

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number:

**0 400 740
A1**

(12)

EUROPEAN PATENT APPLICATION

(21) Application number: **90201333.3**

(51) Int. Cl.⁵: **C10J 3/48**

(22) Date of filing: **23.05.90**

(30) Priority: **30.05.89 GB 8912316**

(43) Date of publication of application:
05.12.90 Bulletin 90/49

(84) Designated Contracting States:
BE DE DK ES GB IT NL SE

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(54) **Coal gasification reactor.**

(57) The slagging efficiency of a coal gasification process is increased to 90% by tangential firing at small angles and the installation of a stack of specific length over diameter ratio between the reactor outlet and the quench inlet. In this manner slag lifting and slag entrainment at the quench inlet -stack outlet are prevented.

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COAL GASIFICATION REACTOR

The present invention relates to a reactor for carrying out a partial oxidation process of a finely divided solid carbon-containing fuel and an oxidant.

Finely divided solid carbon-containing fuels are applied in processes for the preparation of synthesis gas by the partial combustion of a finely divided solid carbon-containing fuel with an oxygen-containing gas in a reactor wherein liquid slag formed during the partial combustion process is removed through an outlet in the bottom of the reactor and passed by gravity through a slag discharge means into a water bath or slag quenching vessel where it is solidified by quenching.

The partial combustion of finely divided solid carbon-containing fuel with substantially pure oxygen as oxygen-containing gas yields synthesis gas mainly consisting of carbon monoxide and hydrogen. When the oxygen-containing gas is air or oxygen-enriched air, the synthesis gas formed of course also contains a substantial quantity of nitrogen. By finely divided solid carbon-containing fuel is generally meant coal or another solid fuel, such as brown coal, peat, wood, coke, soot etc., but mixtures of liquid or gas and particulate solid fuels, are also possible.

Advantageously, a moderator is also introduced into the reactor. The object of the moderator is to exercise a moderating effect on the temperature on the reactor. This is ensured by endothermic reaction between the moderator and the reactants and/or products of the synthesis gas preparation. Suitable moderators are steam and carbon dioxide.

The gasification is advantageously carried out at a temperature in the range from 1200 to 1700 °C and at a pressure in the range from 1 to 200 bar.

The reactor in which the preparation of synthesis gas takes place may have any suitable shape.

The supply of finely divided solid carbon-containing fuel and oxygen-containing gas to the reactor can take place in any manner suitable for the purpose and will not be described in detail.

Liquid slag formed in the partial combustion reaction drops down and is drained through the outlet located in the reactor bottom.

In partial oxidation processes of finely divided solid carbon-containing fuels, such as for example coal gasification, the fuel is fed from a supply device to a gasifier by means of a suitable carrier fluid.

The hot product gas usually contains sticky particles which lose their stickiness upon cooling.

The sticky particles in the hot product gas will cause problems in the plant where the product gas is further processed, since undesirable deposits of

the particles on, for example, walls, valves or outlets will adversely affect the process. Moreover, such deposits are very hard to remove. The sticky particles may be partly or completely in the molten state; they may comprise metals, salts or ashes, and, in general, these particles lose their stickiness at a temperature below about 800 °C.

Therefore, the hot product gas is quenched in a quench section which is located above the product outlet on top of the reactor. In the quench section a suitable quench medium such as for example water or a gas is introduced into the product gas in order to cool the product gas.

It is known to apply tangentially fired burners in partial oxidation processes of finely divided solid carbon-containing fuels, i.e. a plurality of tangentially directed burners are located on the same horizontal level at circumferential spaced points of the wall of the reactor vessel and cause vortex flow in the reactor.

It has now appeared, however, that present reactor designs still have some disadvantages: the slagging efficiency is rather small (40-50%); there is a possibility for slag lifting to occur at the reactor outlet and short-circuiting of hot synthesis gas out of the reactor into the quench may occur.

It is an object of the invention to provide a reactor design which has a slagging efficiency of 90-95%.

It is another object of the invention to provide a reactor design wherein slag lifting and slag droplet entrainment is prevented.

It is still another object of the invention to provide a reactor design wherein said short-circuiting of synthesis gas is prevented.

The invention therefore provides a reactor for carrying out a partial oxidation process of a finely divided solid carbon-containing fuel and an oxidant, said reactor comprising a reactor vessel having an outlet for the product gas at its top, a slag outlet at its bottom, a plurality of burner openings in its side wall, a plurality of tangentially directed burners located on the same horizontal level at circumferential spaced points, with a small firing angle, the reactor being provided with a quench above its outlet, wherein a stack having a predetermined length-to-diameter ratio is located between the reactor outlet and the quench inlet.

The term firing angle is defined as the angle between the symmetry axis of the burner jet and the line through the centre of the burner and the centre of the reactor at the same horizontal level.

