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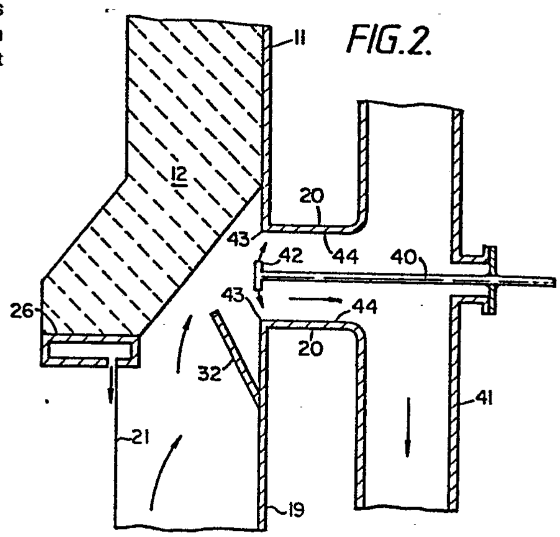
(54) Synthesis gas generation with prevention of deposit formation in exit lines.

(57) Deposition of ash in the outlet conduit (20) of a synthesis gas quench chamber is reduced or eliminated by providing a wetted-wall (44) at the mouth and throat of the outlet conduit.

FIG.2.



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SYNTHESIS GAS GENERATION WITH PREVENTION OF DEPOSIT FORMATION IN EXIT LINES

FIELD OF THE INVENTION

This invention relates to the production of synthesis gas. More particularly it relates to the production of synthesis gas from an ash-containing carbonaceous charge under conditions which minimize the deposition of ash in the outlet from the gas quench chamber.

BACKGROUND OF THE INVENTION

As is well known to those skilled in the art, synthesis gas may be prepared from ash-containing carbonaceous fuel including liquid or solid charge materials. When the charge is characterized by high ash content as may be the case with residual liquid hydrocarbons or solid carbonaceous fuels such as coals of low rank, the high ash content poses an additional burden. The ash must be separated from the product synthesis gas; and the large quantities of ash which accumulate in the system must be efficiently removed from the system and prevented from blocking the various conduits and passageways.

It has been found that the exit conduit or passageway from the quench chamber is particularly susceptible to plugging by fine particles of ash which deposit therein.

It is an object of this invention to provide a process for producing synthesis gas under conditions wherein build-up of ash in the exit conduit is kept within acceptable limits. Other objects will be apparent to those skilled in the art.

STATEMENT OF THE INVENTION

In accordance with certain of its aspects, this invention is directed to a method of cooling from an initial high temperature to a lower final temperature, a hot synthesis gas containing solids under conditions which permit removal of solids from said gas which comprises

passing said hot synthesis gas at initial high temperature downwardly through a first contacting zone;

passing cooling liquid downwardly as a film on the walls of said first contacting zone and in contact with said downwardly descending synthesis gas thereby cooling said synthesis gas and forming a cooled synthesis gas;

passing said cooled synthesis gas into a body of aqueous cooling liquid in a second contacting zone thereby forming a further cooled synthesis gas containing a decreased content of solid particles;

recovering said further cooled synthesis gas containing a decreased content of solid particles;

passing said further cooled synthesis gas containing a decreased content of solid particles through a wetted-wall discharge conduit whereby the deposition of solid particles in said discharge conduit is decreased; and

withdrawing said synthesis gas containing a decreased content of solid particles from said discharge conduit.

DESCRIPTION OF THE INVENTION

The synthesis gas which may be prepared by the process of this invention may be prepared by the gasification of coal. In a typical coal gasification process, the charge coal which has been finely ground typically to an average particle size of 20-500 microns, preferably 30-300, say 200 microns, may be slurried with an aqueous medium, typically water, to form a slurry containing 40-80 w%, preferably 50-75 w%, say 60 w% solids. The aqueous slurry may then be admitted to a combustion chamber wherein it is contacted with oxygen-containing gas, typically air or oxygen or air enriched with oxygen, to effect combustion. The atomic ratio of oxygen to carbon in the system may be 0.7-1.2:1, say 0.9:1. Typically reaction is carried out at 1800°F-2800°F (982-1538°C), say 2500°F (1371°C) and pressure of 100-1500 psig (6.9-103 bars gauge), preferably 500-1200 (34.5-82.7 bars gauge), say 900 psig (62 bars gauge).

