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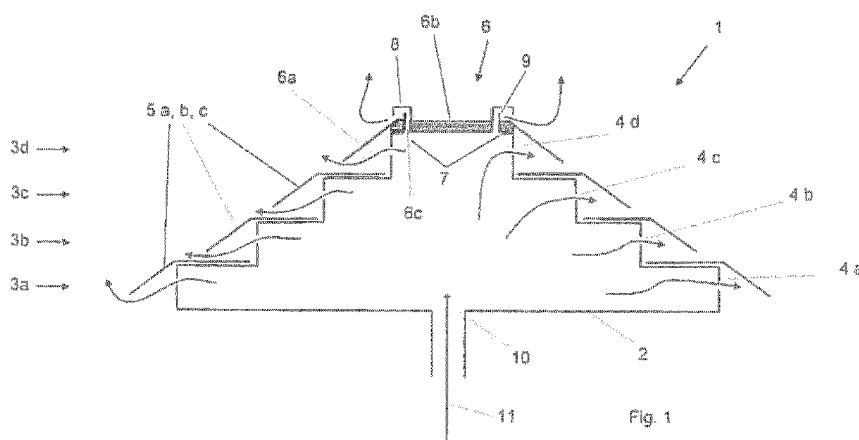
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(54) **Title:** ROTARY GRATE FOR A FIXED-BED GASIFICATION REACTOR



(57) **Abstract:** The invention relates to a rotary grate for fixed-bed gasification reactors, which substantially has the shape of a stepped cone and whose uppermost step is provided with axial gas outlets, so that gasification medium also can be introduced into the middle region of the fixed bed via the rotary grate.

10 Rotary Grate for a Fixed-Bed Gasification Reactor

Field of the Invention

15 The invention relates to a rotary grate for a fixed-bed gasification reactor. The invention also relates to a plant for the fixed-bed gasification of carbonaceous fuels, comprising a fixed-bed pressure gasification reactor equipped with a rotary grate according to the invention. Furthermore, the invention relates to a process for producing synthesis gas, wherein the gasification medium is supplied to the
20 fuel via a rotary grate according to the invention.

Prior art

Fixed-bed gasification reactors equipped with a rotary grate have long since been known. Such reactor is described for example in Ullmann's Encyclopedia of
25 Industrial Chemistry, 6th edition, vol. 15, page 369, Fig. 24.

The rotary grate on the one hand has the task to carry the fixed bed of the fuel and of the ash obtained from the fuel in the reactor. Furthermore, by adjusting the speed of revolution of the rotary grate the amount of ash discharged from the
30 reactor per unit time can be regulated. On the other hand, the rotary grate has the task to introduce the gasification medium, a gas mixture chiefly consisting of oxygen, steam and, in many cases, nitrogen, into the fixed bed as uniformly as

possible. The gasification medium is passed into the reactor below the grate and is introduced into the fixed bed through openings provided therefor in the rotary grate.

- 5 The patent specification DE 968 532 discloses a rotary grate in which the openings are arranged on its surface. In this arrangement it is disadvantageous, however, that the openings directly are in contact with the fixed bed lying on the grate or slipping off over the grate. There is a risk that particles get into the openings and block the same.

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The document DE 23 51 963 discloses a rotary grate which is constructed of overlapping conical parts engaging in each other. Between these parts, the openings for the gasification medium flowing from the grate into the fixed bed are located. Due to the overlapping arrangement of the conical parts, an ingress of particles from the fixed bed into the outlet openings of the gasification medium should be prevented.

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In this rotary grate it disadvantageous, however, that a large region in the middle of the fixed bed is not reached by the gasification medium, as in the upper part 3a of the rotary grate there are no outlet openings for the gasification medium.

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Therefore, it is the object of the invention to provide a rotary grate in which the outlet openings of the gasification medium are protected against the ingress of particles from the fixed bed and which at the same time is able to introduce gasification medium also into the middle region of the fixed bed.

