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(54) **VESSEL FOR COOLING SYNGAS**

BEHÄLTER ZUM ABKÜHLEN VON SYNGAS

Récipient pour le refroidissement de gaz de synthèse

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(73) Proprietor: **Shell Internationale Research Maatschappij B.V.**
2596 HR Den Haag (NL)

(72) Inventors:
- **EBNER, Thomas**
D-51647 Gummersbach (DE)
- **HARTEVELD, Wouter Koen**
NL-1031 HW Amsterdam (NL)
- **SCHMITZ-GOEB, Manfred Heinrich**
D-51647 Gummersbach (DE)

(74) Representative: **Matthezing, Robert Maarten et al**
Shell International B.V.
Intellectual Property Services
P.O. Box 384
2501 CJ The Hague (NL)

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Description

[0001] The invention is directed to a vessel for cooling syngas comprising a syngas collection chamber and a quench chamber. The syngas outlet of the syngas collection chamber is fluidly connected with the quench chamber via a tubular diptube.

[0002] Such a vessel is described in US-A-4828578. This publication describes a gasification reactor having a reaction chamber provided with a burner wherein a fuel and oxidant are partially oxidized to produce a hot gaseous product. The hot gases are passed via a constricted throat to be cooled in a liquid bath located below the reaction chamber. A diptube guides the hot gases into the bath. At the upper end of the diptube a quench ring is present. The quench ring has a toroidal body fluidly connected with a pressurized water source. A narrow channel formed in said body carrier a flow of water to cool the inner wall of the diptube. The quench ring also has openings to spray water into the flow of hot gas as it passes the quench ring.

[0003] US 5271243 describes a device for cooling hot gases deriving from incomplete oxidation in a reactor and loaded with solids. A pressurized vessel accommodates a refrigerator made of cooled pipe-slab walls at the top and a water bath for quench cooling at the bottom. The vessel also accommodates a gas-collecting section upstream of a first gas outlet and another gas-collecting section upstream of a second gas outlet. Accommodated in the first gas-collecting section is a shower ring, which is supplied with water from a circulation system. The ring sprays the gas leaving the refrigerator and lowers its temperature further before the gas exits through the gas outlets.

[0004] US 4808197 discloses a combination diptube and quench ring, which is communicated with a pressurized source of a liquid coolant such as water and which directs a flow thereof against the diptube guide surfaces to maintain such surfaces in a wetted condition.

[0005] US 5976203 describes a synthesis gas generator with combustion and quench chambers for generating, cooling and cleaning gases that are generated by partial oxidation, such generator including quench nozzles for spraying a quenching medium in a finely distributed form into the useful gas stream. The described generator further includes a cone arranged at the outlet of the quench chamber, extending into the water bath chamber gas space.

[0006] WO 2008/065184 describes a vessel for cooling syngas wherein the wall of the reaction chamber is made of an arrangement of interconnected parallel arranged tubes resulting in a substantially gas-tight wall. The described vessel further contains a diptube that is partially submerged in a water bath. Preferably at the upper end of the diptube injecting means are present to add a quenching medium to the, in use, downwardly flowing hot product gas.

[0007] None of US 5271243, US 4808197, US 5976203 or WO 2008/065184 discloses the improved vessel design disclosed and claimed herein, wherein the diameter of the diptube at the end nearest to the syngas collection chamber is greater the diameter of the diptube at the end terminating at the quench chamber and which comprises both a quench ring supplying a film of water to the surface of the diptube and water spray nozzles located in the diptube to spray droplets of water into the syngas as it flows downwardly through the diptube.

[0008] The present invention aims to provide an improved design for a vessel for cooling syngas comprising a syngas collection chamber and a quench chamber.

[0009] This is achieved by the vessel for cooling syngas according to claim 1, said vessel comprising:

> a syngas collection chamber and a quench chamber, wherein the syngas collection chamber has a syngas outlet which is fluidly connected with the quench chamber via a tubular diptube,
> wherein the diameter of the diptube at the end nearest to the syngas collection chamber is greater than the diameter of the diptube at the end terminating at the quench chamber,
> wherein a discharge conduit is preferably present having an outflow opening for liquid water directed such that, in use, a film of water is achieved along the inner wall of the diptube, and
> wherein water spray nozzles are located in the diptube to spray droplets of water into the syngas as it flows downwardly through the diptube.

