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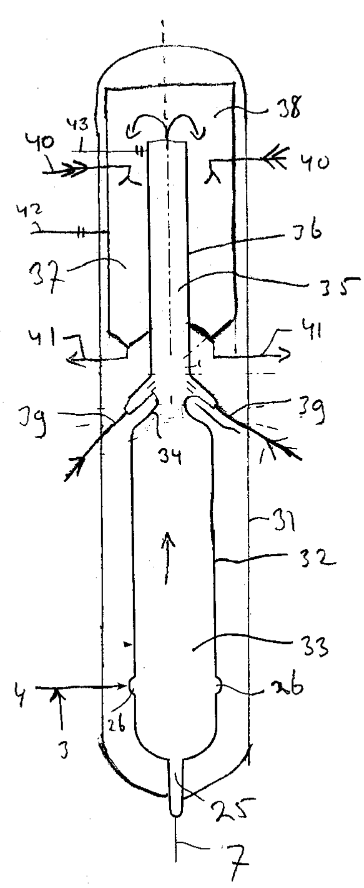

(57) Abstract: The present invention relates to a method of producing synthesis gas comprising CO, CO2 , and H2 from a carbonaceous stream (3) using an oxygen containing stream (4) , the method comprising at least the steps of : (a) injecting a carbonaceous stream (3) and an oxygen containing stream (4) into a gasification reactor (2) ; (b) at least partially oxidising the carbonaceous stream (3) in the gasification reactor (2) , thereby- obtaining a raw synthesis gas; (c) removing the raw synthesis gas obtained in step (b) from the gasification reactor (2) into a quenching section (6) ; and (d) injecting a liquid (17) , preferably water, into the quenching section (2) in the form of a mist. In a further aspect the present invention relates to a system (1) for performing the method.

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METHOD AND SYSTEM FOR PRODUCING SYNTHESIS GAS

The present invention relates to a method for producing synthesis gas comprising CO, CO_2, and H_2 from a carbonaceous stream using an oxygen containing stream. The invention is also directed to an improved gasification reactor for performing said method. The invention is also directed to a gasification system for performing said method.

Methods for producing synthesis gas are well known from practice. An example of a method for producing synthesis gas is described in EP-A-0 400 740. Generally, a carbonaceous stream such as coal, brown coal, peat, wood, coke, soot, or other gaseous, liquid or solid fuel or mixture thereof, is partially combusted in a gasification reactor using an oxygen containing gas such as substantially pure oxygen or (optionally oxygen enriched) air or the like, thereby obtaining a.o. synthesis gas (CO and H_2), CO_2 and a slag. The slag formed during the partial combustion drops down and is drained through an outlet located at or near the reactor bottom.

The hot product gas, i.e. raw synthesis gas, usually contains sticky particles that lose their stickiness upon cooling. These sticky particles in the raw synthesis gas may cause problems downstream of the gasification reactor where the raw synthesis gas is further processed, since undesirable deposits of the sticky particles on, for example, walls, valves or outlets may adversely affect the process. Moreover such deposits are hard to remove.

Therefore, the raw synthesis gas is quenched in a quench section which is located downstream of the gasification reactor. In the quench section a suitable quench medium such as water vapour is introduced into the raw synthesis gas in order to cool it.

A problem of producing synthesis gas is that it is a highly energy consuming process. Therefore, there exists a constant need to improve the efficiency of the process, while at the same time minimizing the capital investments needed.

It is an object of the present invention to at least minimize the above problem.

It is a further object to provide an alternative method for producing synthesis gas.

One or more of the above or other objects can be achieved according the present invention by providing a method of producing synthesis gas comprising CO, CO_2, and H_2 from a carbonaceous stream using an oxygen containing stream, the method comprising at least the steps of:

(a) injecting a carbonaceous stream and an oxygen containing stream into a gasification reactor;

(b) at least partially oxidising the carbonaceous stream in the gasification reactor, thereby obtaining a raw synthesis gas;

(c) removing the raw synthesis gas obtained in step (b) from the gasification reactor into a quenching section; and

(d) injecting a liquid into the quenching section in the form of a mist.

It has surprisingly been found that by injecting a liquid, preferably water, in the form of a mist, the process as a whole can be performed more efficiently.

Further it has been found that the raw synthesis gas is cooled very efficiently, as a result of which less deposits of sticky particles downstream of the gasification reactor occur.

The liquid may be any liquid having a suitable viscosity in order to be atomized. Non-limiting examples of the liquid to be injected are a hydrocarbon liquid, a waste stream etc. Preferably the liquid comprises at least 50% water. Most preferably the liquid is substantially comprised of water (i.e. > 95 vol%). In a preferred embodiment the wastewater, also referred to as black water, as obtained in a possible downstream synthesis gas scrubber is used as the liquid.

The person skilled in the art will readily understand what is meant by the terms 'carbonaceous stream', 'oxygen containing stream', 'gasification reactor' and 'quenching section'. Therefore, these terms will not be further discussed. According to the present invention, as a carbonaceous stream preferably a solid, high carbon containing feedstock is used; more preferably it is substantially (i.e. > 90 wt.%) comprised of naturally occurring coal or synthetic cokes.

With the term 'raw synthesis gas' is meant that this product stream may - and usually will - be further processed, e.g. in a dry solid remover, wet gas scrubber, a shift converter or the like.

