly to each other to provide a wall structure or with fins/ribs between parallel running tube sections.

[0004] As most of corresponding fossil fuels like coal, timber etc. contain sulphur and/or harmful substances it is necessary to clean the gases leaving the combustor, in a suitable way.

[0005] Typically, the fluidized bed combustor has at least one outlet port at its upper end, wherein said outlet port allows a mixture of combustion gases and solid particles (hereinafter also called particulate matter) exhausted from the combustor chamber, to flow into at least one associated separator.

[0006] The separator serves to disengage the flue gases and solids. Thereafter the separated flue gases and solids are treated separately. The solids are either directly returned into the combustor and/or may be fed into an after treatment apparatus such as an intermediate heat exchanger, in particular into at least one Fluidized Bed Heat Exchanger.

[0007] The general design of such CFBA and its components is disclosed in EP 0 495 296 A2.

[0008] The general process engineering of this type of a fluidized bed combustor is more or less defined and includes:

- providing the particulate matter via a material inlet,
- fluidizing the particulate matter by a primary gas, introduced under pressure via corresponding nozzles and/or a grate in the bottom area of the reaction chamber (fluidized bottom),
- transferring the energy (heat), produced in the fluidized bed, via heat transfer elements (in particular tubes, through which a heat transfer fluid like water or steam flows), arranged in or adjacent to the chamber, into said fluid.

Depending on the velocity of the provided gas the fluidized bed can be embodied as stationary, bubbling or circulating fluidized bed.

[0009] While the overall functionality and reliability of such combustors has proven successful over years there is a continuous demand for improvements.

[0010] Usually there are multiple nozzles arranged above the fluidized bottom for providing a secondary gas medium such as secondary air, tertiary air and/or an ox-

xygen poor carrier gas to the fluidized bed, wherein the nozzles of specific gaseous medium are connected with its inlets to a common supply. The nozzles are also secured to a wall of the reaction chamber. If the nozzles are to be replaced due to wear or in order to provide a different flow behavior to the provided gaseous medium, the whole nozzle needs to be disconnected from the central supply and from the wall. Accordingly, there is a great effort to replace a respective nozzle.

[0011] In one embodiment a particulate solid combustion material is introduced through the material inlet, wherein the primary gas comprises oxygen for combusting the combustion material and wherein secondary gas such as secondary air, tertiary air and/or an oxygen poor carrier gas is provided through multiple nozzles arranged above the fluidized bottom.

[0012] In view of this, it is an object of the present invention to provide a fluidized bed combustor, in which the effort for maintaining or exchanging a nozzle arranged above the fluidized bed is reduced.

[0013] This object is achieved by a fluidized bed combustor with the features of the independent claim and by a method for maintaining the fluidized bed combustor. Preferred embodiments of the invention are described in the sub claims and in the whole description, wherein single features of the preferred embodiments can be combined with each other in a technically meaningful manner.

[0014] The object is achieved in particular in that the gas inlet is embodied by a nozzle pipe, preferably being connected to a common supply line for the second gaseous medium and being connected to a wall of the reaction chamber, and in that the gas outlet is embodied by an (separate) outlet insert, the outlet insert being at least partly inserted into the nozzle pipe, wherein the outlet insert is connected to the nozzle pipe by a welded joint.

[0015] The invention also suggests a method for replacing an outlet insert of a nozzle in a fluidized bed combustor in particular in an fluidized bed combustor according to the invention, comprising the following steps:

- destroying a welded joint between the used outlet insert of the nozzle and a nozzle pipe,
- removing the used outlet insert out of the nozzle pipe,
- inserting a new outlet insert into the nozzle pipe,
- welding the new outlet insert to the nozzle pipe.