[0010] Applicants found that by a diptube as claimed a more efficient vessel for cooling is provided. Preferably the diptube comprises a tubular part with the larger diameter and a tubular part with the smaller diameter which parts are fixed together by a frusto conical part. Preferably the ratio between the larger diameter and the smaller diameter is between 1.25:1 and 2:1 .

[0011] The invention and its preferred embodiments will be further described by means of the following figures.

> Figure 1 is a cooling vessel according to the invention.
> Figure 2 is a side-view of detail A of Figure 1.
> Figure 3 is a top view of detail A of Figure 1.
> Figure 4 is a gasification reactor according to the invention.
> Figure 4a shows an alternative design for a section of the reactor of Figure 4.

[0012] Syngas has the meaning of a mixture comprising carbon monoxide and hydrogen. The syngas is preferably prepared by gasification of an ash comprising carbonaceous feedstock, such as for example coal, petroleum coke, biomass and deasphalted tar sands residues. The coal may be lignite, bituminous coal, sub-bituminous coal, anthracite coal and brown coal. The syngas as present in the syngas collection chamber may have a temperature ranging from 600 to 1500 °C and have a pressure of between 2 and 10 MPa. The syngas is preferably cooled, in the vessel according the present invention, to below a temperature, which is 50 °C higher than the saturation temperature of the gas composition. More preferably the syngas is cooled to below a temperature, which is 20 °C higher than the saturation temperature of the gas composition.

[0013] Figure 1 shows a vessel 1 comprising a syngas collection chamber 2 and a quench chamber 3. In use it is vertically oriented as shown in the Figure. References to vertical, horizontal, top, bottom, lower and upper relate to this orientation. Said terms are used to help better understand the invention but are by no means intended to limit the scope of the claims to a vessel having said orientation. The syngas collection chamber 2 has a syngas outlet 4, which is fluidly connected with the quench chamber 3 via a tubular diptube 5. The syngas collection chamber 2 and the diptube 5 have a smaller diameter than the vessel 1 resulting in an upper annular space 2a between said chamber 2 the wall of vessel 1 and a lower annular space 2b between the diptube 5 and the wall of vessel 1. Annular space 2a and 2b are preferably gas tight separated by sealing 2c to avoid ingress of ash particles from space 2b into space 2a.

[0014] The syngas outlet 4 comprises of a tubular part 6 having a diameter, which is smaller than the diameter of the tubular diptube 5. The tubular part 6 is oriented coaxial with the diptube 5 as shown in the Figure. The vessel 1 as shown in Figure 1 is at its upper end provided with a syngas inlet 7 and a connecting duct 8 provided with a passage 10 for syngas. The passage for syngas is defined by walls 9. Connecting duct 8 is preferably connected to a gasification reactor as described in more detail in WO-A-2007125046.

[0015] The diptube 5 is open to the interior of the vessel 1 at its lower end 10. This lower end 10 is located away from the syngas collection chamber 2 and in fluid communication with a gas outlet 11 as present in the vessel wall 12. The diptube is partly submerged in a water bath 13. Around the lower end of the diptube 5 a draft tube 14 is present to direct the syngas upwardly in the annular space 16 formed between draft tube 14 and diptube 5. At the upper discharge end of the annular space 16 deflector plate 16a is present to provide a rough separation between entrained water droplets and the quenched syngas. Deflector plate 16a preferably extends from the outer wall of the diptube 5. The lower part 5b of the diptube 5 has a smaller diameter than the upper part 5a as shown in Figure 1. This is advantageous because the layer of water in the lower end will increase and because the annular area for the water bath 13 will increase. This is advantageous because it enables one to use a more optimized, smaller, diameter for vessel 1. The quench zone 3 is further provided with an outlet 15 for water containing for example fly-ash.

[0016] The tubular part 6 is preferably formed by an arrangement of interconnected parallel arranged tubes resulting in a substantially gas-tight tubular wall running from a cooling water distributor to a header. The cooling of tubular part 6 can be performed by either sub-cooled water or boiling water.

[0017] The walls of the syngas collection chamber 2 preferably comprises of an arrangement of interconnected parallel arranged tubes resulting in a substantially gas-tight wall running from a distributor to a header, said distributor provided with a cooling water supply conduit and said header provided with a discharge conduit for water or steam. The walls of the diptube are preferably of a simpler design, like for example a metal plate wall.