With the term 'mist' is meant that the liquid is injected in the form of small droplets. The liquid may contain small amounts of vapour. If water is to be used as the liquid, then preferably more than 80%, more preferably more than 90%, of the water is in the liquid state.

Preferably the injected mist has a temperature of at most 50 °C below the bubble point at the prevailing pressure conditions at the point of injection, particularly at most 15 °C, even more preferably at most 10 °C below the bubble point. To this end, if the injected liquid is water, it usually has a temperature of above 90 °C, preferably above 150 °C, more preferably from 200 °C to 230 °C. The temperature will obviously depend on the operating pressure of the gasification reactor, i.e. the pressure of the raw synthesis as specified further below. Hereby a rapid vaporization of the injected mist is obtained, while cold spots are avoided. As a result the risk of ammonium chloride deposits and local attraction of ashes in the gasification reactor is reduced.

Further it is preferred that the mist comprises droplets having a diameter of from 50 to 200 μm, preferably from 100 to 150 μm. Preferably, at least 80 vol.% of the injected liquid is in the form of droplets having the indicated sizes.

To enhance quenching of the raw synthesis gas, the mist is preferably injected with a velocity of 30-90 m/s, preferably 40-60 m/s.

Also it is preferred that the mist is injected with an injection pressure of at least 10 bar above the pressure of the raw synthesis gas, preferably from 20 to 60 bar, more preferably about 40 bar, above the pressure of the raw synthesis gas. If the mist is injected with an injection pressure of below 10 bar above the pressure of the raw synthesis gas, the droplets of the mist may become too large. The latter may be at least partially offset by using an atomisation gas, which may e.g. be N_2, CO_2, steam or synthesis gas. Using atomisation gas has the additional advantage that the difference between injection pressure and the pressure of the raw synthesis gas may be reduced.

According to an especially preferred embodiment, the amount of injected mist is selected such that the raw synthesis gas leaving the quenching sections comprises at least 40 vol.% H_2O, preferably from 40 to 60 vol.% H_2O, more preferably from 45 to 55 vol.% H_2O.

In another preferred embodiment the amount of water added relative to the raw synthesis gas is even higher than the preferred ranges above if one chooses to perform a so-called overquench. In an overquench type process the amount of water added is such that not all liquid water will evaporate and some liquid water will remain in the cooled raw synthesis gas. Such a process is advantageous because a downstream dry solid removal system can be omitted. In such a process the raw synthesis gas leaving the gasification reactor is saturated with water. The ratio of the raw synthesis gas and water injection can be 1:1 to 1:4.

It has been found that herewith the capital costs can be substantially lowered, as no further addition of water downstream of the gasification reactor is necessary.

Further it has been found especially suitable when the mist is injected in a direction away from the gasification reactor, or said otherwise when the mist is injected in the flow direction of the raw synthesis gas. Hereby no or less dead spaces occur which might result in local deposits on the wall of the quenching section. Preferably the mist is injected under an angle of between 30-60°, more preferably about 45°, with respect to a plane perpendicular to the longitudinal axis of the quenching section.

According to a further preferred embodiment, the injected mist is at least partially surrounded by a shielding fluid. Herewith the risk of forming local deposits is reduced. The shielding fluid may be any suitable fluid, but is preferably selected from the group consisting of an inert gas such as N_2 and CO_2, synthesis gas, steam and a combination thereof.

In the method of the present invention, the raw synthesis gas leaving the quenching section is usually shift converted whereby at least a part of the water is reacted with CO to produce CO_2 and H_2 thereby obtaining a shift converted synthesis gas stream. As the person skilled in the art will readily understand what is meant with a shift converter, this is not further discussed. Preferably, before shift converting the raw synthesis gas, the raw synthesis gas is heated in a heat exchanger against the shift converted synthesis gas stream. Herewith the energy consumption of the method is further reduced. In this respect it is also preferred that the mist is heated before injecting it in step (d) by indirect heat exchange against the shift converted synthesis gas stream.

In another aspect the present invention provides a system suitable for performing the method of the invention, the system at least comprising:

- a gasification reactor having an inlet for an oxygen containing stream, an inlet for a carbonaceous stream, and downstream of the gasification reactor an outlet for raw synthesis gas produced in the gasification reactor;
- a quenching section connected to the outlet of the gasification reactor for the raw synthesis gas;

wherein the quenching section comprises at least one first injector adapted for injecting a liquid, preferably water, in the quenching section in the form of a mist.

The person skilled in the art will readily understand how to select the first injector to obtain the desired mist. Also more than one first injector may be present.

Preferably the first injector in use injects the mist in a direction away from the gasification reactor, usually in a partially upward direction. To this end the centre line of the mist injected by the first injector forms an angle of between 30-60°, preferably about 45°, with respect to the plane perpendicular to the longitudinal axis of the quenching section.

Further it is preferred that the quenching section comprises a second injector adapted for injecting a shielding fluid at least partially surrounding the mist injected by the at least one first injector. Also in this case the person skilled in the art will readily understand how to adapt the second injector to achieve the desired effect. For instance, the nozzle of the first injector may be partly surrounded by the nozzle of the second injector.

The quenching section wherein the liquid mist is injected may be situated above, below or next to the gasification reactor, provided that it is downstream of the gasification reactor, as the raw synthesis gas produced in the gasification reactor is cooled in the quenching section. Preferably the quenching section is placed above the gasification reactor; to this end the outlet of the gasification reactor will be placed at the top of the gasification reactor.