[0016] With other words, the present invention suggests to provide a nozzle in a fluidized bed combustor which is made of multiple parts, wherein a nozzle pipe, in particular having a constant (inner and/or outer) diameter, connects the nozzle to a common supply for the (second) gaseous medium and to a wall of the reaction chamber, and wherein the outlet insert, comprising elements for providing the desired flow properties to the gaseous medium, is at least partially and interchangeably arranged in the nozzle pipe. Furthermore, a welded connection is provided between the nozzle pipe and the outlet insert, which welded connection is in particular pro-

vided at such a location, that the welded connection can be destroyed, at least when the fluidized bed combustor is shut down. This way, the outlet insert can be easily exchanged, wherein the new outlet insert can be connected by welding to the nozzle pipe. Accordingly, it is not only possible to provide an outlet insert that provides the same flow property to the gaseous medium but it may also be possible to provide an outlet insert that provides a different flow property than the used outlet insert.

[0017] The outer diameter of the section of the outlet insert inserted into the nozzle pipe is of the same dimension/size as the inner diameter of the nozzle pipe.

[0018] While it is principally sufficient that the outlet insert has a constant inner diameter which is smaller than the inner diameter of the nozzle pipe, it is preferred that the outlet insert comprises at least one element which provides a desired flow property to the gaseous medium.

[0019] For example, the inner diameter of the outlet insert may decrease along its extension from the inlet side to the outlet side and may optionally increase after a minimum diameter is reached.

[0020] The outlet insert may also comprise a swirling part, such as a helically extending guiding part in its inner flow cross section, with which a swirl can be provided to the gaseous medium.

[0021] The outlet insert may also comprise a deflecting part, with which the flow of the gaseous medium is at least partially deflected, so that the main direction of the gaseous medium stream leaving the outlet insert is inclined to the axial direction of the nozzle pipe.

[0022] It is also possible that the outlet insert comprises a diverting element, with which the flow of the gaseous medium is diverted in two, three or more sub flows, wherein the main directions of the sub flows are inclined to each other.

[0023] In order that the welded joint is easily accessible, it may be arranged on the outside of the nozzle pipe.

[0024] Preferably, the welded joint is accessible from the reaction chamber, so that it can be manually destroyed during maintenance of the fluidized bed combustor, when the fluidized bed combustor is shut down.

[0025] In one embodiment, it can be provided that the outlet insert has a flange which abuts against an end face of the nozzle pipe, wherein the welded joint is provided between the flange and an outer circumference of the end face of the nozzle pipe. This way the welded joint is easily accessible but it does not affect the flow properties which are provided from the outlet insert to the gaseous medium.

[0026] In order that the nozzle pipe is fixed to a wall of the fluidized bed combustor it is suggested that the nozzle pipe is arranged partly in an inner wall delimiting the reaction chamber, wherein the nozzle pipe protrudes into the reaction chamber and wherein the welded joint is arranged on a section of the nozzle pipe that extends into the reaction chamber.

[0027] The invention and the technical background will now be explained with regard to the figures, which show

an exemplary embodiment of the invention. The figures show schematically

Figure 1: a side view of a part of a fluidized bed combustor and

Figure 2: a nozzle of the fluidized bed combustor having a nozzle pipe and an outlet insert.

[0028] The fluidized bed combustor comprises a reaction chamber 2 with a material inlet 1, through which particulate solid material can be introduced in the reaction chamber 2. At the bottom of the reaction chamber 2 a fluidized bottom 3 is embodied, through which a primary gas is introduced into the reaction chamber 2. The particulate material in the reaction chamber 2 is fluidized by the primary gas.

[0029] The reaction gases produced in the reaction chamber 2 leave the reaction chamber through outlet 4, eventually comprising particulate material. Downstream of the outlet 4 a separator may be arranged for separating the reaction gases from the particulate material.

[0030] Heat exchange tubes 5 are arranged in the reaction chamber 2 and may also be arranged in a wall 10 delimiting the reaction chamber 2.

[0031] In the wall 10 multiple nozzle may be arranged for providing secondary gaseous medium, such as secondary air into the fluidized particulate solid material.

[0032] In figure 2 such a nozzle for providing a gaseous medium, such as secondary air, tertiary air and/or an oxygen poor carrier gas into the reaction chamber 2 is depicted.