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Description of the Invention

This object is solved by a rotary grate 1 for a fixed-bed gasification reactor with an inlet 10 for process gas 11, comprising a body 2, substantially in the form of a stepped cone, wherein each step 3a, 3b, 3c, 3d includes radial gas outlets 4a, 4b, 4c, 4d for process gas and wherein, except for the uppermost step 3d, each step is equipped with a protective shield 5 which is formed such that it protects the

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body 2 against the abrasive contact with the fixed bed and shields the radial gas outlets 4 against the ingress of solid particles from the fixed bed, with a lid 6 for covering the gas outlets 4d of the uppermost step of the grate 3d, wherein the lid 6 substantially has the shape of a hollow truncated cone whose base surface is open and larger than the top surface of the uppermost step 3d, so that the shell surface 6a of the lid 6 radially protrudes beyond the uppermost step 3d and in doing so covers the radial gas outlets 4 thereof against solid particles, and wherein the top surface 6b of the lid 6 covers the axial gas outlet 7 of the uppermost step 3d in a gas-tight manner, and wherein the top surface 6b includes gas outlets 6c arranged on a circle, and wherein these gas outlets are covered by a ring 8 against the ingress of solid particles from the fixed bed, which ring has a profile open downwards and radially to the outside.

The aforementioned reference numerals merely serve for illustrating the features of the invention more clearly in connection with the drawings. They are not to be understood in a limiting sense, for example with respect to the number of pieces of a claim feature according to the invention.

The ingress of particles into the radial gas outlets is prevented by covering the outlets with a conical protective shield.

The introduction of gasification medium into the middle region of the fixed bed becomes possible in that the lid of the rotary grate is formed as truncated cone and hence has a horizontal surface which can be equipped with openings directed vertically upwards. These openings are arranged on a circle for uniformly distributing the gasification medium in the middle region of the fixed bed. The ingress of particles into these openings is prevented in that the openings are covered by a ring which has a profile open downwards and radially to the outside. This design of the rotary grate lid according to the invention was found to be advantageous, as on the one hand it provides for a good supply of the gasification medium into the center of the fixed bed, but on the other hand also provides for a

good movability of the rotary grate despite the weight pressure of the fixed bed resting on the same.

Preferred Aspects of the Invention

- 5 A preferred aspect of the invention consists in that the stepped cone of the body of the grate includes at least four steps. With this number of steps, a good compromise is achieved between the stability of the construction against mechanical wear and the uniformity with which the gasification medium is distributed in the fixed bed through the rotary grate.

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Another preferred aspect of the invention consists in that the open profile of the ring has right-angled edges. Such profile can be manufactured without great technical effort, e.g. as welded construction.

- 15 Another preferred aspect of the invention consists in that the open profile of the ring has a substantially semicircular shape. Such profile can be manufactured without great technical effort, e.g. by a forging or press-forming process.

- Another preferred aspect of the invention consists in that the hole circle of the gas outlets is enclosed by a tire acting as weir with a substantially rectangular profile, in order to protect the gas outlets against the ingress of solid particles or dust which have/has deposited on the lid under the profile.
- 20

- Another preferred aspect of the invention consists in a plant for the fixed-bed gasification of carbonaceous fuels, which comprises a fixed-bed pressure gasification reactor with a gasification medium inlet, a product gas outlet, a fuel bed of solid carbonaceous fuel arranged on an ash discharge grate, a fuel supply device, and an ash discharge device, and in which the ash discharge grate is designed as rotary grate according to claims 1 to 6. The improved gas distribution through the rotary grate according to the invention leads to a more effective conversion of the fuel lying in the middle of the fixed bed.
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Another preferred aspect of the invention consists in a process for producing synthesis gas, containing hydrogen and carbon oxides, comprising the following steps:

- a) providing a plant for the fixed-bed gasification according to claim 7,
 - 5 b) supplying the carbonaceous fuel via the fuel supply device,
 - c) supplying a gasification medium containing oxygen and steam via the gasification medium inlet,
 - d) converting the carbonaceous fuel with the gasification medium under gasification conditions,
 - 10 e) discharging the synthesis gas product gas via the product gas outlet,
 - f) discharging ash via the ash discharge grate and the ash discharge device,
- wherein the gasification medium is supplied via a rotary grate according to claims 1 to 6.