In a preferred embodiment the raw synthesis gas is cooled to a temperature below the solidification temperature of the non-gaseous components before injecting the liquid in the form of a mist according to the present invention. The solidification temperature of the non-gaseous components in the raw synthesis gas will depend on the carbonaceous feedstock and is usually between 600 and 1200 °C and more especially between 500 and 1000 °C, for coal type feedstocks. This initial cooling may be performed by injecting synthesis gas, carbon dioxide or steam having a lower temperature than the raw synthesis gas, or by injecting a liquid in the form of a mist according to the present invention. In such a two-step cooling method step (b) may be performed in a downstream separate apparatus or more preferably within the same apparatus as in which the gasification takes place. Figure 3 will illustrate a preferred gasification reactor in which first and second injection may be performed with the same pressure shell. Figure 4 will illustrate a preferred embodiment wherein the second injection is performed in a separate quench vessel.

The invention is also directed to a novel gasification reactor suited for performing the method of the present invention as described below. Gasification reactor comprising:

- a pressure shell for maintaining a pressure higher than atmospheric pressure;

- a slag bath located in a lower part of the pressure shell;

- a gasifier wall arranged inside the pressure shell defining a gasification chamber wherein during operation the synthesis gas can be formed, a lower open part of the gasifier wall which is in fluid communication with the slag bath and an open upper end of the gasifier wall which is in fluid communication with a quench zone;

- a quench zone comprising a tubular formed part positioned within the pressure shell, open at its lower and upper end and having a smaller diameter than the pressure shell thereby defining an annular space around the tubular part , wherein the lower open end is fluidly connected to the upper end of the gasifier wall and the upper open end is in fluid communication with the annular space;

- wherein at the lower end of the tubular part injecting means are present for injecting a liquid or gaseous cooling medium and wherein in the annular space injecting means are present to inject a liquid in the form of a mist and wherein an outlet for synthesis gas is present in the wall of the pressure shell fluidly connected to said annular space.

The invention is also directed to a novel gasification system suited for performing the method of the present invention comprising a gasification reactor and a quench vessel wherein the gasification reactor comprises:

- a pressure shell for maintaining a pressure higher than atmospheric pressure;

- a slag bath located in a lower part of the pressure shell;

- a gasifier wall arranged inside the pressure shell defining a gasification chamber wherein during operation the synthesis gas can be formed, a lower open part of the gasifier wall which is in fluid communication with the slag bath and an open upper end of the gasifier wall which is in fluid communication with a vertically extending tubular part, which tubular part is open at its lower and upper end, the upper end being in fluid communication with a synthesis gas inlet of the quench vessel and wherein the tubular part provided with means to add a liquid or gaseous cooling medium at its lower end;,

- wherein the quench vessel is provided at its top end with a synthesis gas inlet, with injecting means to inject a liquid in the form of a mist into the synthesis gas and with an outlet for synthesis gas.

The invention will now be described by way of example in more detail with reference to the accompanying non-limiting drawings, wherein:

Figure 1 schematically shows a process scheme for performing a method according the present invention; and

Figure 2 schematically shows a longitudinal cross-section of a gasification reactor used in the system according to the present invention.

Figure 3 schematically shows a longitudinal cross-section of a preferred gasification reactor, which may be used in a preferred the system according to the present invention.

Figure 4 shows a gasification reactor system for performing the two-step cooling method making use of a downstream separate apparatus.

Same reference numbers as used below refer to similar structural elements.

Reference is made to Figure 1. Figure 1 schematically shows a system 1 for producing synthesis gas. In a gasification reactor 2 a carbonaceous stream and an oxygen containing stream may be fed via lines 3, 4, respectively.

The carbonaceous stream is at least partially oxidised in the gasification reactor 2, thereby obtaining a raw synthesis gas and a slag. To this end usually several burners (not shown) are present in the gasification reactor 2. Usually, the partial oxidation in the gasification is carried out at a temperature in the range from 1200 to 1800 °C and at a pressure in the range from 1 to 200 bar, preferably between 20 and 100 bar.

The produced raw synthesis gas is fed via line 5 to a quenching section 6; herein the raw synthesis gas is usually cooled to about 400 °C. The slag drops down and is drained through line 7 for optional further processing.

The quenching section 6 may have any suitable shape, but will usually have a tubular form. Into the quenching section 6 liquid water is injected via line 17 in the form of a mist, as will be further discussed in Figure 2 below.

The amount of mist to be injected in the quenching section 6 will depend on various conditions, including the desired temperature of the raw synthesis gas leaving the quenching section 6. According to a preferred embodiment of the present invention, the amount of injected mist is selected such that the raw synthesis gas leaving the quenching section 6 has a H_2O content of from 45 to 55 vol.%.

As shown in the embodiment of Figure 1, the raw synthesis gas leaving the quenching section 6 is further processed. To this end, it is fed via line 8 into a dry solids removal unit 9 to at least partially remove dry ash in the raw synthesis gas. As the dry solids removal unit 9 is known per se, it is not further discussed here. Dry ash is removed form the dry solids removal unit via line 18.

After the dry solids removal unit 9 the raw synthesis gas may be fed via line 10 to a wet gas scrubber 11 and subsequently via line 12 to a shift converter 13 to react at least a part of the water with CO to produce CO_2 and H_2, thereby obtaining a shift converted gas stream in line 14. As the wet gas scrubber 11 and shift converter 13 are already known per se, they are not further discussed here in detail. Waste water from gas scrubber 11 is removed via line 22 and optionally partly recycled to the gas scrubber 11 via line 23.

