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(54) Gasification reactor

(57) Gasification reactor (1), of the type which retains a fluidizable bed of particulate material, wherein a flow of liquid or solid combustible is thermally decomposed into a combustible synthesis gas, which is evacuated through the upper part of the reactor, as ashes and slag, made up of an essentially cylindrical outer configuration lining, which houses an inner cavity determined by two cylindrical parts, an upper (5) and lower one (6), the upper (5) part being of greater diameter than the lower one (6) and the two parts being joined without interruption by an inverted truncated cone shaped intermediate part, wherein the thickness of the lining (4) corresponding to the lower part (6) is always greater than the thickness of the lining (4) of the upper part (5) of the reactor, said lining (4) comprising one or more inner layers of refractory material, an intermediate refractory stainless steel plate, one or more layers of insulating material and an outer metal plate, the reactor being provided with a pipe (7), which connects the reactor exterior with the lower cylindrical part (6) thereof, through which gasifying agent is injected at a greater speed than the drag speed of the material that forms the fluidized bed, but lower than the slag drag speed, allowing the slag to pass outwardly through the pipe (7) and evacuating it without causing losses of the material which forms the bed, as well as support means (9), arranged on the lining (4) outer surface, adapted for bearing the weight of same and so that the latter can be suspended from said support means, allowing the reactor to expand vertically, and/or with lateral cushioning means which prevent it from moving horizontally.

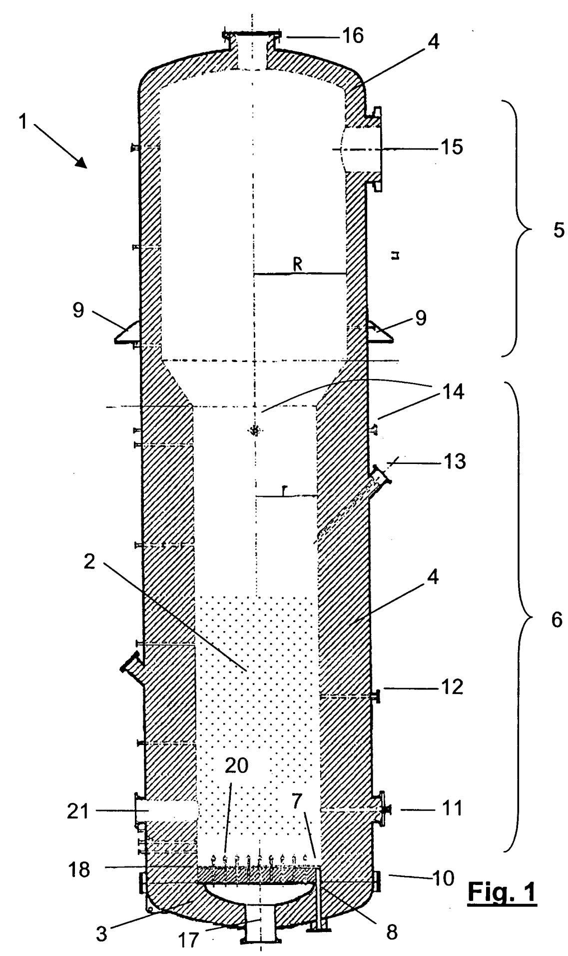

Fig. 1

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Description

Technical field of the invention

[0001] The invention relates to a gasification reactor, of the type which retains a fluidizable bed of particulate material, wherein a flow of liquid or solid combustible is thermally decomposed through the action of a gasifying agent into a combustible synthesis gas, which is evacuated through the upper part of the reactor, as ashes and slag.

Background of the invention

[0002] The gasification consists of the complete transformation of a solid or an organic liquid into a combustible gas of a different chemical structure, by the reaction at a high temperature of said material with one or several gasifying agents such as air, oxygen or water vapour. Originally, this technology was first used to take advantage of the energy from fossil fuels such as coal.