[0033] The nozzle comprises a nozzle pipe 6 and an outlet insert 7. The nozzle pipe 6 is connected on the left side to a common supply of gaseous medium (not shown). The nozzle pipe 6 extends through the wall 10 into the reaction chamber 2.

[0034] The outlet insert 7 is inserted into the nozzle pipe 6, wherein the outlet insert 7 comprises a flange 9, which abuts against an end face of the nozzle pipe 6.

[0035] The outlet insert 7 is connected to the nozzle pipe 6 by a welded joint 8, which is arranged at an outer circumference of the nozzle pipe 6 and behind the flange 9.

[0036] The outlet insert 7 can be easily exchanged by destroying the welded joint 8, so that afterwards the outlet insert 7 can be removed from the nozzle pipe 6. After inserting a new outlet insert 7, the new outlet insert 7 can be connected to the nozzle pipe 6 by welding.

[0037] While the depicted embodiment of the outlet insert 7 only has a slightly smaller inner diameter than the inner diameter of the nozzle pipe 6, the outlet insert 7 may also have different elements (such as diverters, swirlers or similar) in order to affect the flow properties of the provided gaseous medium.

Reference signs

[0038]

- 1 material inlet
- 2 reaction chamber
- 3 fluidized bottom
- 4 outlet
- 5 heat exchange tubes
- 6 nozzle pipe
- 7 outlet insert
- 8 welded joint
- 9 flange
- 10 wall

Claims**1.** Fluidized bed combustor, having

- a material inlet (1) through which particulate solid material can be introduced,
- a reaction chamber (2) in which the particulate solid material is introduced,
- a fluidized bottom (3) below the reaction chamber (2) through which a primary gaseous medium is supplied to the reaction chamber,
- at least one nozzle arranged above the fluidized bottom (3) with which a second gaseous medium can be provided to the reaction chamber, the nozzle having a gas inlet and a gas outlet,

characterized in that

the gas inlet is embodied by a nozzle pipe (6) and the gas outlet is embodied by an outlet insert (7), the outlet insert (7) being at least partly inserted in the nozzle pipe (6), wherein the outlet insert (7) is connected to the nozzle pipe (6) by a welded joint (8).

- 2.** Fluidized bed combustor according to claim 1, the welded joint (8) being arranged on the outside of the nozzle pipe (6).
- 3.** Fluidized bed combustor according to claim 1 or 2, wherein the welded joint (8) is accessible from the reaction chamber (2).
- 4.** Fluidized bed combustor according to one of the preceding claims, wherein the outlet insert (7) has a flange (9) which abuts against an end face of the nozzle pipe (6), wherein the welded joint (8) is provided between the flange (9) and an outer circumference of the end face of the nozzle pipe (6).
- 5.** Fluidized bed combustor according to one of the preceding claims, wherein the nozzle pipe (6) is arranged in a wall (10) delimiting the reaction chamber

(2), wherein the nozzle pipe (6) protrudes into the reaction chamber (2) and the welded joint (8) is arranged on a section of the nozzle pipe (6) that extends into the reaction chamber (2).

- 6.** Fluidized bed combustor according to one of the preceding claims, wherein the welded joint (8) being embodied by at least one of the following:

- a continuous welding seam,
- multiple welding beads,
- multiple welding points.

- 7.** Fluidized bed combustor according to one of the preceding claims, wherein the outlet insert (7) comprises at least one the following:

- a multiple outlet part,
- a deflecting part,
- a swirling part.

- 8.** Fluidized bed combustor according to one of the preceding claims, further having at least

- a separator for separating solid particles from the exhaust gases of the reaction chamber (2),
- a heat exchanger for the separated solid particles and/or
- a return for the separated particles into the reaction chamber.

- 9.** Method for replacing an outlet part of a nozzle in a fluidized bed combustor, comprising the following steps:

- Destroying a welded joint between the used outlet insert (7) of the nozzle and a nozzle pipe (6),
- Removing the used outlet insert (7) out of the nozzle pipe (6),
- Inserting a new outlet insert (7) into the nozzle pipe (6),
- Welding the new outlet insert (7) to the nozzle pipe (6).