It has surprisingly been found that according to the present invention, the vol.% water of the stream leaving the quenching section 6 in line 8 is already such that the capacity of the wet gas scrubber 11 may be substantially lowered, resulting in a significant reduction of capital expenses.

Further improvements are achieved when the raw synthesis gas in line 12 is heated in a heat exchanger 15 against the shift converted synthesis gas in line 14 that is leaving the shift converter 13.

Further it is preferred according to the present invention that energy contained in the stream of line 16 leaving heat exchanger 15 is used to warming up the water in line 17 to be injected in quenching section 6. To this end, the stream in line 16 may be fed to an indirect heat exchanger 19, for indirect heat exchange with the stream in line 17.

As shown in the embodiment in Figure 1, the stream in line 14 is first fed to the heat exchanger 15 before entering the indirect heat exchanger 19 via line 16. However, the person skilled in the art will readily understand that the heat exchanger 15 may be dispensed with, if desired, or that the stream in line 14 is first fed to the indirect heat exchanger 19 before heat exchanging in heat exchanger 15.

The stream leaving the indirect heat exchanger 19 in line 20 may be further processed, if desired, for further heat recovery and gas treatment.

If desired the heated stream in line 17 may also be partly used as a feed (line 21) to the gas scrubber 11.

Figure 2 shows a longitudinal cross-section of a gasification reactor 2 used in the system 1 of Figure 1.

The gasification reactor 2 has an inlet 3 for a carbonaceous stream and an inlet 4 for an oxygen containing gas.

Usually several burners (schematically denoted by 26) are present in the gasification reactor 2 for performing the partial oxidation reaction. However, for reasons of simplicity, only two burners 26 are shown here.

Further, the gasification reactor 2 comprises an outlet 25 for removing the slag formed during the partial oxidation reaction via line 7.

Also, the gasification reactor 2 comprises an outlet 27 for the raw synthesis gas produced, which outlet 27 is connected with the quenching section 6. The skilled person will readily understand that between the outlet 27 and the quenching section 6 some tubing may be present (as schematically denoted with line 5 in Figure 1). However, usually the quenching section 6 is directly connected to the gasification reactor 2, as shown in Figure 2.

The quenching section 6 comprises a first injector 28 (connected to line 17) that is adapted for injecting a water containing stream in the form of a mist in the quenching section.

As shown in Figure 2, the first injector in use injects the mist in a direction away from the outlet 27 of the gasification reactor 2. To this end the centre line *X* of the mist injected by the first injector 28 forms an angle α of between 30-60°, preferably about 45°, with respect to the plane *A-A* perpendicular to the longitudinal axis *B-B* of the quenching section 6.

Preferably, the quenching section also comprises a second injector 29 (connected via line 30 to a source of shielding gas) adapted for injecting a shielding fluid at least partially surrounding the mist injected by the at least one first injector 28. As shown in the embodiment of Figure 2 the first injector 28 is to this end partly surrounded by second injector 29.

As already discussed above in respect of Figure 1, the raw synthesis gas leaving the quenching section 6 via line 8 may be further processed.

Figure 3 illustrates a preferred gasification reactor comprising the following elements:

- a pressure shell (31) for maintaining a pressure higher than atmospheric pressure;

- an outlet 25 for removing the slag, preferably by means of a so-called slag bath, located in a lower part of the pressure shell (31);

- a gasifier wall (32) arranged inside the pressure shell (31) defining a gasification chamber (33) wherein during operation the synthesis gas can be formed, a lower open part of the gasifier wall (32) which is in fluid communication with the outlet for removing slag (25). The open upper end (34) of the gasifier wall (32) is in fluid communication with a quench zone (35);

- a quench zone (35) comprising a tubular formed part (36) positioned within the pressure shell (31), open at its lower and upper end and having a smaller diameter than the pressure shell (31) thereby defining an annular space (37) around the tubular part (36). The lower open end of the tubular formed part (36) is fluidly connected to the upper end of the gasifier wall (32). The upper open end of the tubular formed part (36) is in fluid communication with the annular space (37) via deflector space (38).

At the lower end of the tubular part (36) injecting means (39) are present for injecting a liquid or gaseous cooling medium. Preferably the direction of said injection as described for Figure 2 in case of liquid injections. In the annular space (37) injecting means (40) are present to inject a liquid in the form of a mist, preferably in a downwardly direction, into the synthesis gas as it flows through said annular space (37). Figure 3 further shows an outlet (41) for synthesis gas is present in the wall of the pressure shell (31) fluidly connected to the lower end of said annular space (37). Preferably the quench zone is provided with cleaning means (42) and/or (43), which are preferably mechanical rappers, which by means of vibration avoids and/or removes solids accumulating on the surfaces of the tubular part and/or of the annular space respectively.

The advantages of the reactor according to Figure 3 are its compactness in combination with its simple design. By cooling with the liquid in the form of a mist in the annular space additional cooling means in said part of the reactor can be omitted which makes the reactor more simple. Preferably both via injectors (39) and injectors (40) a liquid, preferably water, is injected in the form of a mist according to the method of the present invention.