[0003] Recently, in the field of waste treatment and the valuation of sub-products, a great deal of effort has been made, both in research and development and in practical tasks, leading to the establishment of a gasification technology as an alternative to waste incineration, since gasification, from an energy and polluting point of view, improves the efficiency of the valuation means of more conventional waste.

[0004] The material to be gasified in a gasification process has to be pretreated in order to comply with a series of specifications in terms of density, moisture, particle size and shape, prior to introduction into the gasification reactor, wherein, under the direct action of air, enriched air or oxygen, the material to be gasified is subject to a partial oxidation, decomposing and giving rise to a gaseous flow.

[0005] In the fluidized bed gasifiers, the reactors are provided with a lower part, or bottom, with a grid on which is supported a fluidisable bed of particles that retains the heat. The bed is fluidized by a flow of a gasifying agent fed through several nozzles arranged in the grid, the lower part of the reactor is also usually provided with an inlet for the particles of the material to be gasified.

[0006] In these reactors, the resultant combustible gas is recovered and evacuated through the upper part of the reactor. The resultant combustible gas incorporates practically all the calorific power that the material to be gasified had, so that, after a subsequent preparation process, it can be used for the production of heat, electricity, or as raw material for the manufacture of chemical products.

[0007] An embodiment example of a gasification reactor is disclosed in Spanish patent document P 9901218, which describes a gasification reactor consisting of an upper cylindrical part and a lower cylindrical part, of lesser diameter, greater height and coaxial as regards the upper part, joined without interruption by an inverted intermediate part shaped like a truncated cone, the outer lining of which is steel plated.

[0008] Another embodiment example is disclosed in the patent document EP 0780459, which presents a cylinder-shaped fluidized bed reactor but in which most of the bed is in the lower part of the reactor, which has a truncated cone shape.

[0009] The known gasification reactors have, to a greater or lesser degree, some drawbacks. First of all, the reactors are anchored or fastened to the floor by their lower part and form a compact nucleus, so it is difficult to have access to their interior to carry out maintenance or repair work. The operator in charge of the operation can only have access to the inside through the upper part of the reactor, suspended by a harness and with safety equipment.

[0010] On the other hand, the different layers making up the gasification wall are subject to important demands of a mechanical and thermal nature. This means that the reactor is subject to dimensional variations, making it difficult for the reactor to work properly, making for numerous stoppages for maintenance and reducing their performance and useful life. Furthermore, the cement which normally makes up the refractory layer of the current gasification reactors present problems of contraction when the reactor starts up. Naturally, these dimensional changes have repercussions on the mechanical problems and the stability of the reactor itself.

[0011] Finally, the ash and slag extraction systems have problems operating continuously due to the high pressure and temperature conditions existing inside the reactor. Of particular importance is the extraction of the slag or heavy materials resulting from the gasification process, as said materials can smelt through the effect of the heat, causing the blocking and malfunctioning of the outlet valves installed at the base of the reactor, preventing its proper ongoing extraction.

[0012] The accumulation of slag entails an increase in the loss charge at the bottom of the reactor, requiring its extraction. In order to be able carry out the extraction the system needs to be stopped, with the resulting decrease in the gas production.

Explanation of the invention

[0013] The gasification reactor, which is presented below, makes it possible to solve the aforementioned drawbacks. The reactor object of the invention is of the type which retains a fluidizable bed of particulate material, wherein a flow of liquid or solid combustible is thermally decomposed through the action of a gasifying agent introduced in the reactor through a grid placed at the bottom of same into a combustible synthesis gas, which is evacuated through the upper part of the reactor, as ashes and slag.

[0014] Essentially, the reactor is characterised in that it is made up of an essentially cylindrical outer configuration lining, which houses an inner cavity determined by two cylindrical parts, an upper and lower one, the upper part being of greater diameter than the lower one and the two parts being joined without interruption by an inverted truncated cone shaped intermediate part, wherein the thickness of the lining corresponding to the lower part is always greater than the thickness of the lining of the upper part of the reactor, said lining also being made up of one or more inner layers of refractory material, an intermediate refractory stainless steel plate, one or more layers of insulating material and an outer metal plate.