[0018] At the end of the diptube 5 which is nearest to the syngas collection chamber 2 a discharge conduit 19 is present having an outflow opening for liquid water directed such that, in use, a film of water is achieved along the inner wall of the diptube. Discharge conduit 19 is connected to water supply conduit 17. Discharge conduit 19 will be described in detail by means of Figures 2 and 3.

[0019] Figure 1 also shows water spray nozzles 18 located in the diptube 5 to spray droplets of water into the syngas as it flows downwardly through the diptube 5. The nozzles 18 are sufficiently spaced away in a vertical direction from the discharge conduit 19 to ensure that any non-evaporated water droplets as sprayed into the flow of syngas will contact a wetted wall of the diptube 5. Applicants have found that if such droplets would hit a non-wetted wall ash may deposit, thereby forming a very difficult to remove layer of fouling. The nozzles 18 are positioned in the larger diameter part 5a of the dipleg 5. More residence time is achieved by the larger diameter resulting in that the water as injected has sufficient time to evaporate.

[0020] Figure 2 shows detail A of Figure 1.

[0021] Figure 2 shows that the tubular part 6 terminates at a point within the space enclosed by the diptube 5 such that an annular space 20 is formed between the tubular part 6 and the diptube 5. In the annular space 20 a discharge conduit 19 for a liquid water is present having a discharge opening 21 located such to direct the liquid water 22 along the inner wall of the diptube 5. Conduit 19 and tubular part 6 are preferably not fixed to each other and more preferably horizontally spaced away from each other. This is advantageous because this allows both parts to move relative to each other. This avoids, when the vessel is used, thermal stress as both parts will typically have a different thermal expansion. The gap 19a as formed between conduit 19 and part 6 will allow gas to flow from the syngas collection chamber 2 to the space 2a between the wall of the chamber 2 and the wall of vessel 1. This is advantageous because it results in pressure equalization between said two spaces. The discharge conduit 19 preferably runs in a closed circle along the periphery of the tubular part 6 and has a slit like opening 21 as the discharge opening located at the point where the discharge conduit 19 and the inner wall of the diptube 5 meet. In use, liquid water 22 will then be discharged along the entire inner circumference of the wall of the diptube 5. As shown conduit 19 does not have discharge openings to direct water into the flow of syngas, which is discharged via syngas outlet 4.

[0022] Figure 2 also shows that the discharge conduit 19 is suitably fluidly connected to a circular supply conduit 23. Said supply conduit 23 runs along the periphery of the discharge conduit 19. Both conduits 19 and 23 are fluidly connected by numerous openings 24 along said periphery. Alternatively, not shown in Figure 2 and 3, is an embodiment wherein the discharge conduit 19 is directly fluidly connected to one or more supply lines 17 for liquid water under an angle with the radius of the closed circle, such that in use a flow of liquid water results in the supply conduit.

[0023] Preferably the discharge conduit 19 or conduit 23 are connected to a vent. This vent is intended to remove gas, which may accumulate in said conduits. The ventline is preferably routed internally in the vessel 1 through the sealing 2c to be fluidly connected to annular space 2b. The lower pressure in said space 2b forms the driving force for the vent. The size of the vent line, for example by sizing an orifice in said ventline, is chosen such that a minimum required flow is allowed, possibly also carrying a small amount of water together with the vented gas into the annular space 2b. Preferably conduit 19 is provided with a vent as shown in Figure 2, wherein the discharge conduit 19 has an extending part 26 located away from the discharge opening 21, which extending part 26 is fluidly connected to a vent conduit 27.

[0024] The circular supply conduit 23 of Figure 3 is suitably fluidly connected to one or more supply lines 17 for liquid water under an angle α, such that in use a flow of liquid water results in the supply conduit 23. Angle α is preferably between 0 and 45°, more preferably between 0 and 15°. The number of supply lines 17 may be at least 2. The maximum number will depend on the dimensions of for example the conduit 23. The separate supply lines 17 may be combined upstream and within the vessel 1 to limit the number of openings in the wall of vessel 1. The discharge end of supply line 17 is preferably provided with a nozzle to increase the velocity of the liquid water as it enters the supply conduit 23. This will increase the speed and turbulence of the water as it flows in conduit 23, thereby avoiding solids to accumulate and form deposits. The nozzle itself may an easy to replace part having a smaller outflow diameter than the diameter of the supply line 17.

[0025] The openings 24 preferably have an orientation under and angle β with the radius 25 of the closed circle, such that in use a flow of liquid water results in the discharge conduit 19 having the same direction has the flow in the supply conduit 23. Angle β is preferably between 45 and 90°.