Figure 4 illustrates an embodiment for performing the two-step cooling method making use of a separate apparatus. Figure 4 shows the gasification reactor (43) of Figure 1 of WO-A-2004/005438 in combination with a downstream quench vessel (44) fluidly connected by transfer duct (45). The system of Figure 4 differs from the system disclosed in Figure 1 of WO-A-2004/005438 in that the syngas cooler 3 of said Figure 1 is omitted and replaced by a simple vessel comprising means (46) to add a liquid cooling medium. Shown in Figure 4 is the gasifier wall (47), which is connected to a tubular part (51), which in turn is connected to an upper wall part (52) as present in quench vessel (44). At the lower end of the tubular part (51) injecting means (48) are present for injecting a liquid or gaseous cooling medium. Quench vessel (44) is further provided with an outlet (49) for cooled synthesis gas. Figure 4 also shows a burner (50). The burner configuration may suitably be as described in EP-A-0400740, which reference is hereby incorporated by reference. The various other details of the gasification reactor (43) and the transfer duct (45) as well as the upper design of the quench vessel (44) are preferably as disclosed for the apparatus of Figure 1 of WO-A-2004/005438.

The embodiment of Figure 4 is preferred when retrofitting existing gasification reactors by replacing the syngas cooler of the prior art publications with a quench vessel (44) or when one wishes to adopt the process of the present invention while maintaining the actual gasification reactor of the prior art.

The person skilled in the art will readily understand that the present invention may be modified in various ways without departing from the scope as defined in the claims.

CLAIMS

1. Method of producing synthesis gas comprising CO, CO_2, and H_2 from a carbonaceous stream using an oxygen containing stream, the method comprising at least the steps of:
(a) injecting a carbonaceous stream and an oxygen containing stream into a gasification reactor;
(b) at least partially oxidising the carbonaceous stream in the gasification reactor, thereby obtaining a raw synthesis gas;
(c) removing the raw synthesis gas obtained in step (b) from the gasification reactor into a quenching section; and
(d) injecting a liquid into the quenching section in the form of a mist.

2. The method of claim 1, wherein the liquid injected in step (d) is water.

3. The method according to any one of claims 1-2, wherein the injected liquid has a temperature of above 150 °C.

4. The method of claim 3, wherein the injected liquid has a temperature of at most 50 °C below the bubble point of the liquid at the pressure of the raw synthesis gas.

5. The method according to any one of claims 2-4, wherein the mist comprises droplets having a diameter of from 50 to 200 μm.

6. The method according to one or more of the preceding claims, wherein the mist is injected with a velocity of between 30-100 m/s.

7. The method of claim 6, wherein the mist is injected with a velocity of between 40-60 m/s.

8. The method according to one or more of the preceding claims, wherein the mist is injected with an injection pressure of from 20 to 60 bar above the pressure of the raw synthesis gas.

9. The method according to one or more of the preceding claims, wherein the amount of injected mist is selected such that the raw synthesis gas leaving the quenching section comprises at least 40 vol.% H_2O, preferably from 40 to 60 vol.% H_2O, more preferably from 45 to 55 vol.% H_2O.

10. The method according to one or more of the preceding claims, wherein the mist is injected in a direction away from the gasification reactor.

11. The method according to claim 10, wherein the mist is injected under an angle of between 30-60° with respect to a plane perpendicular to the longitudinal axis of the quenching section.

12. The method according to one or more of the preceding claims, wherein the injected mist is at least partially surrounded by a shielding fluid.

13. The method according to claim 12, wherein the shielding fluid is selected from the group consisting of an inert gas such as N_2 and CO_2, synthesis gas, steam and a combination thereof.

14. The method according to one or more of the proceeding claims, wherein the raw synthesis gas is first cooled to a temperature below the solidification temperature of the non-gaseous components in the raw synthesis gas by injecting a liquid or gas having a reduced temperature into the raw synthesis gas before performing step (d).

15. The method of claim 14, wherein the raw synthesis gas is first cooled to a temperature below the solidification temperature of the non-gaseous components in the raw synthesis gas by injecting liquid water in the form of a mist.

16. The method of any one of claims 14 or 15, wherein an upwardly moving flow of raw synthesis gas is first cooled to a temperature below the solidification temperature of the non-gaseous components by injecting a liquid or gas having a reduced temperature, wherein the flow is deflected at a more elevated position relative to said injection to a downwardly moving flow of syngas and wherein injection of the liquid of step (d) is performed into the downwardly moving flow of synthesis gas.

17. Gasification reactor comprising:

- a pressure shell for maintaining a pressure higher than atmospheric pressure;
- a slag bath located in a lower part of the pressure shell;
- a gasifier wall arranged inside the pressure shell defining a gasification chamber wherein during operation the synthesis gas can be formed, a lower open part of the gasifier wall which is in fluid communication with the slag bath and an open upper end of the gasifier wall which is in fluid communication with a quench zone;
- a quench zone comprising a tubular formed part positioned within the pressure shell, open at its lower and upper end and having a smaller diameter than the pressure shell thereby defining an annular space around the tubular part , wherein the lower open end is fluidly connected to the upper end of the gasifier wall and the upper open end is in fluid communication with the annular space;
- wherein at the lower end of the tubular part injecting means are present for injecting a liquid or gaseous cooling medium and wherein in the annular space injecting means are present to inject a liquid in the form of a mist and wherein an outlet for synthesis gas is present in the wall of the pressure shell fluidly connected to said annular space.