The synthesis gas may alternatively be prepared by the incomplete combustion of liquid hydrocarbon such as residual fuel oil, asphalt, etc. or of a solid carbonaceous material such as coke from petroleum or from tar sands bitumen, carbonaceous residues from coal hydrogenation processes, etc.

The apparatus which may be used in practice of this invention may include a gas generator such as is generally set forth in the following patents inter alia:

USP 2,818,326	Eastman et al
USP 2,896,927	Nagel et al
USP 3,998,609	Crouch et al
USP 4,218,423	Robin et al

Effluent from the reaction zone in which charge is gasified to produce synthesis gas may be at a temperature of 1800°F-2800°F (982-1538°C), say 2500°F (1371°C) at 100-1500 psig (6.9-103 bars gauge), preferably 500-1200 psig (34.5-82.7 bars gauge), say 900 psig (62 bars gauge).

Under these typical conditions of operation, the synthesis gas commonly contains (dry basis) 35-55 v%, say 44.7 v%, carbon monoxide; 30-45 v%, say 35.7 v% hydrogen; 10-20 v%, say 18 v%, carbon dioxide, 0.3 v% - 2 v%, say 1 v% hydrogen sulfide plus COS; 0.4-0.8 v%, say 0.5 v% nitrogen + argon; and methane in an amount less than about 0.1 v%.

When the fuel is a solid carbonaceous material, the unscrubbed product synthesis gas may commonly contain solids (including ash, char, slag, etc.) in amount of 1-10 pounds (0.45-4.5 kg), say 4 pounds (1.8 kg) per thousand SCF (1.95 kmol) of dry product gas; and these solids may be present in particle size of less than 1 micron up to 3000 microns. The charge coal may contain ash in amount as little as 0.5 w% or as much as 40 w% or more. This ash is found in the product synthesis gas. Although the improved process of this invention will provide some benefit when the synthesis gas contains small amounts of ash, it is found to be particularly advantageous when the gas contains solids in amount of 3% or more.

The hot synthesis gas at this initial temperature of 1800°F-2800°F (982°C-1538°C), say 2500°F (1371°C) is passed downwardly through a first contacting zone. The upper extremity of the first contacting zone may be defined by the lower outlet portion of the reaction chamber of the gas generator. The first contacting zone may be generally defined by an upstanding preferably vertical perimeter wall forming an attenuated conduit, and the cross-section of the zone formed by the wall is in the preferred embodiment substantially cylindrical. The outlet or lower end of the attenuated conduit or dip tube at the lower extremity of the preferably cylindrical wall preferably bears a serrated edge.

The first contacting zone is preferably bounded by the upper portion of a vertically extending, cylindrical dip tube which is coaxial with respect to the combustion chamber.

At the upper extremity of the first contacting zone in the dip tube, there is mounted a quench ring through which cooling liquid, commonly water, is admitted to the first contacting zone. From the quench ring, there is directed a first stream of cooling liquid along the inner surface of the dip tube on which it forms a preferably continuous downwardly descending film of cooling liquid which is in contact with the downwardly descending synthesis gas. Inlet temperature of the cooling liquid may be 100°F-500°F (38°C-260°C), preferably 300°F-480°F (149°C-249°C), say 420°F (216°C). The cooling liquid is admitted to the falling film on the wall of the dip tube in amount of 20-120 (9-54.4 kg), preferably 30-100 (13.6-45.4 kg), say 85 pounds (38.5 kg) per thousand SCF (1.95 kmol) of gas admitted to the first contacting zone.

The cooling liquid admitted to the contacting zones, and particularly that admitted to the quench ring, may include recycled liquids which have been treated to lower their solids content.

As the falling film of cooling liquid contacts the downwardly descending hot synthesis gas, the temperature of the latter may drop by 200°F-400°F (93°C - 204°C), preferably 300°F-400°F (149°C - 204°C), say 300°F (149°C) because of contact with the falling film during its passage through the first contact zone.

The gas may pass through the first contacting zone for 0.1-1 seconds, preferably 0.1-0.5 seconds, say 0.3 seconds, at a velocity of 6-30 (1.8- 9 m/sec), say 20 ft/sec (6 m/sec). Gas exiting this first zone may have a reduced solids content, and be at a temperature of 1400°F - 2300°F (760°C - 1260°C), say 2200°F (1204°C).