Amended claims in accordance with Rule 137(2) EPC.**1.** Fluidized bed combustor, having

- a material inlet (1) through which particulate solid material can be introduced,
- a reaction chamber (2) in which the particulate solid material is introduced,
- a fluidized bottom (3) below the reaction chamber (2) through which a primary gaseous medium is supplied to the reaction chamber,

- at least one nozzle arranged above the fluidized bottom (3) with which a second gaseous medium can be provided to the reaction chamber, the nozzle having a gas inlet and a gas outlet,

characterized in that

the gas inlet is embodied by a nozzle pipe (6) and the gas outlet is embodied by an outlet insert (7), the outlet insert (7) being at least partly inserted in the nozzle pipe (6), wherein the outlet insert (7) is connected to the nozzle pipe (6) by a welded joint (8), the welded joint (8) being arranged on the outside of the nozzle pipe (6).

2. Fluidized bed combustor according to claim 1, wherein the welded joint (8) is accessible from the reaction chamber (2). 15
3. Fluidized bed combustor according to one of the preceding claims, wherein the outlet insert (7) has a flange (9) which abuts against an end face of the nozzle pipe (6), wherein the welded joint (8) is provided between the flange (9) and an outer circumference of the end face of the nozzle pipe (6). 20 25
4. Fluidized bed combustor according to one of the preceding claims, wherein the nozzle pipe (6) is arranged in a wall (10) delimiting the reaction chamber (2), wherein the nozzle pipe (6) protrudes into the reaction chamber (2) and the welded joint (8) is arranged on a section of the nozzle pipe (6) that extends into the reaction chamber (2). 30
5. Fluidized bed combustor according to one of the preceding claims, wherein the welded joint (8) being embodied by at least one of the following: 35
 - a continuous welding seam,
 - multiple welding beads, 40
 - multiple welding points.
6. Fluidized bed combustor according to one of the preceding claims, wherein the outlet insert (7) comprises at least one the following: 45
 - a multiple outlet part,
 - a deflecting part,
 - a swirling part. 50
7. Fluidized bed combustor according to one of the preceding claims, further having at least
 - a separator for separating solid particles from the exhaust gases of the reaction chamber (2), 55
 - a heat exchanger for the separated solid particles and/or
 - a return for the separated particles into the re-

action chamber.

8. Method for replacing an outlet part of a nozzle in a fluidized bed combustor, comprising the following steps: 5

- Destroying a welded joint between the used outlet insert (7) of the nozzle and a nozzle pipe (6), the welded joint (8) being arranged on the outside of the nozzle pipe (6),
- Removing the used outlet insert (7) out of the nozzle pipe (6),
- Inserting a new outlet insert (7) into the nozzle pipe (6),
- Welding the new outlet insert (7) to the nozzle pipe (6).

