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Remarks:

Amended claims in accordance with Rule 137(2) EPC.

(54) **INCINERATION PLANT WITH A NOZZLE, REACTOR FOR CLEANING FLUE GASES WITH A NOZZLE AND RESPECTIVE NOZZLE**

(57) The invention relates to an incineration plant having

- a combustion chamber,
- a combustion material inlet through which solid material can be introduced into the combustion chamber,
- a combustion grate with which the solid material and combusted solid material can be conveyed through the

combustion chamber,

- a primary air supply below the top of the combustion grate,
- at least one nozzle arranged above the combustion grate with which secondary air and/or an oxygen poor carrier gas can be provided, the nozzle having a gas inlet and a gas outlet.

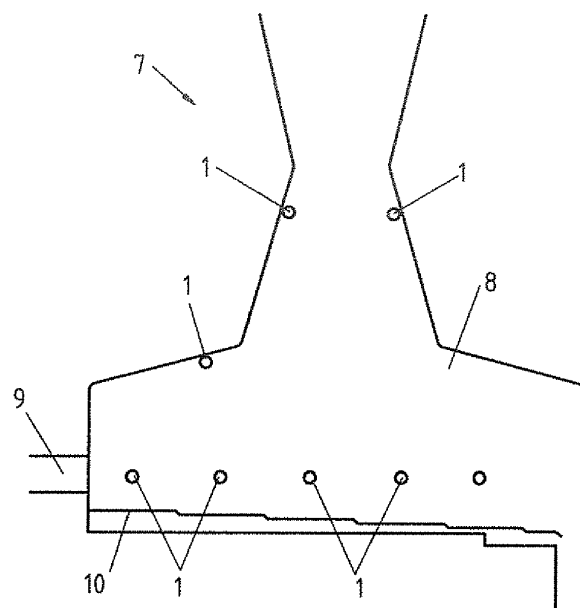


FIG. 4

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Description

[0001] The present invention relates to a nozzle having a gas inlet and a gas outlet and to an incineration plant comprising such a nozzle as well as to a reactor for cleaning flue gases by a dry or quasi-dry sorption process comprising such a nozzle.

[0002] The incineration plant for combusting solid material (i.e. waste) comprises a combustion chamber, a combustion material inlet through which solid material can be introduced into the combustion chamber, a combustion grate with which the solid material and combusted solid material can be conveyed through the combustion chamber, a primary air supply below the top of the combustion grate and at least one nozzle arranged above the combustion grate, with which secondary air and/or an oxygen poor carrier gas can be provided, wherein the nozzle has a gas inlet and a gas outlet. In such an incineration plant the solid material to be combusted is introduced via the inlet into the combustion chamber and is conveyed by the combustion grate towards an outlet on the opposite side of the combustion chamber. Primary air is provided from below the solid material arranged on the combustion grate and the solid material is combusted with the primary air under release of primary combustion gases. The combusted solid particles are also conveyed by the combustion grate to the outlet. Secondary air and eventually an oxygen poor carrier gas (such as flue gases withdrawn from the incinerator downstream of the combustion chamber) are provided to the primary combustion gases above the solid material via a nozzle, to which the present invention relates. Accordingly, the inventive nozzle may be used in an incineration plant in which flue gases (German: Rezigas) may be recirculated. Such an incineration plant and method is known from DE 10 2004 037 442 B4, according to which the recirculated flue gas is provided by a two substance nozzle with a central nozzle section and an outer nozzle section.

[0003] The invention also relates to a nozzle used in a reactor for cleaning (in particular desulfurizing) flue gases by a dry or quasi-dry sorption process, the reactor comprising a flue gas inlet at the bottom of the reactor, an outlet at the top of the reactor, a dry sorbent injection system with at least one dry sorbent nozzle for injecting dry sorbent into the reactor, the at least one nozzle being arranged between the flue gas inlet and the outlet. The combustion gases produced in a combustion chamber are usually introduced as flue gas through the flue gas inlet into the reactor. A dry sorbent is injected into the flue gas, for example calcium oxide or calcium hydroxide powder is injected into the flue gas. The dry sorbent powder can be injected as particles together with a carrier gas through a nozzle according to the present invention. The carrier gas and the dry sorbent powder is mixed with the flue gas, wherein the dry sorbent containing flue gas may be forced through a venturi system, so that a so called fluidized bed is formed downstream of the venturi system in order to enhance the sorption process. The

dry sorbent is usually injected by a nozzle arranged at the wall of the reactor, so that the highest dry sorbent concentration is at the outer circumference of the reactor at the injection side. After the sorbent comprising flue gas leaves the reactor through the outlet it is advanced to a separator/filter, in which solid particles are separated from the stream. A reactor with the above described features is for example known from CN 101 402 019 B.