The gas leaves the lower extremity of the first contacting zone and passes into a second contacting zone wherein it contacts a body of cooling liquid. In this second contacting zone, the gas passes under a serrated edge of the dip tube.

The lower end of the dip tube is submerged in a pool of liquid formed by the collected cooling liquid which defines the second contacting zone. The liquid level, when considered as a quiescent pool, may typically be maintained at a level such that 10%-80%, say 50% of the second contacting zone is submerged. It will be apparent to those skilled in the art that at the high temperature and high gas velocities encountered in practice, there may of course be no identifiable level in this agitated body of liquid.

The further cooled synthesis gas leaves the second contacting zone at typically 600°F-900°F (316°C-482°C), say 800°F (427°C). It passes through the body of cooling liquid in the second contacting zone and under the lower typically serrated edge of the dip tube. The solids fall through the body of cooling liquid wherein they are retained and collected and may be drawn off from a lower portion of the body of cooling liquid.

Commonly the gas leaving the second contacting zone may have had 75% or more of the solids removed therefrom.

The further cooled gas at 600°F-900°F (316°C-482°C), say 800°F (427°C), leaving the body of cooling liquid which constitutes the second contacting zone is preferably passed together with cooling liquid upwardly through a preferably annular passageway through a third contacting zone toward the gas outlet of the quench chamber. In one embodiment, the annular passageway is defined by the outside surface of the dip tube forming the first cooling zone and the inside surface of the vessel which envelops or surrounds the dip tube and which is characterized by a larger radius than that of the dip tube.

In an alternative embodiment, the annular passageway may be defined by the outside surface of the dip tube forming the first and second contacting zones and the inside surface of a circumscribing draft tube which envelopes or surrounds the dip tube and which is characterized by larger radius than that of the dip tube.

As the mixture of cooling liquid and further cooled synthesis gas (at inlet temperature of 600-900°F (315-482°C), say 800°F (427°C) passes upwardly through the annular third cooling zone, the two phase flow therein effects efficient heat transfer from the hot gas to the cooling liquid: the vigorous agitation in this third cooling zone minimizes deposition of the particles on any of the contacted surfaces. Typically the cooled gas exits this annular third contacting zone at a temperature of 350-600°F (177-316°C), say 500°F (260°C). The gas leaving the third contacting zone contains 0.1-2.5 (0.045-1.1 kg), say 0.4 pounds (0.18 kg) of solids per 1000 SCF (1.95 kmol) of gas, i.e. about 85%-95% of the solids will have been removed from the gas.

The solids, particles of ash (including charge and unconverted fuel) which are removed from the synthesis gas during contact with water in the contacting zone, are passed downwardly into a settling zone in the lower portion of the contacting zone. Here the particles accumulate. Intermittently they may be withdrawn through a first valved passageway during a valve-open period and passed to a lock hopper wherein the solids accumulate. Typically the material fed to the lock hopper may contain 10-50 parts or solids, say 30 parts of solid, per 100 parts of water. The pressure in the lock hopper may typically be 100-1500 psig (6.9-103 bars gauge), say 900 psig (62 bars gauge) and the temperature at 100-220°F (38-104°C), say 180°F (82°C). Solids may be withdrawn from the bottom of the lock hopper through a second valved passageway and withdrawn from the system.

The gas leaving the third contacting zone is withdrawn from the quench chamber. It first passes through an entrance section of a gas outlet conduit and then through the remainder of the gas outlet conduit. It has heretofore been found that the entrance section of the gas outlet conduit becomes plugged because of the deposition therein of an agglomeration of ash fines from combustion.

In a typical instance, which utilizes an outlet conduit from the gas quench chamber of 40 cm diameter, these particles of ash are found to occupy a length of 1-5 diameters, say 2 diameters from the entrance to that conduit i.e. 40-200 cm, say 80 cm. The ash readily forms massive deposits which occupy a substantial portion of the total cross-section area of the outlet conduit.