[0026] Figure 3 also shows tubular part 6 as an arrangement of interconnected parallel arranged tubes 28 resulting in a substantially gas-tight tubular wall 29.

[0027] Figure 4 shows a vessel 30 according to the invention wherein the syngas collection chamber 2 is a reaction chamber 31 provided with 4 horizontally firing burners 32. The number of burners may suitably be from 1 to 8 burners. To said burners the carbonaceous feedstock and an oxygen containing gas are provided via conduits 32a and 32b. The wall 33 of the reaction chamber 31 is preferably an arrangement of interconnected parallel arranged tubes 34 resulting in a substantially gas-tight tubular wall. Only part of the tubes are drawn in Figure 4. The tubes 34 run from a lower arranged cooling water distributor 37 to a higher arranged header 38. The burners 32 are arranged in Figure 4 as described in for example WO-A-2008110592, which publication is incorporated by reference. The burners or burner may alternatively be directed downwardly as for example described in WO-A-2008065184 or in US-A-2007079554. In use a layer of liquid slag will be present on the interior of wall 33. This slag will flow downwards and will be discharged from the reactor via outlet 15.

[0028] The reference numbers in Figure 4, which are also used in Figures 1-3, relate to features having the same functionality. Detail A in Figure 4 refers to Figures 2 and 3.

[0029] The syngas outlet 4 consists of a frusto-conical part 35 starting from the lower end of the tubular wall 33 and diverging to an opening 36. Preferably part 35 has a tubular part 35a connected to the outlet opening of said part 35 to guide slag downwards into the diptube 5. This is advantageous because one then avoids slag particles to foul the discharge conduit 19. If such a tubular part 35a would not be present small slag particles may be carried to the conduit 19 by recirculating gas. By having a tubular part of sufficient length such recirculation in the region of conduit 19 is avoided. Preferably the length of 35a is such that the lower end terminates at or below the discharge conduit 19. Even more preferably the lower end terminates below the discharge conduit 19, wherein at least half of the vertical length of the tubular part 35a extends below discharge conduit 19.

[0030] The frusto-conical part 35 and the optional tubular part 35a and 35b comprise one or more conduits, through which in use boiling cooling water or sub-cooled cooling water, flows. The design of the conduits of parts 35, 35a and 35b may vary and may be for example spirally formed, parallel formed, comprising multiple U-turns or combinations. The part 35, 35a and 35b may even have separate cooling water supply and discharge systems. Preferably the temperature of the used cooling water or steam make of these parts 35 and 35a are measured to predict the thickness of the local slag layer on these parts. This is especially advantageous if the gasification process is run at temperatures, which would be beneficial for creating a sufficiently thick slag layer for a specific feedstock, such as low ash containing feedstocks like certain biomass feeds and tar sand residues. Or in situations where a coal feedstock comprises components that have a high melting point. The danger of such an operations is that outlet 4 may be blocked by accumulating slag. By measuring the temperature of the cooling water or the steam make one can predict when such a slag accumulation occurs and adjust the process conditions to avoid such a blockage. The invention is thus also directed to a process to avoid slag blockage at the outlet of the reaction chamber in a reactor as described by Figure 4 by measuring the temperature of the cooling water or the steam make of these parts 35 and 35a in order to predict when a slag blockage could occur and adjust the process conditions to avoid such a blockage. Typically a decrease in temperature of the used cooling water or a decrease in steam make are indicative for a growing layer of slag. The process is typically adjusted by increasing the gasification temperature in the reaction chamber such that the slag will become more fluid and consequently a reduction in thickness of the slag layer on parts 35 and 35a will result. The supply and discharge conduits for this cooling water are not shown in Figure 4.

[0031] The frusto-conical part 35 is connected to the tubular part 6 near its lower end. Opening 36 has a smaller diameter than the diameter of the tubular part 6 such that liquid slag will less easily hit the wall of the tubular part 6 and or of the diptube 5 when it drops down into the water bath 13 and solidifies. In water bath 13 the solidified slag particles are guided by means of an inverted frusto-conical part 39 to outlet 15.

[0032] In Figure 4a a preferred embodiment for tubular part 35a is shown, wherein the lower end of tubular part 35a is fixed by a plane 35b extending to the lower end of the next tubular part 6. This design is advantageous because less stagnant zones are present where solid ash particles can accumulate.