[0004] It is desirable that the secondary air and/or oxygen poor gas (i.e. recirculated flue gas) is more efficiently mixed with the primary combustion gases in an incineration plant. It is also desirable that the dry sorbent powder provided with a carrier gas stream to the reactor for cleaning (desulfurization) of flue gases is more efficiently mixed with the flue gases. Additionally, it is desirable that flow properties of the gases (i.e. pure gases, gas mixture, carrier gases with particles) provided through the nozzle can be easily altered, eventually even during operation, in order to influence the mixing behavior with the medium (i.e. primary combustion gases in the incineration plant or flue gases in the reactor), in which the gases are introduced.

[0005] These objects are achieved by an incineration plant, a reactor and a nozzle having the features of the respective independent claims. Preferred embodiments are disclosed in the dependent claims and in the description, wherein single features of the preferred embodiments can be combined with each other in a technically meaningful manner. In particular, the features disclosed with regard to any nozzle can be applied to a nozzle of an inventive incineration plant and/or to a nozzle of an inventive reactor and vice versa.

[0006] The object is in particular achieved in that the nozzle has a helically shaped guiding element, which helically shaped guiding element is arranged between the gas inlet and the gas outlet of the nozzle for impinging a swirl to the gas, wherein the helically shaped guiding element has a front edge and a back edge, the front edge and the back edge being displaced with a distance to each other in a longitudinal direction of the nozzle.

[0007] By embodying such a helically shaped guiding element in the nozzle, the gas stream provided to the gas (nozzle) inlet is forced into a helically shaped movement (trajectory), so that the gas stream, which leaves the gas (nozzle) outlet comprises a swirl (angular momentum). By this swirl the gas provided through the nozzle is more efficiently mixed with the medium, in which the gas is introduced. The degree of the swirl is characterized by the so called swirl number.

[0008] The front edge of a helically shaped guiding element is that edge, which is assigned to the gas (nozzle) inlet and the back edge is that edge of the helically shaped guiding element, which is assigned to the gas (nozzle) outlet. Preferably, the helically shaped guiding element extends continuously from the front edge to the back edge. But, it may also be possible, that a helically shaped guiding element comprises multiple sections, which are arranged behind each other. Preferably, the

front edge is arranged in the plane of the gas (nozzle) inlet or downstream of the gas inlet (inside the nozzle), while the back edge of the helically shaped guiding element is arranged upstream or in the plane of the gas (nozzle) outlet. But, it may also be possible that at least the back edge is arranged downstream of the nozzle, in particular outside of an outer tube of the nozzle, so that the helically shaped guiding element extends over the nozzle body.

[0009] The helically shaped guiding element might extend only over a part of a flow cross section (flow channel) of the nozzle, in which case the helically shaped guiding element may extend from an outer wall or from an inner wall into the flow channel of the nozzle. But, preferably the helically shaped guiding element extends over the whole flow cross section of the respective flow channel of the nozzle, thereby forcing the complete gas stream on a helically shaped trajectory through the nozzle.

[0010] Preferably, the helically shaped guiding element extends at least 360° around a central (imaginary) axis, so that one helically shaped guiding element covers the whole cross section of the respective flow channel of the nozzle.

[0011] Each nozzle or each flow channel of the nozzle may have exactly one or more than one helically shaped guiding element, for example two, three or four helically shaped guiding elements, which are arranged parallel to each other. The front edge and the back edge of each of this multiple helically shaped guiding elements may be arranged in a respective plane so that all of the helically shaped guiding elements extend over the same length of the nozzle. But, it may also be possible, that some of the multiple helically shaped guiding elements are shorter than other helically shaped guiding elements.

[0012] In a simple embodiment the nozzle body is provided by a tube like structure, wherein the helically shaped guiding element is arranged in the tube like structure.