[0015] In a preferred embodiment, the reactor is provided with a pipe for the extraction of the slag, which connects the reactor exterior with the lower cylindrical part thereof, through which gasifying agent is injected at a greater speed than the drag speed of the material that forms the fluidized bed, but lower than the slag drag speed, allowing the slag to pass outwardly through the pipe and evacuating it without causing losses of the material which forms the bed.

[0016] In accordance with another feature, the reactor is provided with support means, arranged on the lining outer surface, adapted for bearing the weight of same, so the reactor is suspended from said support means, allowing the reactor to expand vertically, and/or with lateral cushioning means which prevent it from moving horizontally.

[0017] In accordance with another feature of the reactor, the grid through which the gasifying agent is introduced is supported by a metal lining, resting on the inner surface of the reactor base.

[0018] In a preferred embodiment, the reactor base can be separated from the rest of the reactor lining, to which it is joined by coupling means which allow for it to be detachably fastened.

Brief description of the drawings

[0019] Illustrated in the attached drawings, by way of non-limiting example, is a preferred embodiment of the gasification reactor object of the invention. In said drawings:

Fig.1, is an elevation cross-section view of a embodiment of the gasification reactor; and

Fig. 2, is a detailed cross-section view of the reactor base in Fig. 1.

Detailed description of the drawings

[0020] The gasification reactor 1 in Fig. 1, is made up of a lining 4 which has an essentially outer cylindrical shape, housing an inner cavity which determines two parts 5, 6. The two parts 5, 6 are cylindrical and the upper part 5 is greater in diameter than the lower part 6, both being joined without interruption by an intermediate section shaped like an inverted truncated cone.

[0021] Thus, the lining 4 is thicker in the part corresponding to the lower part 6 of the inner cavity. Such an arrangement presents some advantages with regard to the existing reactors, such as greater simplicity in their construction, a reduction in the reactor's vibrations and an increased resistance against mechanical stress. The thicker part of the lining 4 is located in the reactor area where the movement of the particles forming the bed 2, gives rise to vibrations in the reactor and erode the lining when they hit the inner walls.

[0022] In addition, the concentration of the weight in the lower part of the reactor makes it possible to lower the centre of gravity of same, so the vibrations during the working of the reactor are reduced if it is suspended by the supports 9.

[0023] In the lower cylindrical area, corresponding to the lower part 6 of the inner cavity, the reactor 1 has an inlet for the material to be gasified 21, at least one inlet for the re-injection of the reclaimed tar 11 in the process subsequent to setting up the combustible gas, two inlets to introduce the bed constituent material or the catalysts contributing to the reaction 12, 13 and several inlets enabling secondary air 14 to be added.

[0024] Preferably, the height of the lower cylindrical part 6 of the gasification reactor 1, is double the vertical distance between the synthesis gas outlet pipe 15 and the lower base of the upper cylindrical part 5, and the respective radii of the different cylindrical parts verify the relationship $R=r\cdot2^{1/2}$, R being the inner radius of the upper cylindrical part 5 and r the inner radius of the lower cylindrical part 6.

[0025] The reactor lining 4 is, from outside to inside, preferably made up of one or more layers of refractory bricks arranged in quincunxes, a refractory stainless steel plate which acts as a shield for the solids contained in the bed, one or more layers of bricks with vibrated concrete, one or more layers of insulating brick and an outer carbon steel plate.

[0026] The interposition of a metal layer, such as refractory stainless steel, in the lining reduces the probability of the particles forming the bed 2, or the solids enclosed in the reactor 1 going through the inner layers of the lining and causing hot spots to appear on the outer surface of the reactor lining.

[0027] Fig. 2 shows, in detail, the base 3, or bottom, of the reactor 1. Just as can be observed in said figure, unlike the known reactors, the grid 18 through which the gasifying agent is introduced in the lower cylindrical part 6 of the reactor, is supported by a metal lining 19, preferably made of steel, which rests on the inner surface of the reactor base 3.