Claims

1. Vessel for cooling syngas comprising
   a syngas collection chamber and a quench chamber, wherein the syngas collection chamber has a syngas outlet which is fluidly connected with the quench chamber via a tubular diptube,
   wherein the diameter of the diptube at the end nearest to the syngas collection chamber is greater than the diameter of the diptube at the end terminating at the quench chamber,
   wherein the syngas outlet comprises of a, co-axial with the diptube oriented, tubular part having a diameter which is smaller than the diameter of the tubular diptube at the end nearest to the syngas collection chamber,
   wherein the tubular part terminates at a point within the diptube such that an annular space is formed between the tubular part and the diptube, and
   wherein in the annular space a discharge conduit for a liquid water is present having a discharge opening located such to direct the liquid water along the inner wall of the diptube, and
   wherein nozzles are positioned in the larger diameter part of the diptube such that in use droplets of water are sprayed via these nozzles into the syngas as it flows downwardly through the diptube.

2. Vessel according to claim 1, wherein the ratio between the larger diameter and the smaller diameter is between 1.25:1 and 2:1.

3. Vessel according to any one of claims 1-2, wherein at the end of the diptube which is nearest to the syngas collection a discharge conduit is present having an outflow opening for liquid water directed such that, in use, a film of water is achieved along the inner wall of the diptube.

4. Vessel according to any one of claims 1-3, wherein the syngas collection chamber comprises of an arrangement of interconnected parallel arranged tubes resulting in a gas-tight tubular wall running from a distributor to a header, said distributor provided with a cooling water supply conduit and said header provided with a steam/water discharge conduit.

5. Vessel according to any one of claims 1-4, wherein the diptube is partly submerged in a water bath at the end terminating at the quench chamber.

6. Vessel according to any one of claims 1-5, wherein a draft tube is present around the lower end of the diptube forming an annular space between the draft tube and the diptube.

7. Vessel according to claim 6, wherein a deflector plate extends from the outer wall of the diptube at the upper discharge end of the annular space.

8. Vessel according to any one of claims 2-7, wherein the syngas outlet further comprises a frusto conical part starting from the lower end of the tubular wall of the syngas collecting chamber diverging to an opening.

9. Vessel according to claim 8, wherein a tubular part is connected to the outlet opening of the frusto conical part, such that the lower end of the tubular part terminates below the discharge conduit.

10. Vessel according to claim 9, wherein at least half of the vertical length of the tubular part extends below the discharge conduit.

Patentansprüche

1. Gefäß zum Kühlen von Synthesegas, wobei das Gefäß Folgendes umfasst:

   eine Synthesegassammelkammer und eine Abkühlkammer, wobei die Synthesegassammel-

kammer einen Synthesegasauslass aufweist, der über ein rohrförmiges Fallrohr mit der Abkühlkammer fluidtechnisch verbunden ist,
wobei der Durchmesser des Fallrohrs bei dem Ende, das der Synthesegassammelkammer am nächsten ist, größer ist als der Durchmesser des Fallrohrs bei dem Ende, das bei der Abkühlkammer endet,
wobei der Synthesegasauslass aus einem koaxial mit dem Fallrohr orientierten rohrförmigen Teil mit einem Durchmesser, der kleiner ist als der Durchmesser des rohrförmigen Fallrohrs bei dem Ende, das der Synthesegassammelkammer am nächsten ist, besteht,
wobei das rohrförmige Teil in der Weise bei einem Punkt innerhalb des Fallrohrs endet, dass zwischen dem rohrförmigen Teil und dem Fallrohr ein Ringraum gebildet ist, und
wobei in dem Ringraum eine Ablassleitung für flüssiges Wasser vorhanden ist, die eine Ablassöffnung aufweist, die so angeordnet ist, dass sie das flüssige Wasser entlang der Innenwand des Fallrohrs leitet, und
wobei in dem Teil mit größerem Durchmesser des Fallrohrs Düsen positioniert sind, so dass in Verwendung über diese Düsen Wassertröpfchen in das Synthesegas gesprüht werden, während es durch das Fallrohr nach unten strömt.

2. Gefäß nach Anspruch 1, wobei das Verhältnis zwischen dem größeren Durchmesser und dem kleineren Durchmesser zwischen 1,25:1 und 2:1 liegt.

