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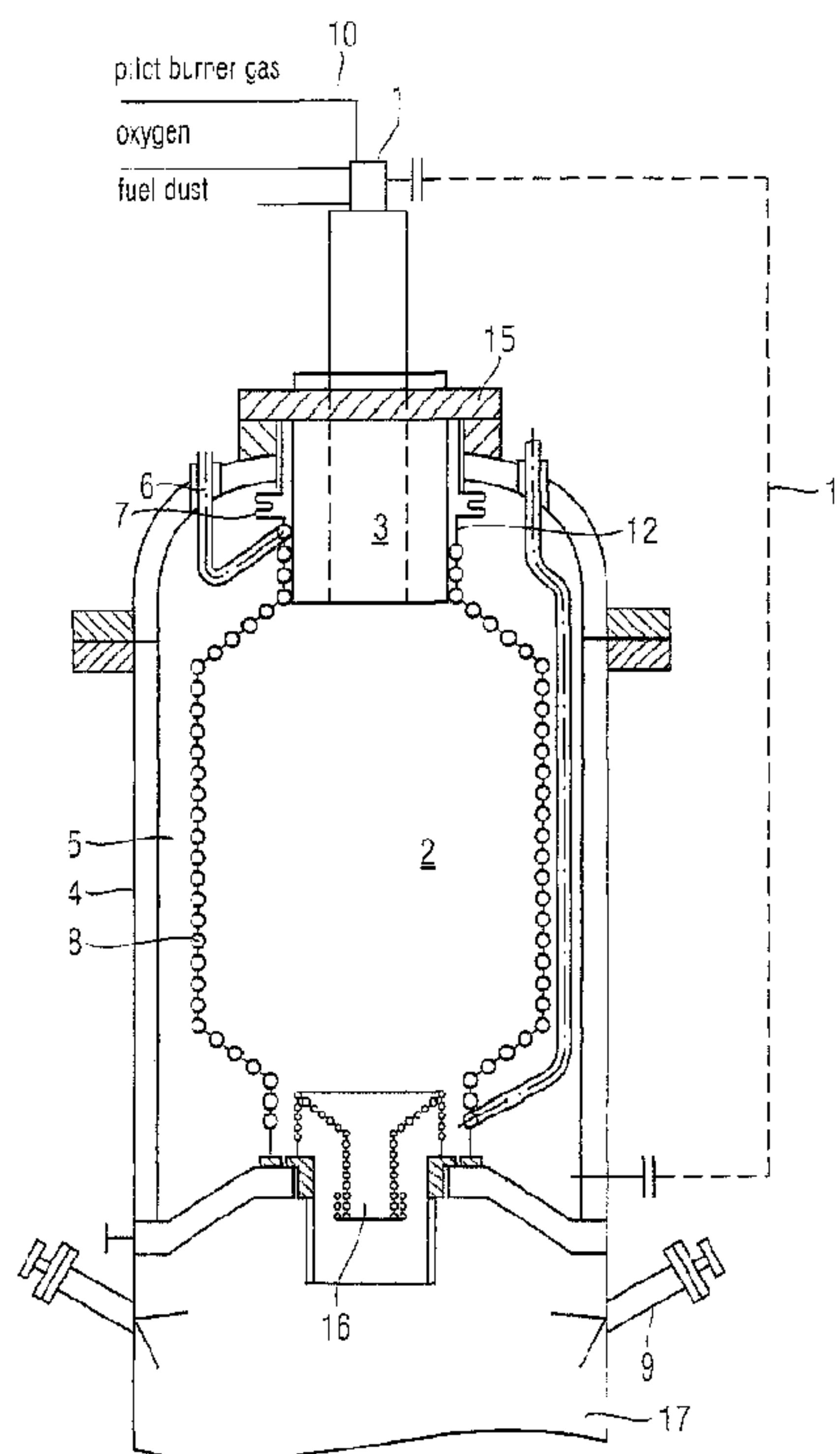
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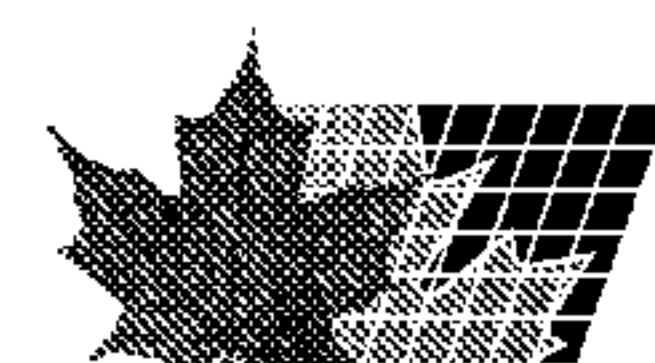
(54) **Titre : REACTEUR DE DEGAZEIFICATION A LIT ENTRAINE AVEC ECRAN DE REFROIDISSEMENT ET COMPENSATEUR A SOUFFLET**

(54) **Title: ENTRAINED-FLOW GASIFIER WITH COOLING SCREEN AND BELLOWS COMPENSATOR**



(57) **Abrégé/Abstract:**

In a reactor for the gasification of solid and liquid fuels in the entrained flow at temperatures between 1200 and 1900 °C and pressures between ambient pressure and 10 MPa with an oxidizing agent containing free oxygen, the cooling screen is connected in a gas-tight manner to the pressure shell via a bellows compensator to accommodate linear deformation. Continuous sweeping by gas of the annular gap between pressure shell and cooling screen is unnecessary and backflow by producer gas is prevented.