[0028] In the known systems, the grid is secured to the reactor walls, causing unwanted deformations when expanding due to the effect of the temperature and because their ends are fixed to the reactor walls.

[0029] With the arrangement of the grid over the lining 19, this problem is greatly reduced, as the grid ends are not fixed but are integral to a support which absorbs the dimensional variations that may be caused due to the effect of the temperature. In order to increase, if at all possible, the behaviour of an arrangement such as that in Fig. 2, the reactor base 3 can comprise insulating fibre, which would absorb the expansion that the lining may bear, and thus would not undergo mechanical stress in the grid 18 through the effect of the expansion of the materials composing it.

[0030] Naturally, the lining 19 is adapted to let through the gasifying agent which is introduced in the reactor through the pipe 17, which goes through the reactor base 3.

[0031] The density of the diffuser nozzles 20 arranged in the grid is approximately 15 nozzles per square metre, and the free space of the grid 18 remaining between the nozzles can be covered by refractory concrete.

[0032] In order to extract from the reactor 1 the unusable and heavy products deriving from the reaction, called slag, the reactor 1 is provided with a pipe 8, which connects the outside of the reactor 1 with the lower cylindrical part 6 of same, through which a vein of gasifying agent fluid is introduced into the reactor at sufficient speed to drag the particles from the bed 2, but not enough to drag the slag, so that the latter is introduced into the pipe 8 through the outlet 7 and is extracted from the reactor.

[0033] The reactor 1 is also provided with supports 9 arranged on the surface of the lining 4 at a height corresponding to the upper cylindrical part 5 of the reactor cavity. The supports 9 are adapted to support the weight of the reactor, so it is capable of being suspended by the supports 9, thus permitting the reactor 1 to expand vertically.

[0034] In order to further reduce the vibrations which may occur, it is also possible to have lateral cushioning means, such as lateral retention cushioning buffers below the supports 9 or a ring-shaped anchorage that clasps the lining.

[0035] The reactor base 3 in Figs. 1 and 2, is joined to the reactor lining 4 by fastening means 10. When the reactor is suspended from the supports, the base reactor 3 can be separated from the lining 4, greatly easing access to the interior of the reactor lower area, it being possible to carry out different maintenance or repair operations.

[0036] In the case of the Figs., both the reactor base 3 and lower circular end of the lining are provided with clamps, making it possible to couple the base 3 and the reactor lining 4. Naturally, the fastening means can be of another kind as long as they are easily removable or allow the base 3 to be uncoupled quickly and simply from the lining 4.

Claims

1. Gasification reactor (1), of the type which retains a fluidizable bed (2) of particulate material, wherein a flow of liquid or solid combustible is thermally decomposed through the action of a gasifying agent introduced in the reactor through a grid (18) placed at the bottom of same, into a combustible synthesis gas, which is evacuated through the upper part of the reactor, as ashes and slag, **characterised in that** it is made up of an essentially cylindrical outer configuration lining (4), which houses an inner cavity determined by two cylindrical parts, an upper (5) and lower one (6), the upper part (5) being of greater diameter than the lower one and the two parts being joined without interruption by an inverted truncated cone shaped intermediate part, wherein the thickness of the lining corresponding to the lower part is always greater than the thickness of the lining of the upper part of the reactor, said lining comprising one or more inner layers of refractory material, an intermediate refractory stainless steel plate, one or more layers of insulating material and an outer metal plate.

2. Reactor (1) according to claim 1, **characterised in that** it is provided with a pipe (8), which connects the reactor exterior with the lower cylindrical part (6) thereof, through which gasifying agent is injected at a greater speed than the drag speed of the material that forms the fluidized bed (2), but lower than the slag drag speed, allowing the slag to pass outwardly through the pipe and evacuating it without causing losses of the material which forms the bed.