3. Gefäß nach einem der Ansprüche 1-2, wobei bei dem Ende des Fallrohrs, das der Synthesegassammlung am nächsten ist, eine Ablassleitung vorhanden ist, die eine Ausströmöffnung für flüssiges Wasser aufweist, die in der Weise gerichtet ist, dass in Verwendung entlang der Innenwand des Fallrohrs eine Wasserschicht erzielt wird.

4. Gefäß nach einem der Ansprüche 1-3, wobei die Synthesegassammelkammer aus einer Anordnung miteinander verbundener parallel angeordneter Rohre besteht, die dazu führen, dass eine gasdichte rohrförmige Wand von einem Verteiler zu einem Sammelrohr verläuft, wobei der Verteiler mit einer Kühlwasserzufuhrleitung versehen ist und wobei der Sammler mit einer Dampf/Wasser-Ablassleitung versehen ist.

5. Gefäß nach einem der Ansprüche 1-4, wobei das Fallrohr bei dem Ende, das bei der Abkühlkammer endet, teilweise in ein Wasserbad getaucht ist.

6. Gefäß nach einem der Ansprüche 1-5, wobei um das untere Ende des Fallrohrs ein Saugrohr vorhanden ist, das zwischen dem Saugrohr und dem Fallrohr einen Ringraum bildet.

7. Gefäß nach Anspruch 6, wobei bei dem oberen Ablassende des Ringraums von der Außenwand des Fallrohrs eine Ablenkplatte ausgeht.

8. Gefäß nach einem der Ansprüche 2-7, wobei der Synthesegasauslass ferner aus einem kegelstumpfförmigen Teil besteht, das von dem unteren Ende der rohrförmigen Wand der Synthesegassammelkammer beginnend zu einer Öffnung auseinanderläuft.

9. Gefäß nach Anspruch 8, wobei mit der Auslassöffnung des kegelstumpfförmigen Teils ein rohrförmiges Teil in der Weise verbunden ist, dass das untere Ende des rohrförmigen Teils unter der Ablassleitung endet.

10. Gefäß nach Anspruch 9, wobei wenigstens die Hälfte der vertikalen Länge des rohrförmigen Teils unter der Ablassleitung verläuft.

Revendications

1. Cuve de refroidissement de gaz de synthèse comprenant
une chambre de collecte de gaz de synthèse et une chambre de trempe, la chambre de collecte de gaz de synthèse ayant une sortie de gaz de synthèse qui est reliée fluidiquement à la chambre de trempe par un tube plongeur tubulaire,
le diamètre du tube plongeur à l'extrémité la plus proche de la chambre de collecte de gaz de synthèse étant supérieur au diamètre du tube plongeur à l'extrémité se terminant à la chambre de trempe,
la sortie de gaz de synthèse comprenant, orientée coaxialement avec le tube plongeur, une partie tubulaire ayant un diamètre qui est inférieur au diamètre du tube plongeur tubulaire à l'extrémité la plus proche de la chambre de collecte de gaz de synthèse,
la partie tubulaire se terminant en un point à l'intérieur du tube plongeur de telle sorte qu'un espace annulaire est formé entre la partie tubulaire et le tube plongeur, et
une conduite d'évacuation pour une eau liquide ayant une ouverture d'évacuation positionnée de manière à diriger l'eau liquide le long de la paroi intérieure du tube plongeur étant présente dans l'espace annulaire, et
des buses étant positionnées dans la partie de plus grand diamètre du tube plongeur de telle sorte qu'à l'usage, des gouttelettes d'eau sont pulvérisées par ces buses dans le gaz de synthèse lorsqu'il circule vers le bas à travers le tube plongeur.

2. Cuve selon la revendication 1, dans laquelle le rapport entre le plus grand diamètre et le plus petit diamètre se situe entre 1,25:1 et 2:1.

3. Cuve selon l'une quelconque des revendications 1 et 2, dans laquelle est présente à l'extrémité du tube plongeur qui est la plus proche de la collecte de gaz de synthèse une conduite d'évacuation ayant une ouverture d'écoulement pour l'eau liquide dirigée de telle sorte qu'à l'usage, un film d'eau est obtenu le long de la paroi intérieure du tube plongeur.

4. Cuve selon l'une quelconque des revendications 1 à 3, dans laquelle la chambre de collecte de gaz de synthèse comprend un agencement de tubes disposés parallèlement interconnectés constituant une paroi tubulaire étanche aux gaz courant depuis un distributeur jusqu'à un collecteur, ledit distributeur étant pourvu d'une conduite d'alimentation en eau de refroidissement et ledit collecteur étant pourvu d'une conduite d'évacuation de vapeur d'eau/d'eau.