54106-166

## Abstract

Entrained-flow gasifier with cooling screen and bellows compensator

In a reactor for the gasification of solid and liquid fuels in  
5 the entrained flow at temperatures between 1200 and 1900 °C and  
pressures between ambient pressure and 10 MPa with an oxidizing  
agent containing free oxygen, the cooling screen is connected  
in a gas-tight manner to the pressure shell via a bellows  
compensator to accommodate linear deformation. Continuous  
10 sweeping by gas of the annular gap between pressure shell and  
cooling screen is unnecessary and backflow by producer gas is  
prevented.



54106-166

1

Entrained-flow gasifier with cooling screen and bellows compensator

The invention concerns a reactor for the gasification of solid and liquid fuels in the entrained flow.

- 5 The invention relates to a reactor for the entrained-flow gasification of different solid and liquid fuels with an oxidizing agent containing free oxygen under normal or increased pressure up to 8 MPa. Here solid fuels are pulverized coal dust from coals of differing ranks, petrol cokes and other
- 10 pulverizable solids having a calorific value exceeding 7 MJ/Nm<sup>3</sup>. Liquid fuels are oils or oil-solids or water-solids suspensions, such as coal-water slurries, for example. Autothermal entrained-flow gasification has been known for many years in gas generation technology using solid fuels. In this
- 15 case the ratio of fuel to oxygenic gasification agent is chosen so that temperatures are obtained which are above the melting point of ash. The ash is then melted to a liquid slag which leaves the gasification chamber along with the producer gas or separately and is then directly or indirectly cooled. Such a
- 20 device is disclosed in DE 197 181 317 A1.

- A detailed description of one such gasification reactor fitted with a cooling screen can be found in J. Carl et al, NOELL CONVERSION PROCESS, EF-Verlag for Power and Environmental Engineering GmbH 1996, pages 32-33. In the design described
- 25 there, a cooling screen consisting of gas-tight, welded cooling tubes is located inside a pressure vessel. This cooling screen is supported on a false bottom and can freely expand upwards. This ensures that the different temperatures due to start-up



54106-166

2

and shut-down processes and the resulting changes in length which occur, do not result in mechanical stresses which could possibly lead to destruction. In order to achieve this, there is no fixed connection at the upper end of the cooling screen, 5 but a gap between the collar of the cooling screen and the burner flange, which ensures free movement. In order to prevent backflow in the cooling screen gap during pressure fluctuations in the producer gas system, the cooling screen gap is swept with a dry, condensate-free and oxygen-free gas. As practical 10 experience shows, backflow with producer gas occurs in spite of sweeping - resulting in corrosion on the rear side of the cooling screen or on the pressure shell. This can lead to operational failures or even destruction of the cooling screen or pressure shell.

15 The object of the present invention is to avoid the cited disadvantages.

According to one aspect of the present invention, there is provided a reactor for the gasification of solid and liquid fuels in an entrained-flow at temperatures between 1200 and 20 1900°C. and pressures between ambient pressure and 10 MPa, comprising: a burner comprising a burner outlet; a pressure shell; a cooling screen comprising cooling tubes enclosing a gasification chamber, comprising a first end fixed with respect to the pressure shell and defining an outlet, and a second end 25 associated with the burner outlet, wherein the second end is free to thermally expand in a direction of a central axis of the reactor, and wherein the first end, the second end, the burner outlet, and the cooling screen are disposed concentric with the reactor central axis; a bellows compensator concentric



54106-166

2a

with the reactor central axis and connected to the cooling screen second end, configured to accommodate thermal expansion of the cooling screen wherein the pressure shell and cooling screen are separated by an annular gap disposed therebetween,

5 wherein the bellows compensator maintains gas-tightness between the annular gap and the gasification chamber, and a fluid conduit that provides fluid communication between pilot burner fuel gas upstream of the burner and the annular gap, effective to enable pressurization of the annular gap with pilot burner

10 fuel gas, wherein the reactor operates with an oxidizing agent containing free oxygen and on fuels selected from the group consisting of: finely-pulverized coals of differing ranks, petrol cokes, other solid carbonaceous materials, oils, oil-solids and water-solids suspensions, and wherein an

15 overpressure with respect to the gasification chamber is established and maintained in the annular gap between the pressure shell and the cooling screen by the fluid conduit such that the reactor operates with a steady state pressure difference.

20 According to the invention, a permanent connection between the cooling screen and the pressure shell or the upper reactor flange is proposed, which makes continuous sweeping with gas unnecessary and prevents backflow by producer gas. The permanent connection between cooling screen and pressure shell

25 is gas-tight and allows movement between cooling screen and pressure shell in the direction of the central axis of the reactor.