[0013] In order to alter the properties with which the gas provided through the nozzle is introduced into the medium, it is desirable to be able to alter the swirl number of the provided gas. Accordingly, it is suggested that the helically shaped guiding element is flexible and that the nozzle has a setting element embodied to alter the distance between the front edge and the back edge of the helically shaped guiding element. By altering the distance between the front edge and the back edge of the helically shaped guiding element the helically shaped guiding element is compressed or uncompressed in the longitudinal direction of the nozzle, so that the pitch (slope) of the helically shaped guiding element is altered, whereby the trajectory of the gas and thereby the swirl number can be altered.

[0014] In particular, the helically shaped guiding element is flexible and the nozzle has a setting element embodied to alter the distance between the front edge and the back edge of the helically shaped guiding element. For example, the helically shaped guiding element can

be made of an elastic material or can be formed by a (rubber or metal) sheet, which can be deformed elastically.

[0015] The setting element can be embodied by a rod or tube, to which the helically shaped guiding element is directly or indirectly attached at its front or back, wherein the setting element can be displaced in the longitudinal direction of the nozzle. For example, the rod may be arranged centrally within the nozzle, so that the helically shaped guiding element extends around the rod. Alternatively, a tubelike setting element may surround at least a part of the helically shaped guiding element.

[0016] In particular, the front or back of the helically shaped guiding element is stationary fixed to a stationary part of the nozzle (such as the nozzle body), while the back or the front is fixed to the setting element, which can be displaced in the longitudinal direction of the nozzle, in particular relative to the nozzle body.

[0017] The setting element might be actuated manually, for example by a manually displaceable setting wheel, or by an electronically controllable actuator. The actuator may be an electrical, pneumatically or hydraulically driven motor. While a manually actuatable setting element is preferable to alter the guiding element between two operation periods, the helically shaped guiding element might be altered by the electronically controllable actuator even during operation.

[0018] The invention is in particular suitable for a nozzle having only one flow channel for one gas (pure gas, gas mixture, carrier gas with solid particles), wherein the helically shaped guiding element is arranged in the one flow channel. But, the invention can also be applied to a multiple substance nozzle, wherein more than one flow channel for different gases (mixtures) are embodied, each flow channel being connectable to different gas sources. A helically shaped guiding element might be arranged in only one, multiple or all flow channels of the multiple substance nozzle. In particular, the invention is applicable to a two-substance nozzle, in which the nozzle has a central flow channel and an outer flow channel surrounding the central flow channel, wherein a helically shaped guiding element is arranged in the central flow channel and/or in the outer flow channel. The helically shaped guiding elements assigned to the different flow channels may be altered independently of each other. With such a multiple substance nozzle there is a higher degree of flexibility for altering the parameters with which the gas or gases can be supplied to the medium.

[0019] In particular, with regard to the incineration plant recirculated flue gas or other oxygen poor carrier gas may be provided through one flow channel, while secondary air may be provided through the other flow channel.

[0020] The incineration plant has preferable more than four, in particular at least six or even at least twelve nozzles according to the invention, which are preferable arranged in a horizontal plane within the combustion chamber.

[0021] The reactor according to the present invention is preferable arranged in a vertical manner, wherein the flue gas inlet is arranged at the very bottom of the reactor, meaning that there is preferable no mean for collecting residuals below the flue gas inlet. Usually, the flue gas is provided through a duct from a combustion chamber, which duct leads in horizontal manner to the flue gas inlet of the reactor. In such a vertical reactor, the flue gas outlet is arranged vertically above the flue gas inlet, so that the reactor can be considered that part, in which the flue gas advances vertically from the bottom to the top. The reactor is delimited by a reactor wall.

[0022] A dry sorbent (i.e. CaO or Ca(OH)_2) powder is provided through the nozzle of the dry sorbent injection system into the reactor. It is preferred, that more than one dry sorbent nozzle is arranged at the reactor wall. For example, three, four or more nozzles are arranged in preferably one horizontal plane.

[0023] It is also possible that dry sorbent nozzles are arranged above each other.