The invention will now be described by way of example in more detail by reference to the accompanying drawings, in which:

- fig. 1 represents schematically a longitudinal section of a conventional reactor and quench section;

- fig. 2 represents schematically a longitudinal section of a reactor design of the invention;

- fig. 3a represents a cross-section along the lines I-I of fig. 1, and

- fig. 3b represents a cross-section along the lines II-II of fig. 2.

Referring now to fig. 1, a reactor vessel 1 has been shown. The reactor vessel 1 is provided with a slag outlet 2 at its bottom, a plurality of tangentially fired burners 3, a gas outlet 4 at its top and a quench system 5 comprising a quench inlet 5a above the reactor outlet 4. The tangentially directed burners 3 are located on the same horizontal level at circumferential spaced points and cause vortex flow in the reactor vessel 1.

The quench system 5 is at its outlet 6 connected to equipment for further treating the synthesis gas. Such equipment is known to those skilled in the art and will not be described in detail. In fig. 2 the same reference numerals have been used as in fig. 1.

In fig. 2 the reactor 1 is provided with an extended pipe or stack 4a at its outlet 4. This extension is located between the reactor outlet 4 and the quench inlet 5a and has a predetermined length-to-diameter ratio L_s/D_s .

The quench system 5 is located remote from the reactor outlet. Advantageously, L_s/D_s is 4 to 6 and more in particular L_q/D_q is 5 (as shown in fig. 2).

Further, in fig. 2, the quench system 5 has a length-to-diameter ratio $L_q/D_q = 3$ and the reactor 1 has a length-to-diameter ratio $L_r/D_r = 3$.

Fig. 3a represents a tangential burner arrangement comprising 4 burners A, B, C, D. The burners are arranged horizontally and are directed to a central point E, which means that the firing angles are 0 degrees.

Fig. 3b represents a tangential burner arrangement of the invention comprising 4 burners A', B', C', D' wherein the firing angles are 5 degrees. Advantageously, the firing angles according to the present invention are in the range of 3 to 5 degrees. The burners are directed to a central circle E' having a determined area.

When the reactor design of the invention is used, large centrifugal forces inside the stack will cause a large settling velocity and thus a large slagging efficiency, since most of the slag will be deposited in the lower part of the pipe extension, it is possible to decrease the swirl of the product gas by either installing cross hairs or by a further narrowing of the pipe. This will prevent cold syngas from re-entering the reactor.

The stack will also reduce the turbulence of the

syngas. This reduction and the fact that the stack wall immediately below the quench inlet is vertical and thus much steeper than the reactor roof in fig. 1 will be beneficial to prevent slag lifting or slag entrainment.

Finally the stack will reduce flow short-circuiting. Thus the breakthrough times toward the reactor outlet increase. Consequently the conversion is enhanced and the outlet temperature may decrease.

Various modifications of the present invention will become apparent to those skilled in the art from the foregoing description and accompanying drawings. Such modifications are intended to fall within the scope of the appended claims.

Claims

1. A reactor for carrying out a partial oxidation process of a finely divided solid carbon-containing fuel and an oxidant, said reactor comprising a reactor vessel having an outlet for the product gas at its top, a slag outlet at its bottom, a plurality of burner openings in its side wall, a plurality of tangentially directed burners located on the same horizontal level at circumferential spaced points, with a small firing angle, the reactor being provided with a quench above its outlet, wherein a stack having a predetermined length-to-diameter ratio is located between the reactor outlet and the quench inlet.

2. The reactor as claimed in claim 1 wherein the stack has a length-to-diameter ratio of 4 to 6.

3. The reactor as claimed in claim 2 wherein the stack has a length-to-diameter ratio of 5.

4. The reactor as claimed in any one of claims 1-3 wherein the firing angle is 3 to 5 degrees.

5. Reactor for carrying out a partial oxidation process of a finely divided solid carbon-containing fuel and an oxidant, substantially as described in the specification by reference to fig. 2 and 3B of the accompanying drawings.