54106-166

2b

In another embodiment, technical measures are illustrated for the pressure regime between the gasification chamber and the cooling screen gap.

The invention is explained below by way of an exemplary  
5 embodiment to aid understanding, and with the aid of a figure, in which:

Figure 1 shows an inventive seal with a bellows compensator for compensating temperature-related linear deformation.



2007P19676

3

50 t of coal dust and 35,000 Nm<sup>3</sup> of steam, which are converted in the gasification chamber 2 to 75,000 Nm<sup>3</sup> of raw syngas at 3 MPa (30 bar) are fed per hour via a gasification burner 1, which also contains a pilot burner, to a gasification reactor as shown in Figure 1. The gasification burner 1 is arranged in a burner mounting device 3. The gasification chamber 2 is bounded by a cooling screen 8 formed by gas-tight, welded cooling tubes. The gasification temperature measured at the outlet device 16 is 1500°C. The hot producer gas along with the liquid slag resulting from the coal ash leaves the gasification chamber 2 via the outlet device 16 and reaches the cooling chamber 17, in which the raw producer gas is cooled to approximately 200 °C by being sprayed with cold water via the nozzles 9 and simultaneously being saturated with steam. The cooled raw gas is then fed to further gas conditioning technologies. An annular gap which has to be protected against underpressure and excessive overpressure, is located between the pressure shell 4 of the gasification reactor and the cooling screen 8. On the other hand it is advisable to maintain a low overpressure of 1 to 2 bar with respect to the gasification chamber 2. This is achieved, for example, by establishing a connection 11 from the gas of the pilot burner 10 to the annular gap 5. Since the pressure loss of the pilot fuel gas 10 in the burner is 1 to 2 bar, the slight overpressure in the annular gap 5 is assured by the connection 11. Naturally, this slight overpressure can also be provided by another gas source, for example from a nitrogen supply. In order to establish gas-tightness between the annular gap 5 and the gasification chamber 2, a permanent connection 12 is made to the pressure shell 4 at the upper end of the cooling screen 8. The permanent connection between cooling screen and pressure shell allows movement between the cooling screen and the pressure shell in the direction of the central axis of the reactor. In order to eliminate linear deformation of the cooling screen, which can occur during temperature variations in the gasification chamber 2, a



2007P19676

4

bellows compensator 7 is built into the permanent connection 12 between the cooling screen 8 and the pressure shell 4. The bellows compensator, which is essentially cylindrical, can be expanded or compressed in the direction of its central axis.

The resulting gap between the upper end of the cooling screen 8 and the burner mounting unit 3 is filled during assembly. The cooling water for the cooling screen 8 is fed in via the supply 6.



2007P19676

5

List of references:

- 1 Gasification burner with pilot burner
- 2 Gasification chamber
- 3 Burner mounting device
- 4 Pressure shell
- 5 Annular gap
- 6 Cooling water supply
- 7 Bellows compensator
- 8 Cooling screen
- 9 Nozzles
- 10 Pilot burner gas
- 11 Connecting pipe between pilot burner 10 and annular gap 5
- 12 Connection between cooling screen 8 and pressure shell 4
- 13
- 14
- 15 Cover flange
- 16 Outlet device
- 17 Quench chamber



54106-166

6

CLAIMS:

1. A reactor for the gasification of solid and liquid fuels in an entrained-flow at temperatures between 1200 and 1900°C. and pressures between ambient pressure and 10 MPa,  
5 comprising:

a burner comprising a burner outlet;

a pressure shell;

a cooling screen comprising cooling tubes enclosing a gasification chamber, comprising a first end fixed with respect  
10 to the pressure shell and defining an outlet, and a second end associated with the burner outlet, wherein the second end is free to thermally expand in a direction of a central axis of the reactor, and wherein the first end, the second end, the burner outlet, and the cooling screen are disposed concentric  
15 with the reactor central axis;

a bellows compensator concentric with the reactor central axis and connected to the cooling screen second end, configured to accommodate thermal expansion of the cooling screen wherein the pressure shell and cooling screen are  
20 separated by an annular gap disposed therebetween, wherein the bellows compensator maintains gas-tightness between the annular gap and the gasification chamber, and

a fluid conduit that provides fluid communication between pilot burner fuel gas upstream of the burner and the  
25 annular gap, effective to enable pressurization of the annular gap with pilot burner fuel gas,



54106-166

7

wherein the reactor operates with an oxidizing agent containing free oxygen and on fuels selected from the group consisting of: finely-pulverized coals of differing ranks, petrol cokes, other solid carbonaceous materials, oils, oil-  
5 solids and water-solids suspensions, and

wherein an overpressure with respect to the gasification chamber is established and maintained in the annular gap between the pressure shell and the cooling screen by the fluid conduit such that the reactor operates with a  
10 steady state pressure difference.

2. The reactor as claimed in claim 1, wherein the bellows compensator encloses the burner in a concentric manner.

3. The reactor as claimed in claim 1, wherein the annular gap between the pressure shell and the cooling screen  
15 is pressurized via an external gas supply.



200719676

1/1