15 Exemplary embodiment

Further features, advantages and possible applications of the invention can also be taken from the following description of an exemplary embodiment. All features described form the subject-matter of the invention per se or in any combination, independent of their inclusion in the claims or their back-
20 reference.

With reference to the drawings Fig. 1 and Fig. 2, the invention will now be explained in detail. In the drawings:

- 25 Fig. 1 shows a longitudinal section through a rotary grate according to the invention, and
- Fig. 2 shows a longitudinal section of the rotary grate according to the invention in the region of its uppermost step and of the lid as enlarged detail from Fig. 1.

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Fig. 1 shows the body 2 of the rotary grate 1, how it is constructed of the four steps 3a to 3d. The gasification medium 11 in this example is introduced into the

rotary grate at a central point via the inlet 10 located on the bottom side of the body 2. Each of the steps 3a to 3d is equipped with radial gas outlets 4a to 4d, each distributed over the entire circumference, through which the gasification medium flows out of the rotary grate. The steps 3a to 3c are equipped with a protective shield 5a to 5c. These protective shields are made of a particularly resistant material and protect the rotary grate against the abrasive effect of the ash which as bottommost part of the fixed bed slides off via the grate. In addition, the protective shields prevent the ingress of particles into the radial gas outlets 4a to 4c.

Fig. 1 and in particular Fig. 2 show the uppermost step 3d of the rotary grate. The same has an axial gas outlet 7 which is covered by a lid 6 in a gas-tight manner. The lid 6 is equipped with a shell surface 6a which is mounted and arranged on the top surface 6b such that it covers the radial gas outlets 4d against the ingress of particles.

The top surface 6b of the lid 6 is equipped with axial gas outlets 6c arranged on a circle. Via the same, the gasification medium is introduced into the middle region of the fixed bed. A ring 8, with a profile open downwards and radially to the outside, covers the gas outlets 6c against particles from the fixed bed.

The hole circle of the gas outlets 6c is enclosed by a tire 9 acting as weir with a substantially rectangular profile, in order to protect the gas outlets 6c against the ingress of solid particles. Particularly preferably, the upper edge of the tire 9 is arranged above the edge of the ring 8 pointing downwards and radially to the outside in axial direction. In this way, particles can be kept away from the fixed bed particularly efficiently.

Industrial Applicability

The rotary grate according to the invention reliably provides for the introduction of gasification medium also into the middle region of the fixed bed of a fixed-bed

gasification reactor and hence is able to increase the performance and the economy of a fixed-bed gasification reactor.

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List of Reference Numerals

- | | | |
|----|----|---|
| | 1 | rotary grate |
| | 2 | body of the rotary grate 1 |
| | 3 | a, b, c, d radial gas outlets |
| 10 | 4 | a, b, c, d steps in the outer profile of the rotary grate 1 |
| | 5 | a, b, c protective shields |
| | 6 | lid |
| | 6a | shell surface of the lid 6 |
| | 6b | top surface of the lid 6 |
| 15 | 6c | axial gas outlets of the lid 6 |
| | 7 | axial gas outlet of the step 3d |
| | 8 | ring for covering the gas outlets 6c |
| | 9 | tire for covering the gas outlets 6c |

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Claims:

1. A rotary grate 1 for a fixed-bed gasification reactor with an inlet 10 for process gas 11, comprising a body 2, substantially in the form of a stepped cone, wherein each step 3a, 3b, 3c, 3d includes radial gas outlets 4a, 4b, 4c, 4d for process gas and wherein, except for the uppermost step 3d, each step is equipped with a protective shield 5 which is formed such that it protects the body 2 against the abrasive contact with the fixed bed and shields the radial gas outlets 4 against the ingress of solid particles from the fixed bed, with a lid 6 for covering the gas outlets 4d of the uppermost step of the grate 3d, wherein the lid 6 substantially has the shape of a hollow truncated cone whose base area is open and larger than the top surface of the uppermost step 3d, so that the shell surface 6a of the lid 6 radially protrudes beyond the uppermost step 3d and in doing so covers the radial gas outlets 4 thereof against solid particles, and wherein the top surface 6b of the lid 6 covers the axial gas outlet 7 of the uppermost step 3d in a gas-tight manner, and wherein the top surface 6b includes gas outlets 6c arranged on a circle, and wherein these gas outlets are covered by a ring 8 against the ingress of solid particles from the fixed bed, which ring has a profile open downwards and radially to the outside.
2. The rotary grate according to claim 1, characterized in that the stepped cone of the body 2 includes at least four steps 3a to 3d.
3. The rotary grate according to any of claims 1 and 2, characterized in that the open profile of the ring 8 has right-angled edges.
4. The rotary grate according to any of the preceding claims, characterized in that the open profile of the ring 8 has a substantially semicircular shape.
5. The rotary grate according to any of the preceding claims, characterized in that the hole circle of the gas outlets 6c is enclosed by a tire 9 acting as weir with a substantially rectangular profile, in order to protect the gas outlets 6c against the ingress of solid particles.
6. A plant for the fixed-bed gasification of carbonaceous fuels, comprising a fixed-bed pressure gasification reactor with a gasification medium inlet, a

product gas outlet, a fuel bed of solid carbonaceous fuel arranged on an ash discharge grate, a fuel supply device, and an ash discharge device, characterized in that the ash discharge grate is designed as rotary grate according to claims 1 to 6.

- 5 7. A process for producing synthesis gas, containing hydrogen and carbon oxides, comprising the following steps:
- a) providing a plant for the fixed-bed gasification according to claim 7,
 - b) supplying the carbonaceous fuel via the fuel supply device,
 - c) supplying a gasification medium containing oxygen and steam via the
 - 10 gasification medium inlet,
 - d) converting the carbonaceous fuel under gasification conditions with the gasification medium,
 - e) discharging the synthesis gas product gas via the product gas outlet,
 - f) discharging ash via the ash discharge grate and the ash discharge
 - 15 device,
- characterized in that the gasification medium is supplied via a rotary grate according to claims 1 to 6.