[0024] In this regard, the outlet of the (dry sorbent) nozzles may be arranged with a distance from the wall, so that the dry sorbent does not contact the wall of the reactor immediately after injection. By impinging a swirl to the dry sorbent provided through the nozzle the mixture and therefore the sorption process with the flue gases is enhanced. This way, the need of a fluidized bed above the dry sorption injection system can eventually be avoided or reduced, so that the reactor can be built smaller.

[0025] The (dry sorbent) nozzles may be arranged below a venturi nozzle or below multiple venturi systems for the flue gases within the reactor. It is also possible that at least one dry sorbent nozzle is arranged within the venturi system.

[0026] The invention and the technical background are now explained with regard to the figures. The figures depict schematically

Figure 1: a nozzle according to the invention in a first state,

Figure 2: the nozzle in a second state,

Figure 3: the nozzle in a third state,

Figure 4: an incineration plant with a respective nozzle and

Figure 5 a reactor for desulfurization of flue gases with a respective nozzle.

[0027] Figures 1 to 3 depict a nozzle 1 in different states. The nozzle comprises a gas inlet 2 and a gas outlet 3. A helically shaped guiding element 4 is arranged between the gas inlet 2 and the gas outlet 3.

[0028] The helically shaped guiding element 4 comprises a front edge 5 and a back edge 6.

[0029] A gas (eventually comprising solid material to

be transported) can be supplied through the gas inlet 2 into the nozzle 1, wherein the gas is forced by the helically shaped guiding element 4 onto a helical trajectory through the nozzle 1. Due to this helical trajectory the gas has a swirl at the gas outlet 3 when leaving the nozzle 1. The swirl of the gas is characterized by the swirl number.

[0030] In order to alter the swirl number, the front edge 5 is connected to a setting element, with which the front edge 5 can be moved towards the outlet 3 and back. By this movement the helically shaped guiding element 4 is compressed, so that the pitch of the helically shaped guiding element 4 is altered, thereby altering the swirl number.

[0031] As can be seen by a comparison of figures 1, 2 and 3 the compression of the helically shaped guiding element 4 can be set to different levels so that the swirl number can be altered continuously.

[0032] The nozzle depicted in figures 1 to 3 can be used in an incineration plant 7 as depicted in figure 4. The incineration plant 7 comprises a combustion chamber 8 with a combustion material inlet 9. The combustion material (i.e. waste) can be conveyed through the combustion chamber 8 by a combustion grate 10. Primary air for combusting the solid material on top of the combustion grate 10 is provided from below the combustion grate 10 (not depicted). Additionally, secondary air is supplied to the primary combustion gases through nozzles 1, which are arranged above the combustion grate 10. The nozzle 1 can also be used in a reactor 11 for desulfurization of flue gases by a dry or quasi-dry sorption process. A respective reactor 11 is depicted in figure 5. The reactor 11 comprises a flue gas inlet 12 and a flue gas outlet 13, which is arranged vertically above the flue gas inlet 12. The flue gas inlet 12 is connected to a vertically extending supply line, through which flue gases are supplied to the reactor 11. A venturi section is formed between the flue gas inlet 12 and the flue gas outlet 13. In the area of the venturi system a nozzle 1 is arranged as part of a dry sorbent injection system 14. Dry sorbent powder is provided with a carrier gas through the nozzle 1. The carrier gas and also the dry sorbent powder is provided into the reactor with a swirl, so that an enhanced mixture with the flue gas and therefore an enhanced sorption process occurs.

Reference signs

[0033]

- 1 nozzle
- 2 gas inlet
- 3 gas outlet
- 4 helically shaped guiding element
- 5 front edge
- 6 back edge
- 7 incineration plant
- 8 combustion chamber

- 9 combustion material inlet
- 10 combustion grate
- 11 reactor
- 12 flue gas inlet
- 13 flue gas outlet
- 14 dry sorbent injection system

gitudinal direction of the nozzle (1).