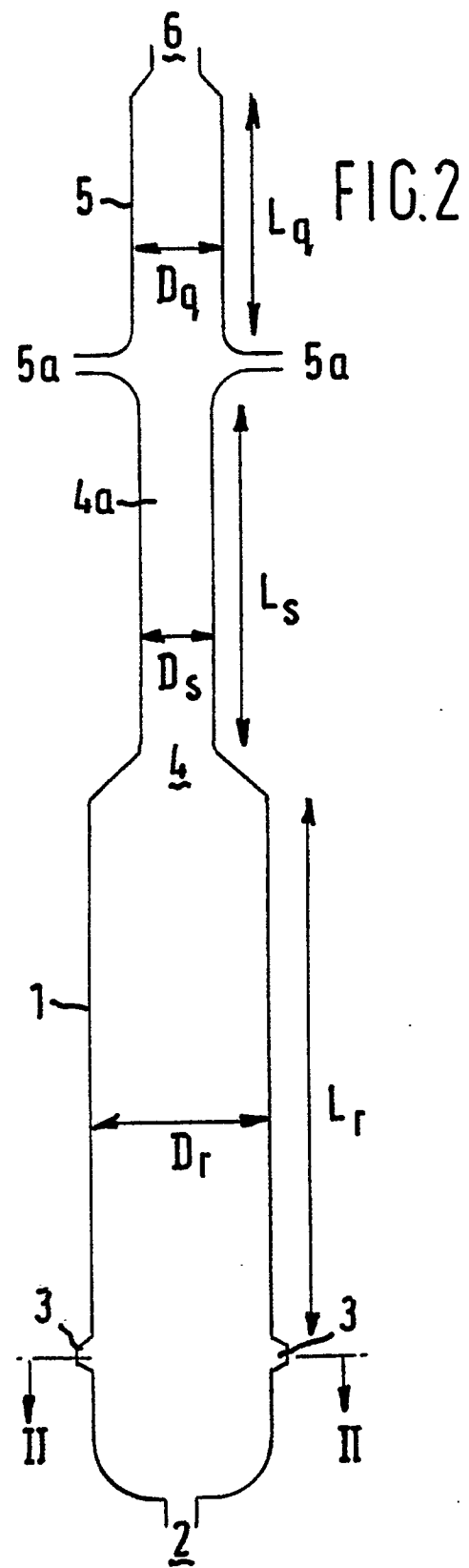
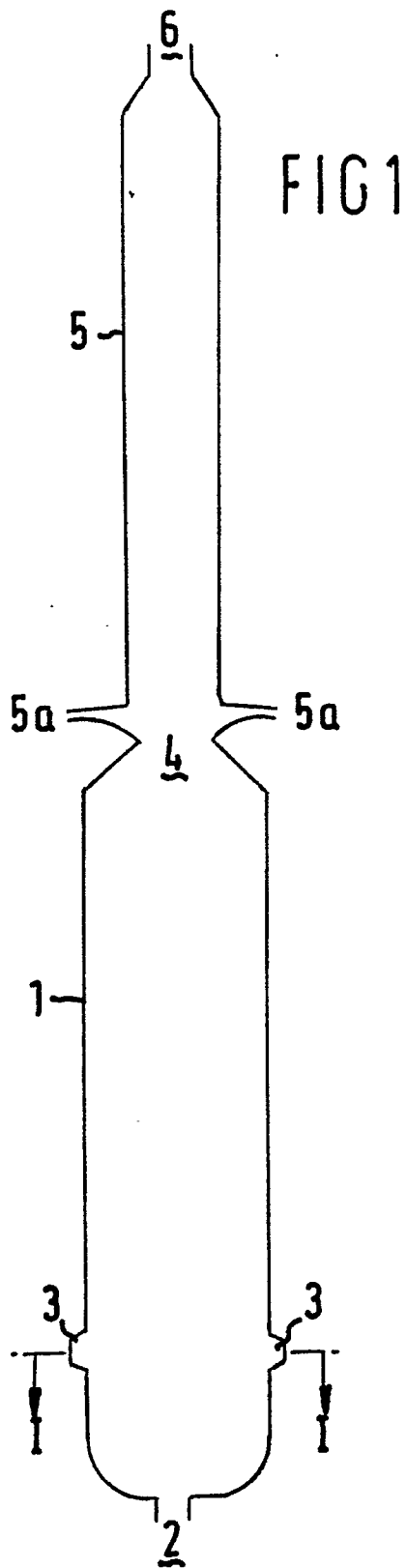


FIG. 3a

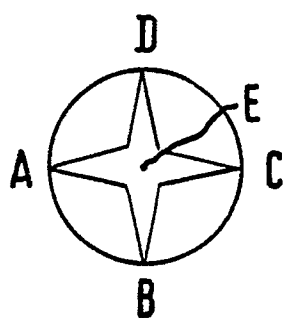
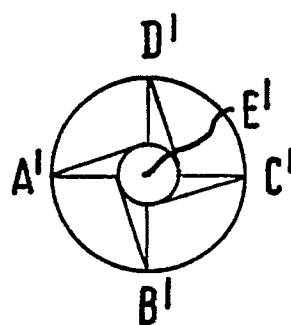


FIG. 3b





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EUROPEAN SEARCH REPORT

Application Number

EP 90 20 1333

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	GB-A- 718 410 (THE BABCOCK & WILCOX) * Page 4, lines 51-120; page 5, lines 106-117 * ---	1	C 10 J 3/48
A	GB-A- 840 699 (SUMITOMO CHEM.) * Page 5, line 109 - page 6, line 70 * ---	1	
A	GB-A- 840 700 (SUMITOMO CHEM.) * Page 5, line 87 - page 6, line 3 * ---	1	
A	DE-C- 911 313 (KOPPERS) * Page 2, lines 119-126 * ---	1	
A	EP-A-0 050 863 (HITACHI) * Page 24, line 7 - page 25, line 21 * -----	1	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			C 10 J
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 06-09-1990	Examiner WENDLING J.P.
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