It will be found that deposition of solids from the solid laden gas will be decreased in the discharge conduit of this novel quench tube assembly, which comprises an attenuated upstanding dip tube having inner and outer perimetric surfaces, and an upper inlet end and a lower outlet end:

an outlet portion of said dip tube adjacent to the outlet end thereof;

a quench ring adjacent to the inner perimetric surface at the inlet end of said dip tube and adapted to direct a curtain of liquid along the inner perimetric surface of said dip tube and toward the outlet end of said dip tube;

serrations on the outlet end of said outlet portion of said dip tube;

a discharge conduit leading from said quench chamber adjacent to the upper inlet end of said attenuated upstanding dip tube; and

spray means for admitting liquid into said discharge conduit and to form therein a wetted wall adjacent to the mouth portion thereof;

a mouth portion at the entrance to said discharge conduit;

spray means for admitting liquid into said discharge conduit and to form therein a wetted wall adjacent to the mouth portion thereof;

whereby charge gas admitted to the inlet end of said dip tube may be contacted with a film of cooling liquid passing downwardly through a first contacting zone in said dip tube, a second contacting zone in said dip tube wherein it is contacted with a body of cooling liquid, upwardly through a third contacting zone in contact with cooling liquid, and laterally through the wetted wall mouth portion at the entrance to said discharge conduit thereby decreasing deposition of solid particles contained in said charge gas in said discharge conduit.

In accordance with practice of the process of this invention, deposition is minimized, and in many instances eliminated, by utilizing an outlet or discharge conduit from the quench gas chamber, at least the entrance position of which includes a wetted-wall. A wetted-wall, as the term is used in this specification, means that the inner surface of the outlet conduit leaving the quench chamber is substantially completely wetted by a spray or film of liquid, preferably water; and in the preferred embodiment, the film is substantially continuous to the end that the gas passing through the outlet conduit (and the solids contained therein) do not come into contact with a metal or refractory surface of the conduit but rather with a thin film of liquid thereon.

In accordance with certain of its aspects, this invention is directed to a quench chamber assembly which comprises

an attenuated upstanding dip tube having inner and outer perimetric surfaces, and an upper inlet end and a lower outlet end;

an outlet portion of said dip tube adjacent to the outlet end thereof;

a quench ring adjacent to the inner perimetric surface at the inlet end of said dip tube and adapted to direct a curtain of liquid along the inner perimetric surface of said dip tube and toward the outlet end of said dip tube;

a discharge conduit leading from said quench chamber adjacent to the upper inlet end of said attenuated upstanding dip tube;

a mouth portion at the entrance to said discharge conduit; and

means for admitting liquid to the inside perimeter of said discharge conduit adjacent to said mouth portion thereof and to form thereon a wetted-wall;

whereby charge gas admitted to the inlet end of said dip tube may be contacted with a film of cooling liquid passing downwardly through a first contacting zone in said dip tube, a second contacting zone in said dip tube wherein it is contacted with a body of cooling liquid, a third contacting zone wherein it is further in contact with cooling liquid, and then through the mouth portion at the entrance to said discharge conduit in contact with said wetted-wall thereby decreasing deposition of solid particles contained in said charge gas in said discharge conduit.

Preferably this wetted-wall is maintained at the inlet to the outlet or discharge conduit and typically for 1-5 diameters, preferably 1-3 diameters, say about 2 diameters into the conduit.

The wetted-wall of the outlet conduit may be provided by a collar around the outside of the conduit which admits liquid into the conduit preferably with an axial component of velocity which may be 150-1500, preferably 300-1000, say 500 cm/second. It is alternatively possible to obtain the wetted-wall by spraying liquid into the outlet conduit at a point proximate to that at which the gas enters the outlet conduit.

The presence of the wetted-wall is found to minimize or eliminate the deposition of solids in the outlet conduit, and particularly at the entrance thereto. Although it is not clear why this is so, it appears that one or more of the following factors may be relevant:

(i) the film of liquid on the wetted-wall physically prevents contact of solids in the gas with the metal surface;

(ii) the motion of the film of liquid washes away any solids which may deposit on the metal surface;

(iii) the vaporization of the liquid may dislodge any solids which may deposit on the metal surface;

(iv) the presence of the stream may form an inner vapor film adjacent to the liquid film which serves as another barrier to particles which might be directed toward the wall;

(v) the addition of water to the stream of gas may serve as a solubilizing medium for the solids in the gas or possibly as a film around the particles which may prevent adjacent particles from adhering to one another and from adhering to the walls of the conduit;

(vi) the radially directed velocity component of the water stream may alter the gas velocity profiles next to the wall in such a way as to inhibit the deposition of solid particles on the wall.