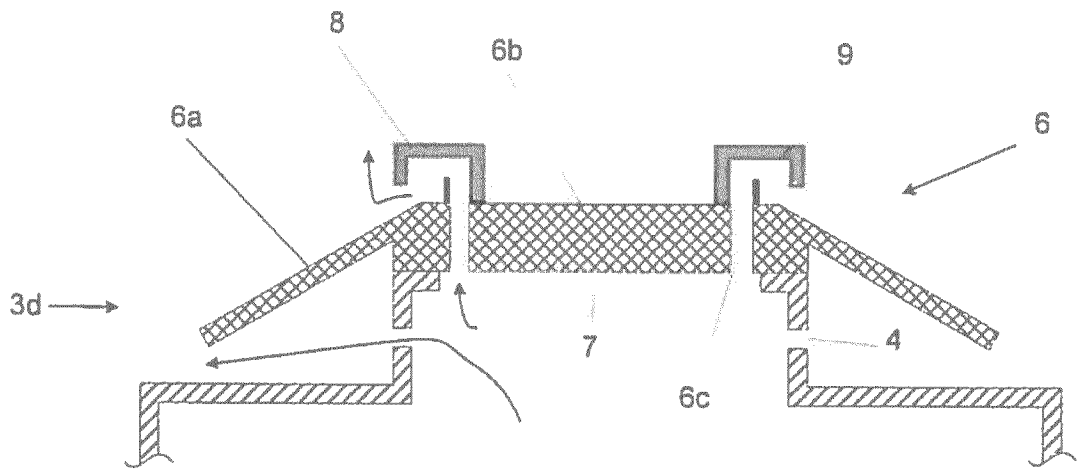
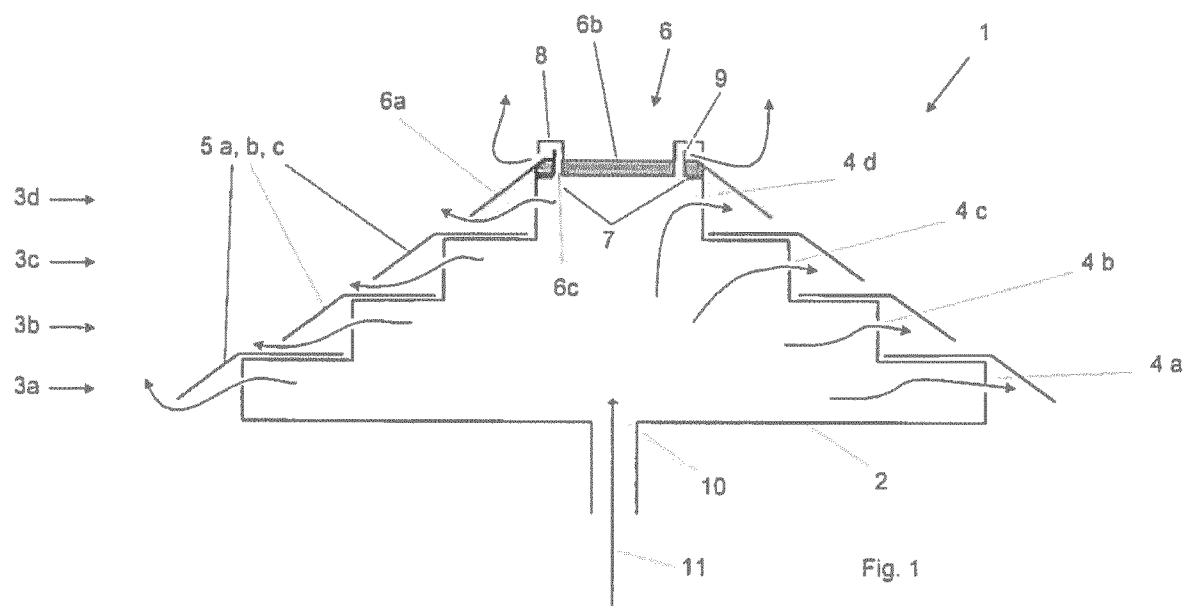


Fig. 2

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2015/025028

A. CLASSIFICATION OF SUBJECT MATTER
INV. C10J3/42 F23H9/02
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
C10J F23H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2006/061738 A2 (SASOL LURGI TECHNOLOGY COMPANY [ZA]; STADLER JACOBUS ANDREAS [ZA]; VAN) 15 June 2006 (2006-06-15) page 10, line 1 - page 13, line 16; figures 1, 7 page 18, line 25 - page 21, line 4 -----	1-7
X	GB 2 493 957 A (SASOL TECH PTY LTD [ZA]) 27 February 2013 (2013-02-27) page 4, line 13 - page 4, line 27; figure 1 page 7, line 26 - page 8, line 28 -----	1-7
X	WO 99/10094 A1 (SASOL TECH PTY LTD [ZA]; SASOL CHEMICALS EUROP LTD [GB]; MEYER PHILIPP) 4 March 1999 (1999-03-04) page 7, line 16 - page 12, line 33; figure 1 -----	1-7



Further documents are listed in the continuation of Box C.



See patent family annex.

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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