18. Gasification system comprising a gasification reactor and a quench vessel wherein the gasification reactor comprises:

- a pressure shell for maintaining a pressure higher than atmospheric pressure;

- a slag bath located in a lower part of the pressure shell;

- a gasifier wall arranged inside the pressure shell defining a gasification chamber wherein during operation the synthesis gas can be formed, a lower open part of the gasifier wall which is in fluid communication with the slag bath and an open upper end of the gasifier wall which is in fluid communication with a vertically extending tubular part, which tubular part is open at its lower and upper end, the upper end being in fluid communication with a synthesis gas inlet of the quench vessel and wherein the tubular part provided with means to add a liquid or gaseous cooling medium at its lower end;,

- wherein the quench vessel is provided at its top end with a synthesis gas inlet, with injecting means to inject a liquid in the form of a mist into the synthesis gas and with an outlet for synthesis gas.

19. The method according to claim 16 as performed in a gasification reactor according to claim 17.

20. The method according to claim 16 as performed in a gasification system according to claim 18.

21. The method according to one or more of the preceding claims, wherein the raw synthesis gas leaving the quenching section is shift converted whereby at least a part of the water is reacted with CO to produce CO_2 and H_2 thereby obtaining a shift converted synthesis gas stream.

22. The method of claim 21, wherein before shift converting the raw synthesis gas, the raw synthesis gas

is heated in a heat exchanger against the shift converted synthesis gas stream.

23. The method of claim 21 or 22, wherein the mist is heated before injecting it in step (d) by indirect heat exchange against the shift converted synthesis gas stream.

24. System for producing synthesis gas comprising CO, CO_2, and H_2, the system at least comprising:

- a gasification reactor having an inlet for an oxygen containing stream, an inlet for a carbonaceous stream, and downstream of the gasification reactor an outlet for raw synthesis gas produced in the gasification reactor;
- a quenching section connected to the outlet of the gasification reactor for the raw synthesis gas;

wherein the quenching section comprises at least one first injector adapted for injecting a liquid, preferably water, in the quenching section in the form of a mist.

25. System according to claim 24, wherein the first injector in use injects the mist in a direction away from the gasification reactor.

26. System according to claims 24 or 25, wherein the quenching section comprises a second injector adapted for injecting a shielding fluid at least partially surrounding the mist injected by the at least one first injector.

27. System according to any one of claims 24-26, wherein the system comprises a slag bath located at a separate outlet than the outlet for raw synthesis gas in the gasification reactor.

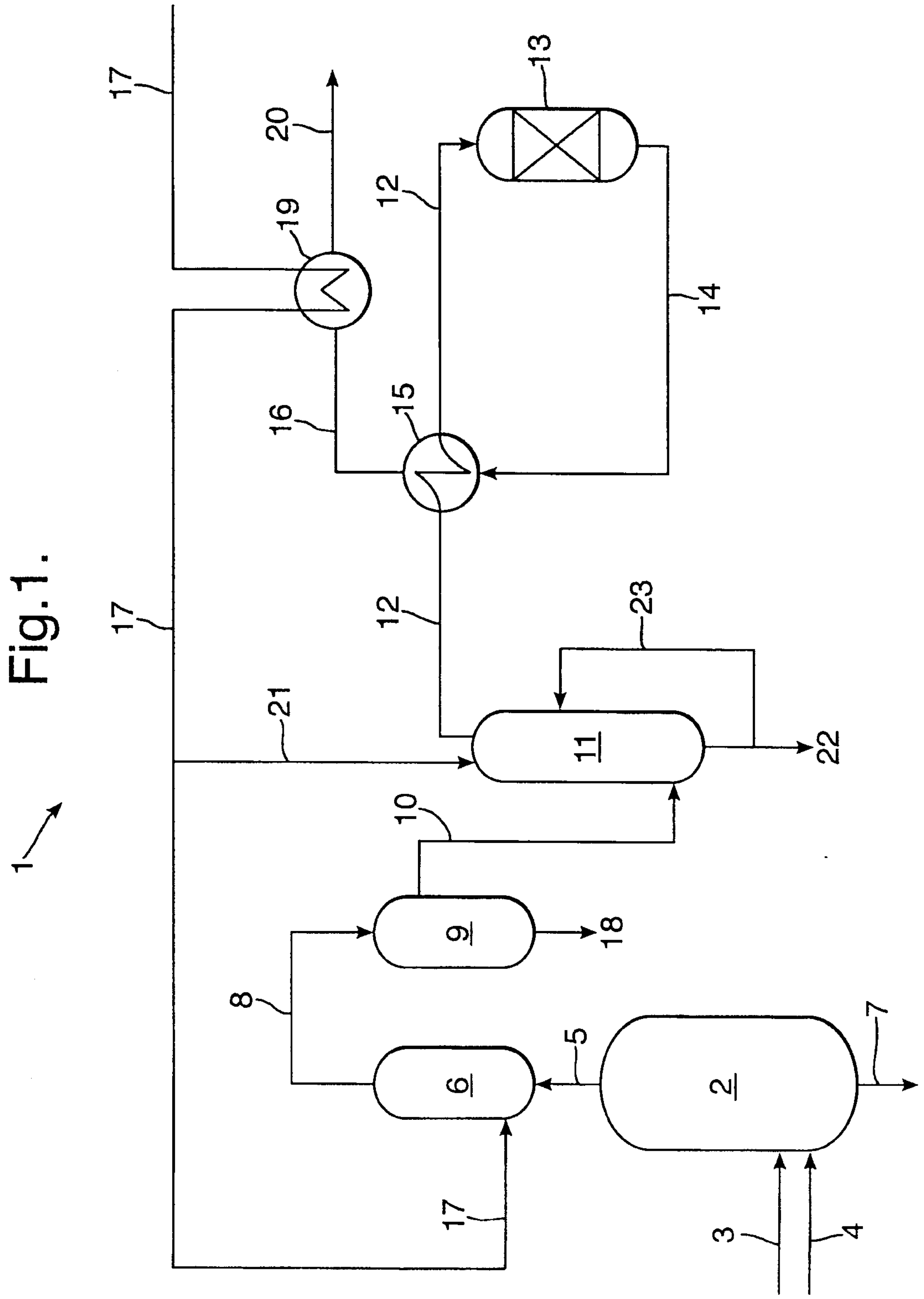


Fig.1.