The liquid which may be employed to form the wetted-wall may be any liquid which is available. Preferably the liquid may be an aqueous liquid containing a minimum of entrained or dissolved solids. The water spray into the outlet conduit, preferably as introduced axially into the inlet thereof in a manner to wet the interior surfaces thereof, is found to be sufficient to prevent build-up of solids in the outlet conduit.

DESCRIPTION OF THE DRAWINGS

Figure 1 of the drawing show a schematic vertical section of a generator and associated therewith a quench chamber and outlet conduit. Figure 2 shows, in greater detail, the preferred embodiment with particular reference to the outlet conduit 20 of Figure 1. Figure 3 shows an alternative embodiment of the water spray device at the entrance to the outlet conduit and Figure 4 shows a section of Figure 3 portion. Figure 5 shows an alternative embodiment.

DESCRIPTION OF PREFERRED EMBODIMENTS

In this Example which represents the best mode of practicing the invention known at this time, there is provided in Figures 1 and 2 a reaction vessel 11 having a refractory lining 12 and inlet nozzle 13. The reaction chamber 15 has an outlet portion 14 which includes a narrow throat section 16 which feeds into opening 17. Opening 17 leads into first contacting zone 18 inside of dip tube 21. The lower extremity of dip tube 21, which bears serrations 23, is immersed in bath 22 of quench liquid. The quench chamber 19 includes, preferably at an upper portion thereof, a gas discharge conduit 20.

A quench ring 24 is mounted at the upper end of dip tube 21. This quench ring may include an upper surface 26 which preferably rests against the lower portion of the lining 12 of the vessel 11. A lower surface 27 of the quench ring preferably rests against the upper extremity of the dip tube 21. The inner surface 28 of the quench ring may be adjacent to the edge of opening 17.

Quench ring 24 includes outlet nozzles 25 which may be in the form of a series of holes or nozzles around the periphery of quench ring 24 - positioned immediately adjacent to the inner surface of dip tube 21. The liquid projected through passageways or nozzles 25 passes in a direction generally parallel to the axis of the dip tube 21 and forms a thin falling film of cooling liquid which descends on the inner surface of dip tube 21. This falling film of cooling liquid forms an outer boundary of the first contacting zone.

At the lower end of the first contacting zone 18, there is a second contacting zone 30 which extends downwardly toward serrations 23 and which is also bounded by the portion of the downwardly descending film of cooling liquid which is directed towards the wall on the lower portion of dip tube 21.

The solids, including particles of ash, char, and unconverted fuel which are removed from the gas by contact with the water in bath 22 accumulate and collect in the lower portion of the body of liquid 22. Once during an operating cycle, valve 37 is closed and the particles are maintained in the settling zone. For the remainder of the cycle during a valve-open period, valve 37 is opened and the particles pass downwardly through valve 37 and are withdrawn from the system.

The gas flows downwardly past serrations 23 into the third contacting zone, and upwardly therein between the outer circumference of dip tube 21 and quench chamber 19.

The further cooled synthesis gas containing a decreased content of solid particles flows upwardly towards discharge conduit 20. The gas enters the discharge conduit 20. In this preferred embodiment as shown in detail in Figure 2, there is mounted a spray-insert in the inlet or entrance portion of the discharge conduit 20.

The spray insert includes a spray water supply tube 40 which is mounted on the side of conduit 41 and which projects into outlet or discharge conduit 20. Supply tube 40 in this embodiment terminates in spray head 42 adjacent to mouth 43 of discharge conduit 20. The spray head 42 contains nozzles 45 which direct the flow of liquid onto the inner surface 44 of conduit 20 and preferably completely over the surface 44 with a wetted film of liquid.

Figure 3-4 show details of one embodiment of a spray water supply tube 40 and openings 45 therein.

Figure 5 shows an alternative means for admitting liquid into the discharge conduit 20 and to form therein a wetted-wall adjacent to the mouth portion thereof.

This embodiment of Figure 5 includes a collar 46 which in the preferred embodiment includes a cylindrical structure mounted on the side of the chamber 19 at point preferably adjacent to the junction thereof with the outlet conduit 20. Collar 45, to which liquid may be admitted through line 46 includes slits or openings 47 through which cooling liquid is admitted and forms a film on the wetted-wall 44 of the conduit 20. The cooling liquid is preferably admitted with a substantial axial component and forms a film on the conduit wall which extends downstream.