3. Nozzle (1) having

- 5 - a gas inlet (2) and
- a gas outlet (3),

Claims

1. Incineration plant (7) having

- a combustion chamber (8),
- a combustion material inlet (9) through which solid material can be introduced into the combustion chamber (8),
- a combustion grate (10) with which the solid material and combusted solid material can be conveyed through the combustion chamber (8),
- a primary air supply below the top of the combustion grate (10),
- at least one nozzle (1) arranged above the combustion grate (10) with which secondary air and/or an oxygen poor carrier gas can be provided, the nozzle (1) having a gas inlet (2) and a gas outlet (3),

characterized in that

a helically shaped guiding element (4) is arranged in the nozzle between the gas inlet (2) and the gas outlet (3) for impinging a swirl to the gas, the helically shaped guiding element (4) having a front edge (5) and a back edge (6), wherein the front edge (5) and the back edge (6) are displaced with a distance to each other in a longitudinal direction of the nozzle (1).

2. Reactor (11) for cleaning flue gases by a dry or quasi-dry sorption process, comprising

- a flue gas inlet (12) at the bottom of the reactor (11),
- an outlet (13) at the top of the reactor (11),
- a dry sorbent injection system (14) with at least one dry sorbent nozzle (1) for injecting dry sorbent with a carrier gas into the reactor (11), the at least one nozzle (1) being arranged between the flue gas inlet (12) and the outlet (13),
- the at least one nozzle (1) having a gas inlet (2) and a gas outlet (3),

characterized in that

a helically shaped guiding element (4) is arranged in the nozzle between the gas inlet (2) and the gas outlet (3) for impinging a swirl to the dry sorbent comprising carrying gas, the helically shaped guiding element (4) having a front edge (5) and a back edge (6), wherein the front edge (5) and the back edge (6) are displaced with a distance to each other in a lon-

characterized in that

a helically shaped guiding element (4) is arranged between the gas inlet (2) and the gas outlet (3) for impinging a swirl to the gas, the helically shaped guiding element (4) having a front edge (5) and a back edge (6), wherein the front edge (5) and the back edge (6) are displaced with a distance to each other in a longitudinal direction of the nozzle (1).

4. Nozzle (1) according to claim 3, **characterized in that** the helically shaped guiding element (4) is flexible and **in that** the nozzle (1) has a setting element embodied to alter the distance between the front edge (5) and the back edge (6) of the helically shaped guiding element (4).

5. Nozzle (1) according to claim 3 or 4, wherein the helically shaped guiding element (4) is made of an elastic material or of an elastically deformable sheet.

6. Nozzle (1) according to one of claims 3 to 5, wherein the front or back of the helically shaped guiding element (4) is stationary fixed and the back or the front is fixed to the setting element which can be displaced in the longitudinal direction.

7. Nozzle (1) according to one of claims 3 to 6, wherein the setting element is to be actuated manually or by an electronically controllable actuator.

8. Nozzle (1) according to one of claims 3 to 7, wherein the nozzle (1) has a central flow channel and an outer flow channel surrounding the central flow channel, wherein a helically shaped guiding element (4) is arranged in the central flow and/or in the outer flow channel.

Amended claims in accordance with Rule 137(2) EPC.

1. Incineration plant (7) having

- a combustion chamber (8),
- a combustion material inlet (9) through which solid material can be introduced into the combustion chamber (8),
- a combustion grate (10) with which the solid material and combusted solid material can be conveyed through the combustion chamber (8),
- a primary air supply below the top of the com-

bustion grate (10),
 - at least one nozzle (1) arranged above the combustion grate (10) with which secondary air and/or an oxygen poor carrier gas can be provided, the nozzle (1) having a gas inlet (2) and a gas outlet (3),

characterized in that

a helically shaped guiding element (4) is arranged in the nozzle between the gas inlet (2) and the gas outlet (3) for impinging a swirl to the gas, the helically shaped guiding element (4) having a front edge (5) and a back edge (6), wherein the front edge (5) and the back edge (6) are displaced with a distance to each other in a longitudinal direction of the nozzle (1).

2. Reactor (11) for cleaning flue gases by a dry or quasi-dry sorption process, comprising

- a flue gas inlet (12) at the bottom of the reactor (11),
 - an outlet (13) at the top of the reactor (11),
 - a dry sorbent injection system (14) with at least one dry sorbent nozzle (1) for injecting dry sorbent with a carrier gas into the reactor (11), the at least one nozzle (1) being arranged between the flue gas inlet (12) and the outlet (13),
 - the at least one nozzle (1) having a gas inlet (2) and a gas outlet (3),

characterized in that

a helically shaped guiding element (4) is arranged in the nozzle between the gas inlet (2) and the gas outlet (3) for impinging a swirl to the dry sorbent comprising carrying gas, the helically shaped guiding element (4) having a front edge (5) and a back edge (6), wherein the front edge (5) and the back edge (6) are displaced with a distance to each other in a longitudinal direction of the nozzle (1).