Fig.2.

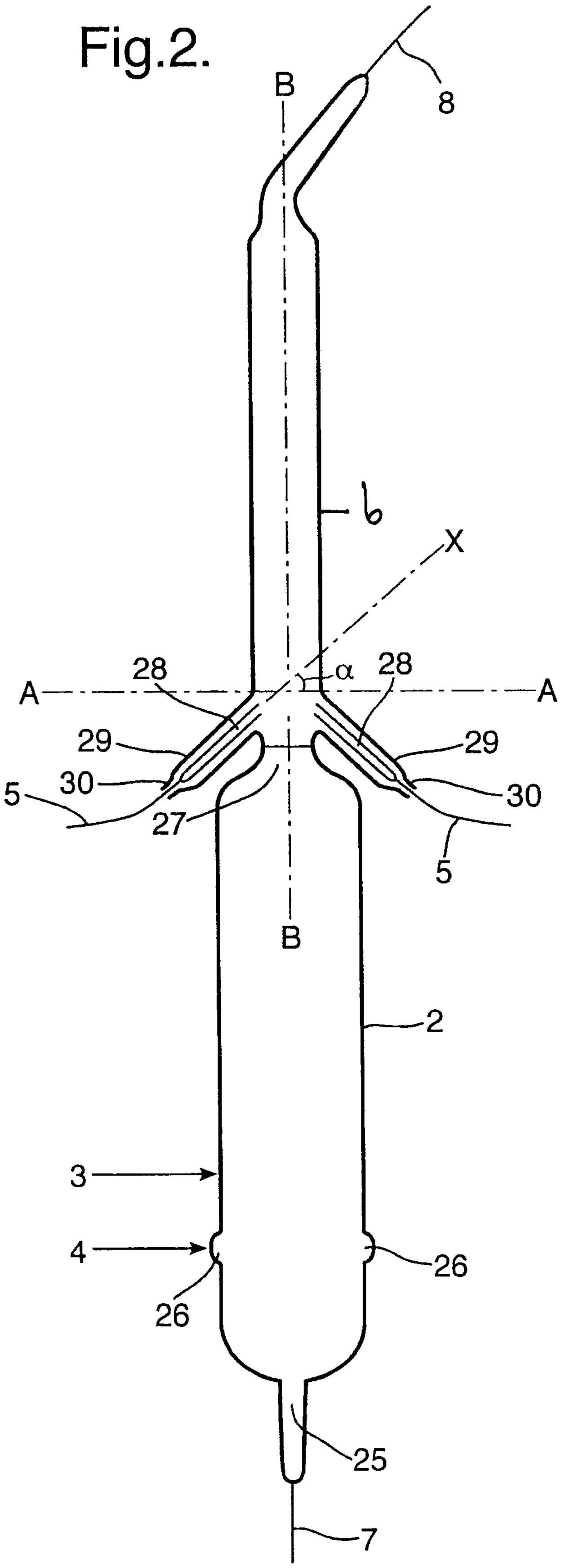
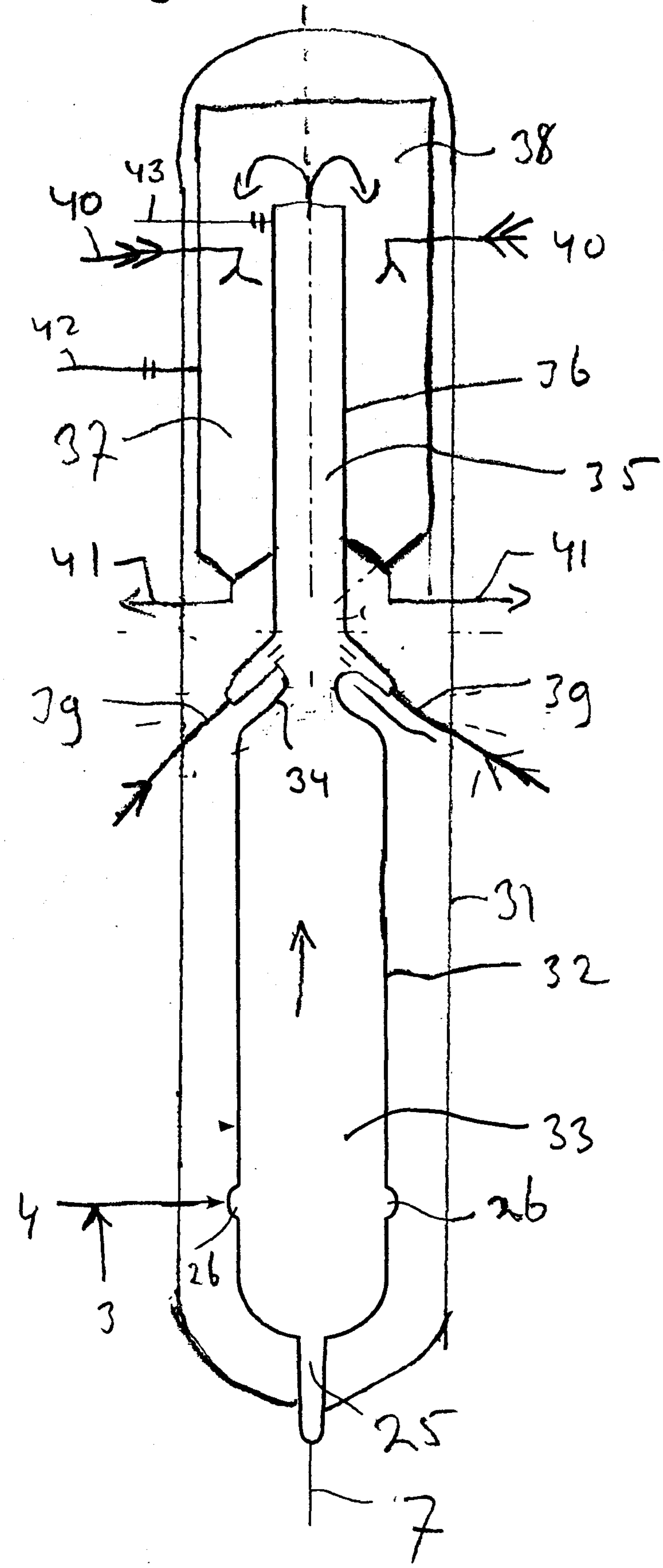