5. Cuve selon l'une quelconque des revendications 1 à 4, dans laquelle le tube plongeur est partiellement immergé dans un bain d'eau à l'extrémité se terminant à la chambre de trempe.

6. Cuve selon l'une quelconque des revendications 1 à 5, dans laquelle un tube d'aspiration est présent autour de l'extrémité inférieure du tube plongeur, ce qui forme un espace annulaire entre le tube d'aspiration et le tube plongeur.

7. Cuve selon la revendication 6, dans laquelle une plaque déflectrice s'étend de la paroi extérieure du tube plongeur à l'extrémité d'évacuation supérieure de l'espace annulaire.

8. Cuve selon l'une quelconque des revendications 2 à 7, dans laquelle la sortie de gaz de synthèse comprend en outre une partie tronconique partant de l'extrémité inférieure de la paroi tubulaire de la chambre de collecte de gaz de synthèse s'écartant jusqu'à une ouverture.

9. Cuve selon la revendication 8, dans laquelle une partie tubulaire est reliée à l'ouverture de sortie de la partie tronconique, de telle sorte que l'extrémité inférieure de la partie tubulaire se termine au-dessous de la conduite d'évacuation.

10. Cuve selon la revendication 9, dans laquelle au moins la moitié de la longueur verticale de la partie tubulaire s'étend au-dessous de la conduite d'évacuation.