3. Incineration plant (7) according to claim 1 or reactor (11) according to claim 2, **characterized in that** the helically shaped guiding element (4) is flexible and **in that** the nozzle (1) has a setting element embodied to alter the distance between the front edge (5) and the back edge (6) of the helically shaped guiding element (4).

4. Incineration plant (7) or reactor (11) according to one of the respective preceding claims, wherein the helically shaped guiding element (4) is made of an elastic material or of an elastically deformable sheet.

5. Incineration plant (7) or reactor (11) according to claim 3 or 4, wherein the front or back of the helically shaped guiding element (4) is stationary fixed and the back or the front is fixed to the setting element which can be displaced in the longitudinal direction.

6. Incineration plant (7) or reactor (11) according to claim 3 to 5, wherein the setting element is to be actuated manually or by an electronically controllable actuator.

7. Incineration plant (7) or reactor (11) according to one of the preceding claims, wherein the nozzle (1) has a central flow channel and an outer flow channel surrounding the central flow channel, wherein a helically shaped guiding element (4) is arranged in the central flow and/or in the outer flow channel.

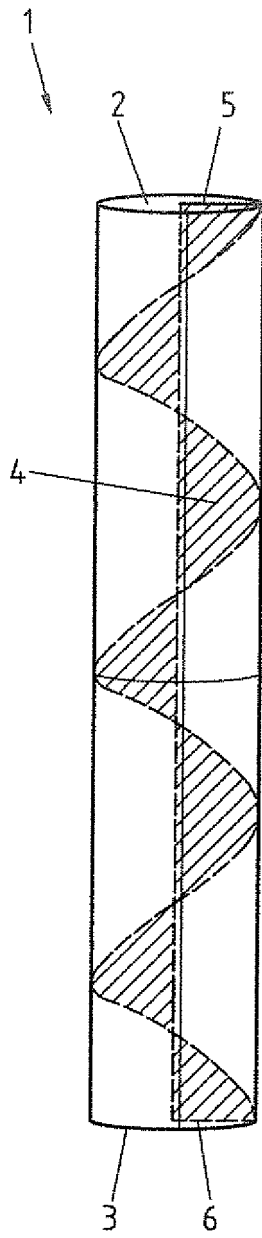


FIG.1

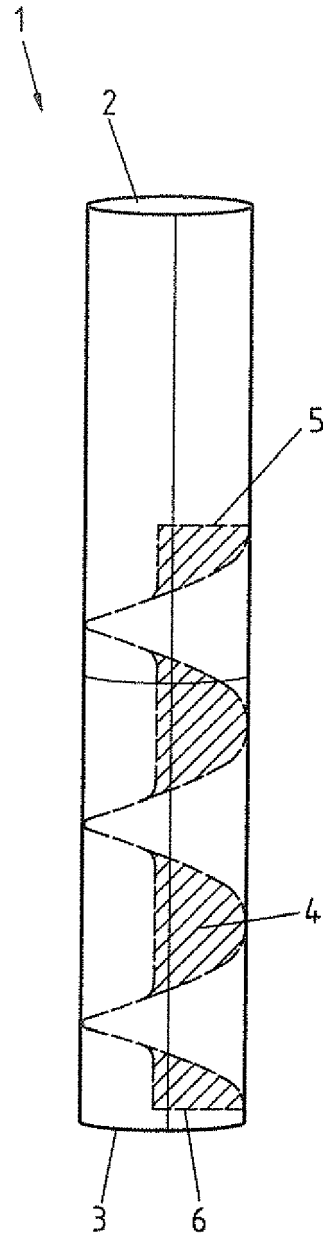


FIG.2

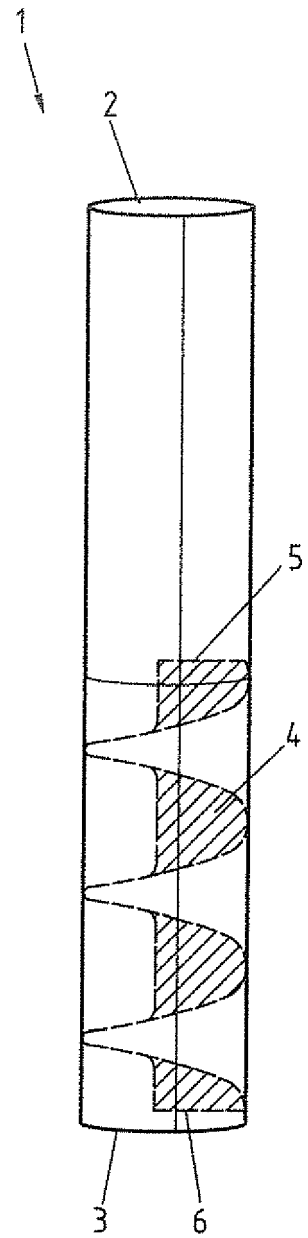
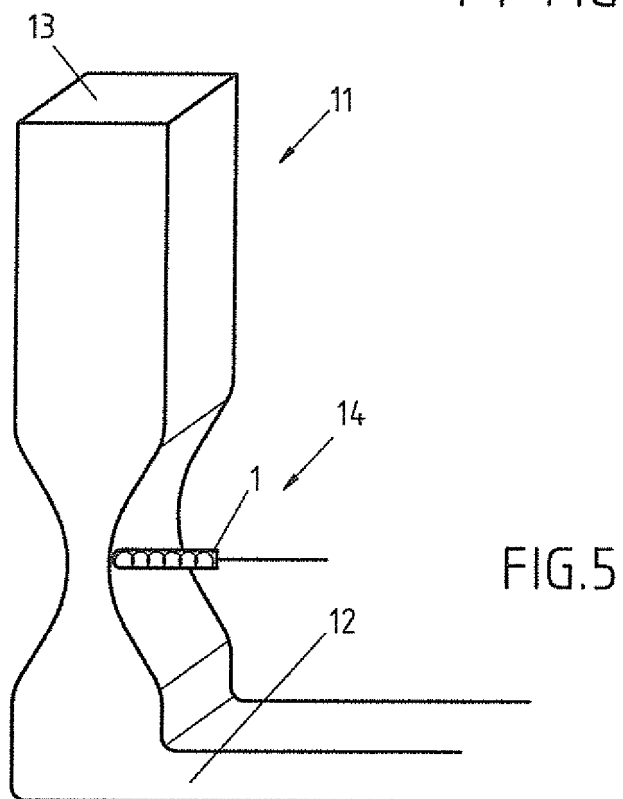
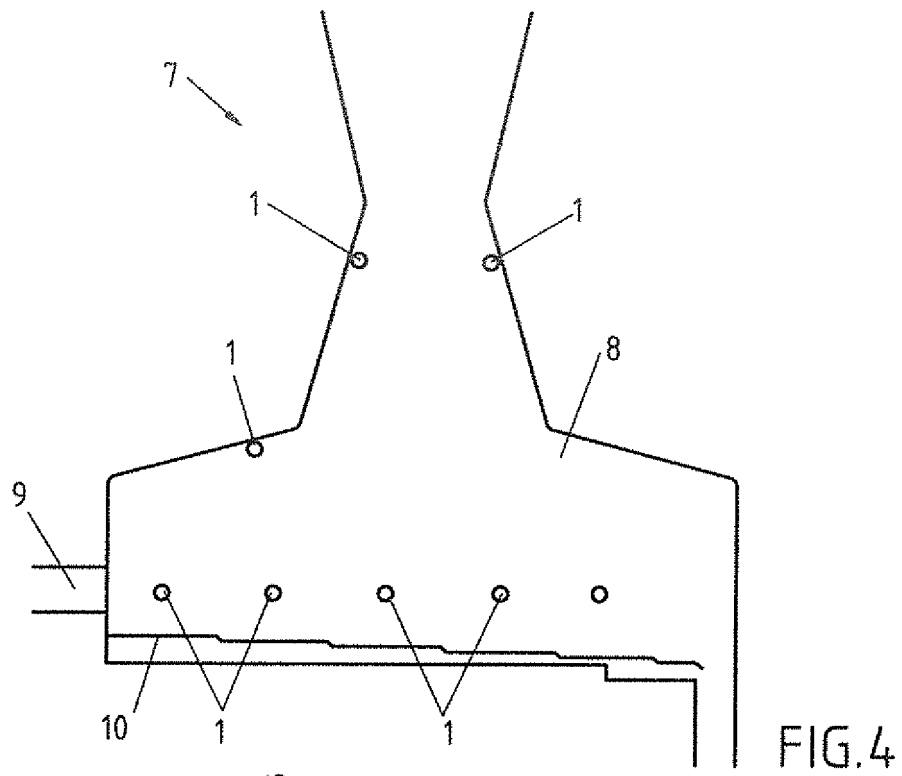