3. Reactor (1) according to claims 1 or 2, **characterised in that** it is provided with support means (9), arranged on the lining (4) outer surface, adapted for bearing the weight of same and so that the latter can be suspended from said support means (9), allowing the reactor to expand vertically, and/or with lateral cushioning means which prevent it from moving horizontally.

4. Reactor (1), according to the previous claims, **characterised in that** the grid (18) through which the gasifying agent is introduced, is supported by a metal lining (19), resting on the inner surface of the reactor base (3).

5. Reactor (1), according to the previous claims, **characterised in that** the reactor base (3) can be separated from the rest of the reactor lining (4), to which it is joined by coupling means (10) which allow for it to be detachably fastened.

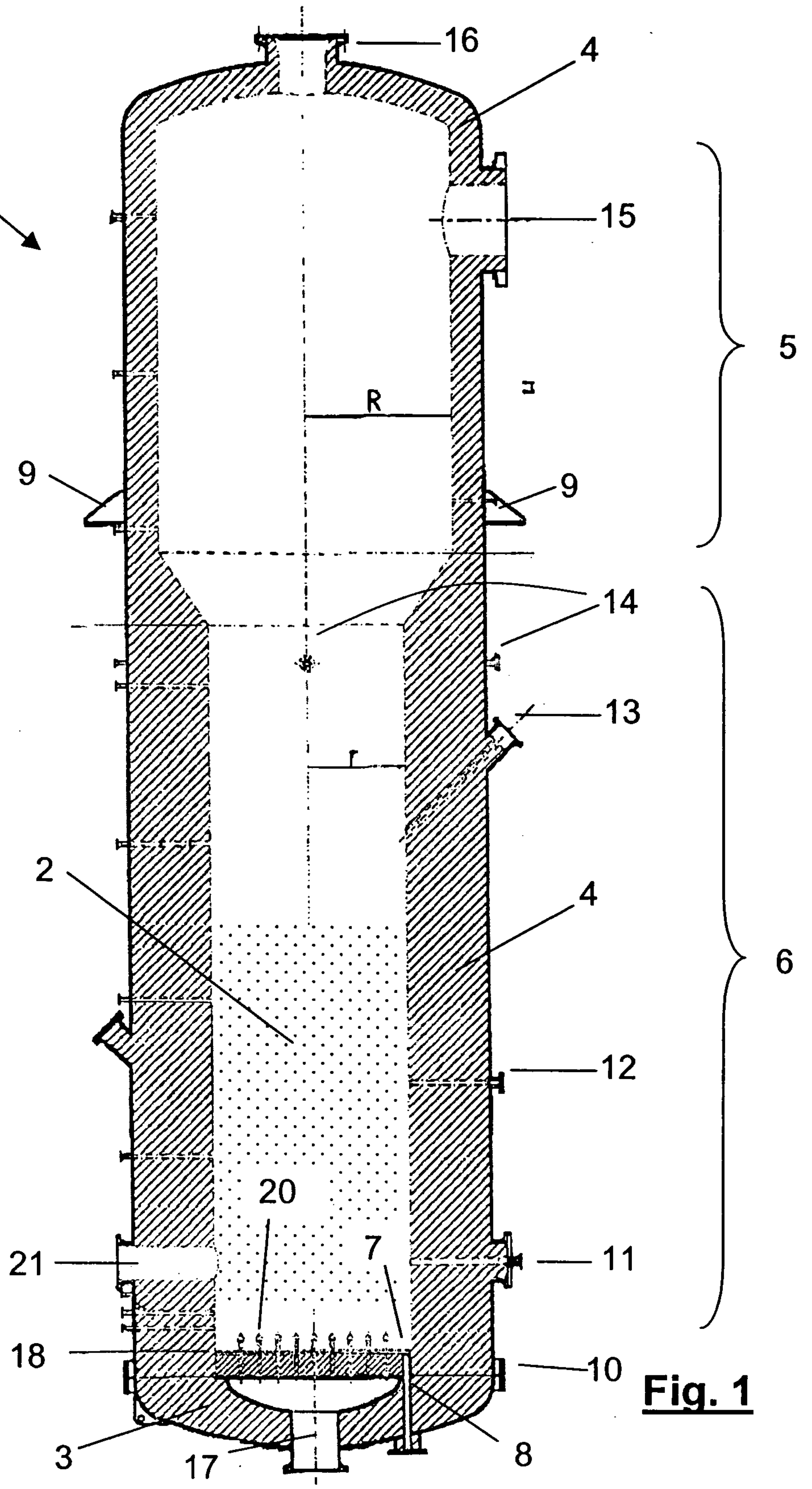

Fig. 1

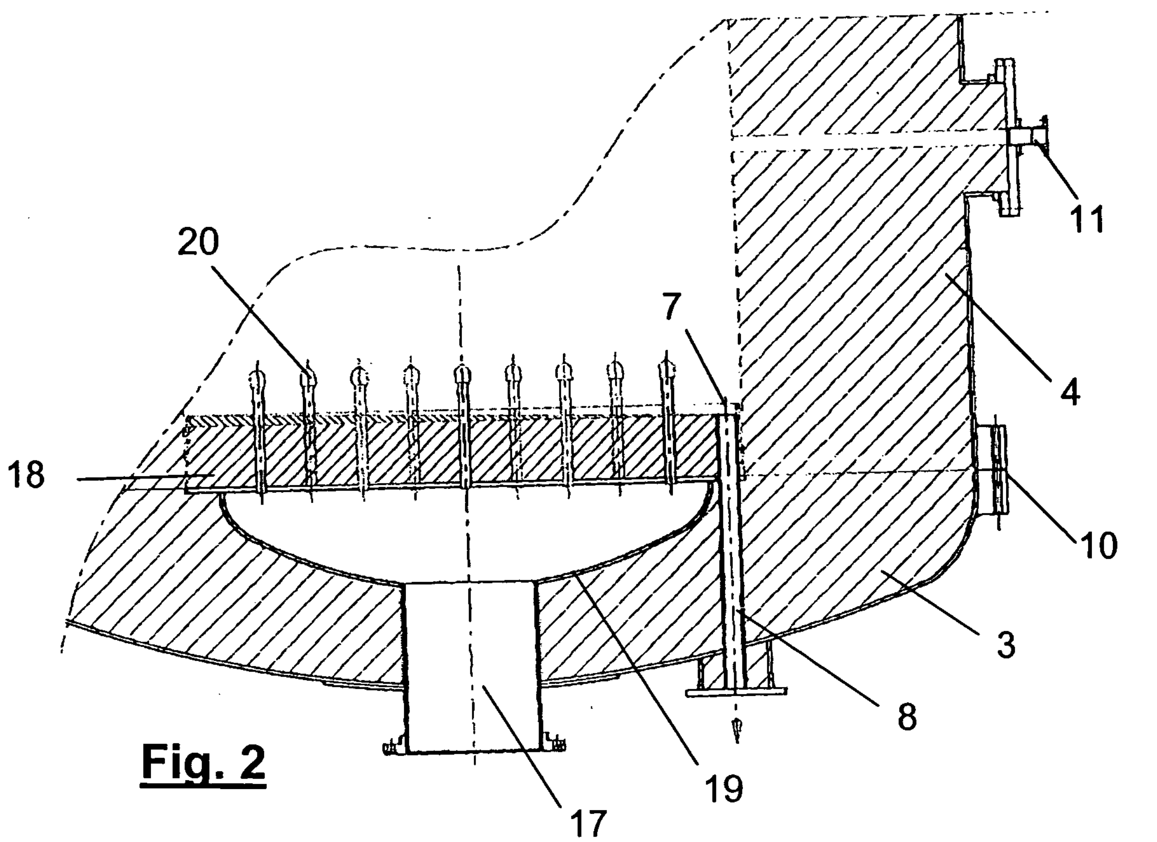

Fig. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 04 38 0018

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	27 May 2004	Lapeyrere, J

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