Fig. 3



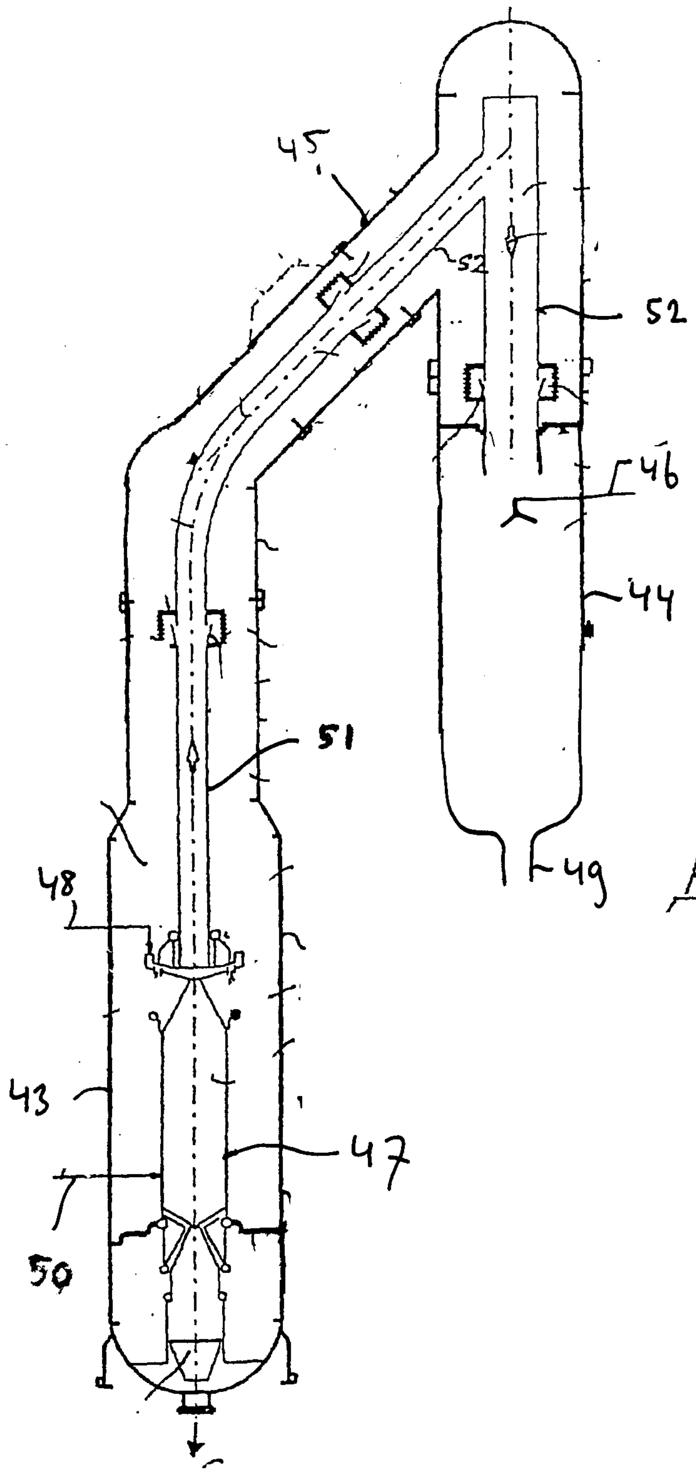


Fig. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2006/061951

A. CLASSIFICATION OF SUBJECT MATTER
INV. C10J3/84 F28C3/06

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 F28C

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 practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 534 659 A (SPRINGER ET AL) 9 July 1996 (1996-07-09) abstract; figures column 7, line 13 - line 23 column 9, line 50 - line 58 column 10, line 21 - line 33	1
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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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"A" document defining the general state of the art which is not considered to be of particular relevance

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
19 July 2006	26/07/2006

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Lapeyrere, J

INTERNATIONAL SEARCH REPORT

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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