EXAMPLE II

In operation of the process of this invention utilizing the preferred embodiment of the apparatus of Figure 1, there is admitted through inlet nozzle 13, a slurry containing 100 parts per unit time (all parts are by weight unless otherwise specifically stated) of charge coal and 60 parts of water. This charge coal is characterized as follows:

TABLE

Component	Weight % (dry)
Carbon	67.6
Hydrogen	5.2
Nitrogen	3.3
Sulfur	1.0
Oxygen	11.1
Ash	11.8

There are also admitted 90 parts of oxygen of plurity of 99.5 v%. Combustion in chamber 15 raises the temperature to 2500°F (1371°C) at 900 psig (62 bars gauge). Product synthesis gas, passed through outlet portion 14 and throat section 16, may contain the following gaseous components.

TABLE

Component	Volume % Wet Basis	Volume % Dry Basis
CO	35.7	44.7
H_2	28.5	35.7
CO_2	14.4	18
H_2O	20	--
H_2S + COS	0.9	1.1
N_2 + Argon	0.4	0.5
CH_4	0.08	0.1

This synthesis gas may also contain about 4.1 pounds (1.85 kg) of solid (char and ash) per 1000 SCF (1.95 kmol) dry gas.

The product synthesis gas leaving the throat section 16 passes through opening 17 in the quench ring 24 into first contacting zone 18. Aqueous cooling liquid at 420°F (216°C) is admitted through inlet 34 to quench ring 24 from which it exits through outlet nozzles 25 as a downwardly descending film on the inner surface of dip tube 21 which defines the outer boundary of first contacting zone 18. As synthesis entering the first contacting zone at about 2500°F (1371°C) passes downwardly through the zone 18 in contact with the falling film of aqueous cooling liquid, it is cooled to about 2150°F-2200°F (1177°C-1204°C).

The so-called synthesis gas is then admitted to the second contacting zone 30. It passes under serrated edge 23 into contact with the body of liquid. Although the drawing shows a static representation having a delineated "water-line", it will be apparent that in operation, the gas and the liquid in the second contacting zone will be in violent turbulence as the gas passes downwardly through the body of liquid, leaves the dip tube 21 passing serrated edge 23 thereof, and passes upwardly through the body of liquid outside the dip tube 21.

The further cooled synthesis gas, during its contact with cooling liquids loses at least a portion of its solids content. Typically the further cooled synthesis gas containing a decreased content of ash particles leaving the body of liquid 22 in second contacting zone 30 contains solids (including ash and char) in amount of about 0.6 pounds (0.27 kg) per 1000 SCF (1.95 kmol) dry gas.

The exiting gas at 500°F (260°C) is admitted to the mouth 43 of discharge conduit 20. Here it passes mouth portion 43 and adjacent to wall portion 44 as it leaves the system.

In practice of the process of this invention, there is admitted, through spray water supply tube 40, aqueous liquid. This liquid is sprayed through the nozzles in spray head 42 in manner to impinge upon inside wall 44 and to form a wetted-wall thereon. The exiting gas passes through outlet conduit 20 and because of the wetted-walls thereon, there is little or no build-up of solid on the wall 44.

It is found that the solid content of the exit gases passes through the discharge conduit 20 without deposition therein. In prior systems wherein the exit gas passed into a conduit which did not have the described spray conduit 40 and head 42, it was found that there was a substantial build-up of solids in the area generally occupied by the structure 43 and 44 and ultimately the build-up reached a point at which it was necessary to shut down the entire unit for cleaning.

Although this invention has been illustrated by reference to specific embodiments, it will be apparent to those skilled in the art that various changes and modifications may be made which clearly fall within the scope of this invention.

CLAIMS

1. A method of cooling from an initial high temperature to a lower final temperature, a hot synthesis gas containing solids under conditions which permit removal of solids from said gas which comprises:

passing said hot synthesis gas at initial high temperature downwardly through a first contacting zone;

passing cooling liquid downwardly as a film on the walls of said first contacting zone and in contact with said downwardly descending synthesis gas thereby forming a further cooled synthesis gas containing a decreased content of solid particles;

recovering said further cooled synthesis gas containing a decreased content of solid particles; and

withdrawing said synthesis gas containing a decreased content or solid particles through a discharge conduit; characterized in that

said further cooled synthesis gas containing a decreased content of solid particles is passed through a wetted-wall discharge conduit whereby the deposition of solid particles in said conduit is decreased.