FIG.3





EUROPEAN SEARCH REPORT

 Application Number
 EP 18 21 1081

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2 613 481 A (EICHELMAN FRANK J) 14 October 1952 (1952-10-14) * column 1, line 1 - line 4; figures 2,3 * * column 2, line 13 - line 29 * * column 3, line 7 - line 15 * * column 3, line 27 - line 51 * -----	3	INV. F23J15/00 F23L9/02
X	GB 2 354 451 A (VECTURA LTD [GB]) 28 March 2001 (2001-03-28) * page 1, line 3 - line 5; figure 1 * * page 14, line 1 - page 15, line 18 * -----	3	
X	US 2016/258685 A1 (WESLEY ADAM TAYLOR [AU] ET AL) 8 September 2016 (2016-09-08) * paragraph [0001]; figures 1A,1B,1C * * paragraphs [0013] - [0017], [0019]; figure 6 * * paragraphs [0027], [0028], [0030], [0031] * * paragraph [0038] - paragraph [0043] * * paragraph [0067] * * paragraphs [0094], [0096] * * paragraph [0162] - paragraph [0171] * * paragraph [0174] - paragraph [0176] * * paragraph [0180] * -----	3,5 4,6,7	
A	US 5 503 089 A (FRONTINI LUIS E [IT] ET AL) 2 April 1996 (1996-04-02) * column 1, line 10 - line 14; figures 1-3 * * column 3, line 40 * * column 4, line 46 - line 54 * ----- -/--	1,2	
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 24 June 2019	Examiner Hauck, Gunther
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document	

EPO FORM 1503 03.82 (P04C01)



EUROPEAN SEARCH REPORT

Application Number
EP 18 21 1081

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 0 543 705 A1 (INST FRANCAIS DU PETROLE [FR]; BABCOCK ENTREPRISE [FR]) 26 May 1993 (1993-05-26) * column 1, line 1 - line 27; figures 1,2A,B-6A,B * * column 1, line 39 - column 2, line 3 * * column 3, line 19 - column 5, line 41 * -----	2	
A	US 5 011 400 A (VATSKY JOEL [US]) 30 April 1991 (1991-04-30) * column 1, line 11 - line 15; figures 1,3-5 * * column 2, line 28 - line 31 * * column 2, line 47 - line 58 * * column 3, line 26 - line 60 * * column 4, line 25 - line 36 * * column 4, line 61 - column 5, line 25 * * column 5, line 33 - line 52 * * column 5, line 67 - column 6, line 32 * -----	4,6,7	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
Place of search Munich		Date of completion of the search 24 June 2019	Examiner Hauck, Gunther
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

EPO FORM 1503 03.82 (P04C01)



Application Number

EP 18 21 1081

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☒ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

1-7

☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).



LACK OF UNITY OF INVENTION
SHEET B

Application Number

EP 18 21 1081

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-3

Reactor for gas featuring a gas nozzle configured to introduce gas into the reactor; a helically shaped guiding element is arranged within the gas nozzle for impinging a swirl to the medium flowing through the gas nozzle.

2. claims: 4-7

Gas nozzle featuring a helically shaped guiding element being arranged within the gas nozzle for impinging a swirl to the medium flowing through the gas nozzle; the guiding element being flexible, such that the shape of the guiding element can be altered.

3. claim: 8

Gas nozzle featuring a helically shaped guiding element being arranged within the gas nozzle for impinging a swirl to the medium flowing through the gas nozzle; the nozzle features a central flow channel and an outer flow channel.

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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24-06-2019

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