Fig.1

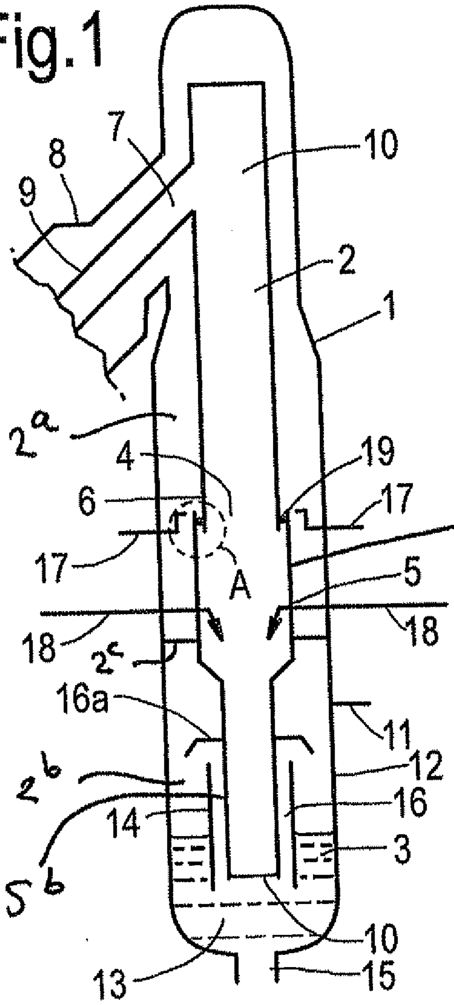


Fig.2

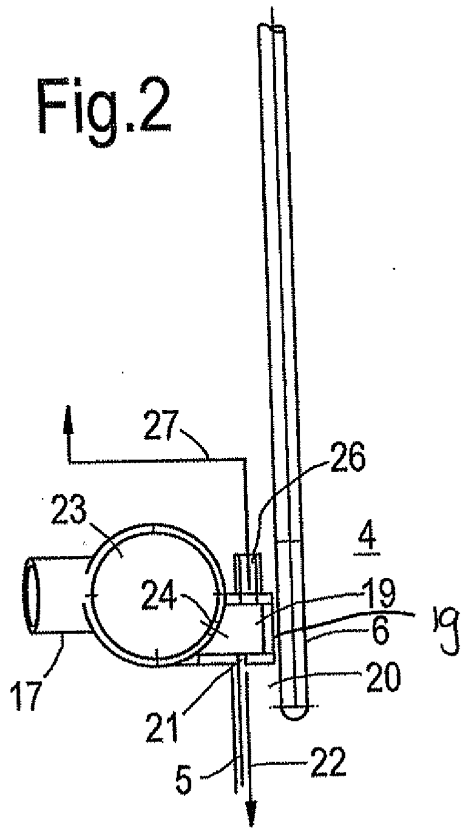


Fig.3

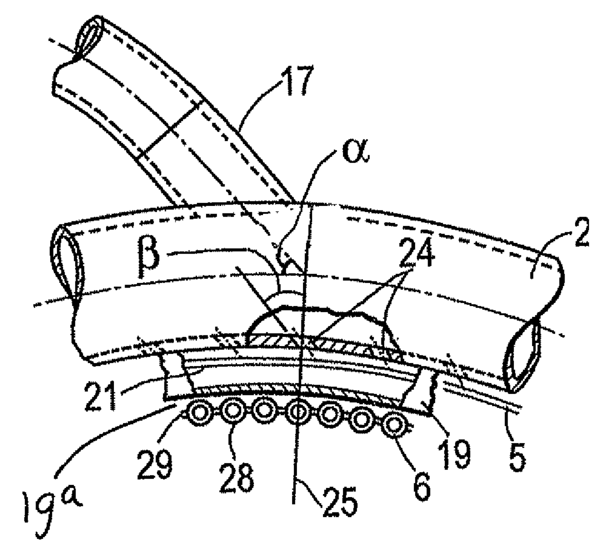
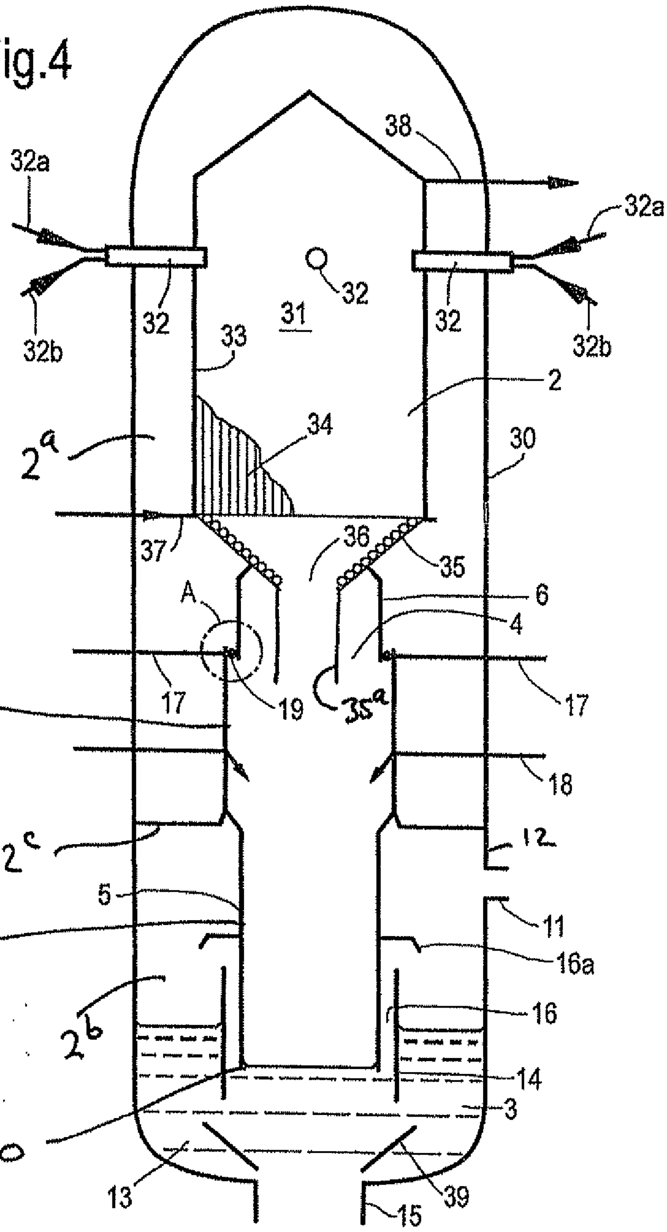


Fig.4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17
17
5a
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3
13
39
15

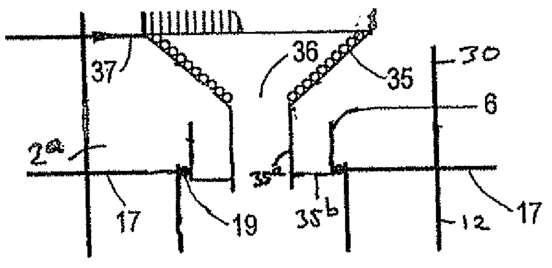
37
36
35
30
6
2a
35a
17
19
35b
12
17

Fig.4a

REFERENCES CITED IN THE DESCRIPTION

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