2. A method as claimed in Claim 1 wherein liquid is sprayed onto the walls of said wetted-wall discharge conduit.

3. A method as claimed in Claim 1 wherein liquid is sprayed onto at least the entrance portion of the wetted-wall discharge conduit.

4. A method as claimed in Claim 1 wherein the wetted-wall portion of the discharge conduit

is maintained wetted at the inlet end of the discharge conduit and for 1-5 diameters into the discharge conduit.

5. A method as claimed in Claim 1 wherein the wetted-wall portion of the discharge conduit is maintained wetted at the inlet end of the discharge conduit and for 1-3 diameters into the discharge conduit.

6. A method as claimed in Claim 1 wherein the wetted-wall portion of the discharge conduit is maintained wetted at the inlet end of the discharge conduit and for about 2 diameters into the discharge conduit.

7. A method as claimed in Claim 1 wherein liquid is admitted to the discharge conduit as a substantially continuous film.

8. A method as claimed in Claim 1 wherein liquid is admitted to the discharge conduit as a substantially continuous film at the periphery of the mouth at the inlet to the discharge conduit.

9. A method as claimed in Claim 1 wherein liquid is admitted to the discharge conduit as a substantially continuous film, onto the inner surface thereof at the periphery of the mouth at the inlet to the discharge conduit, with an axial component of velocity of 150-1500 cm/sec.

10. A quench chamber assembly which comprises an attenuated upstanding dip tube (21), a quench ring (28) adjacent to the inner perimetric surface at the upper inlet end of said dip tube and adapted to direct a curtain of liquid along the inner perimetric surface of said dip tube and toward the lower outlet

end of said dip tube; a discharge conduit (20) leading from said quench chamber adjacent to the upper inlet end of said attenuated upstanding dip tube; characterized by means (40;46) for admitting liquid to the inside perimeter of said discharge conduit adjacent to an entrance, mouth portion thereof and to form thereon a wetted-wall to decrease deposition of solid particles contained in a charge gas flow in said discharge conduit.

11. Apparatus as claimed in Claim 10 including a spray (42) within said discharge conduit (20) adjacent to said mouth portion whereby liquid is directed onto said wetted-wall.

12. Apparatus as claimed in Claim 10 including a collar (46) around the outside of the mouth portion of said discharge conduit (20) whereby a substantially continuous film of liquid is directed onto said wetted-wall.

FIG.1.

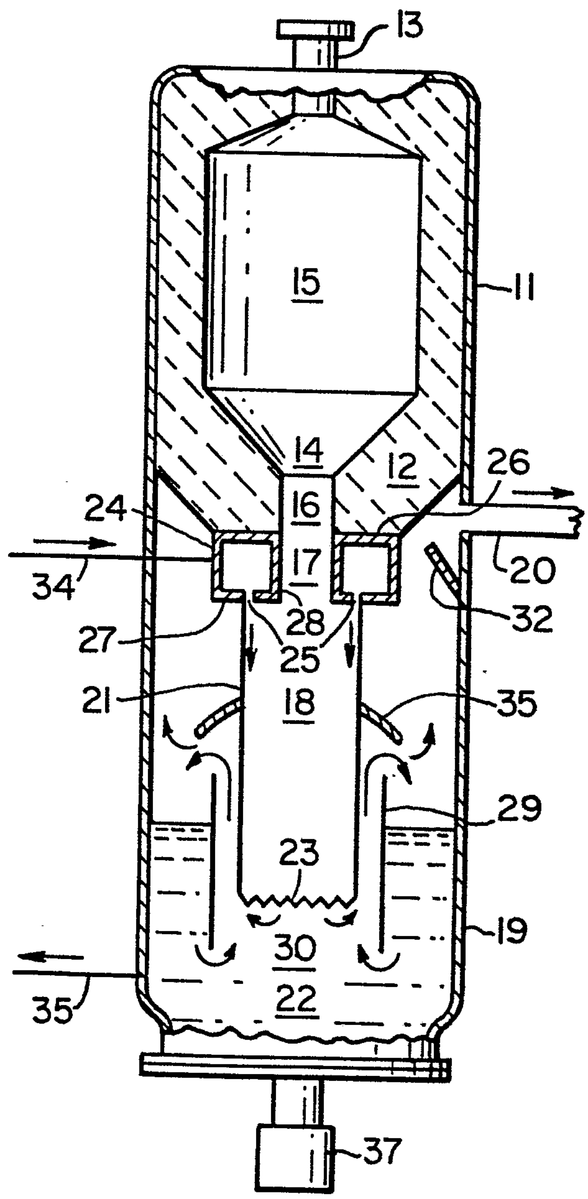
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FIG.2.