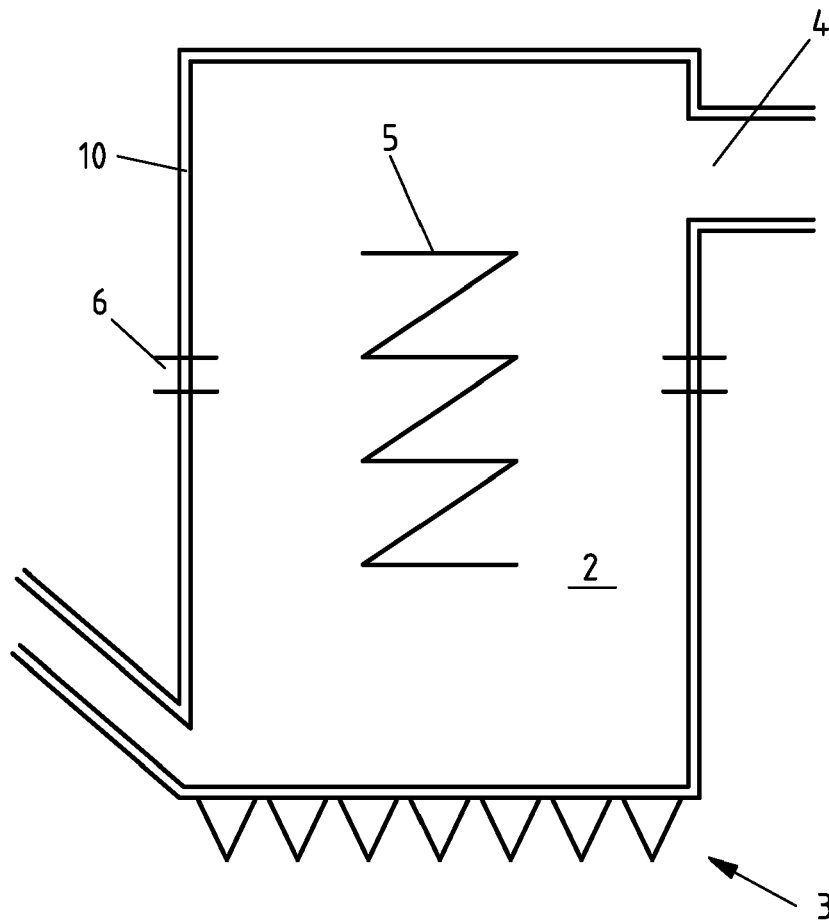


FIG.1

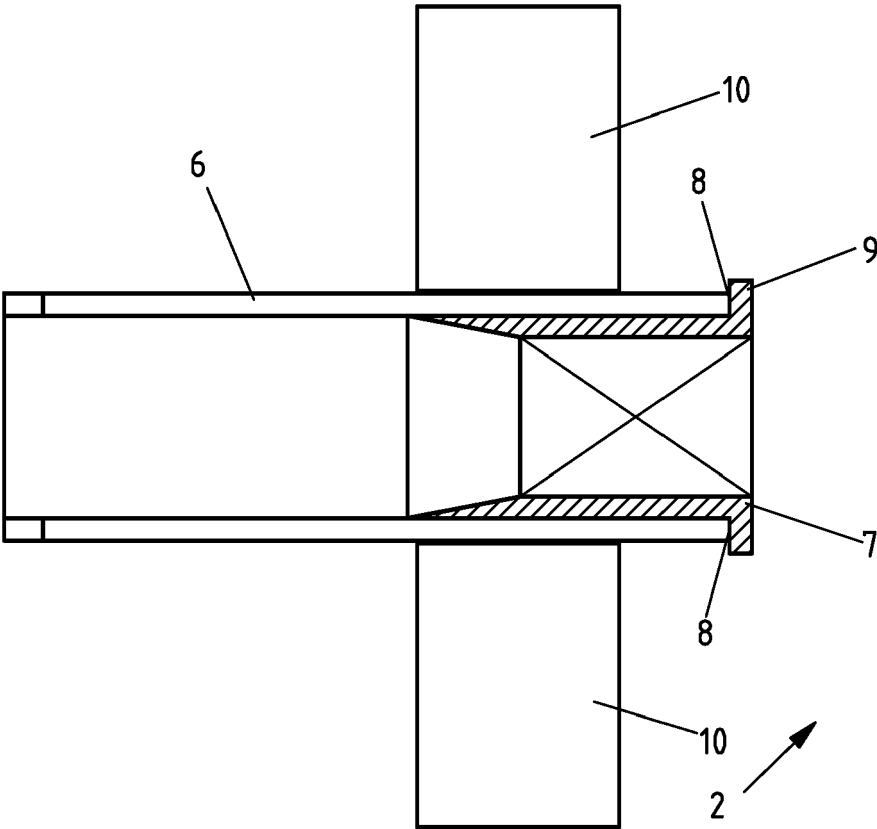


FIG.2



EUROPEAN SEARCH REPORT

Application Number
EP 19 17 4197

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Place of search Munich		Date of completion of the search 17 October 2019	Examiner Theis, Gilbert
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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