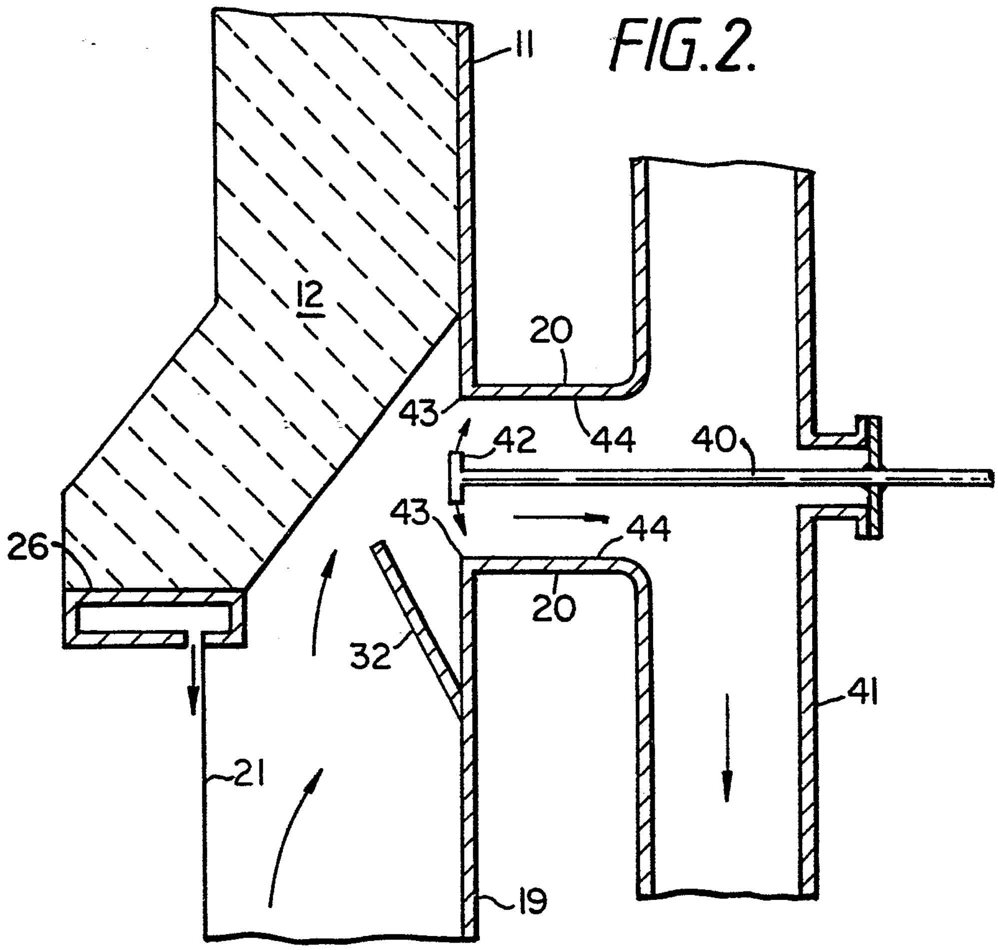

FIG.3.

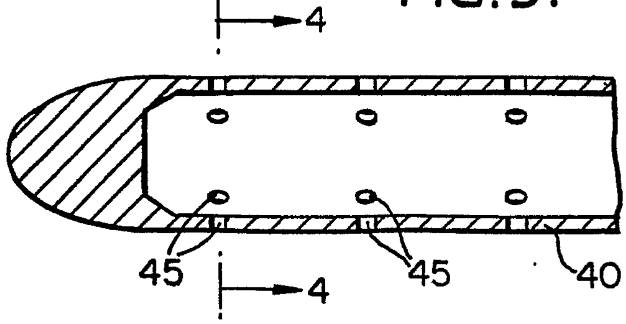

FIG.4.

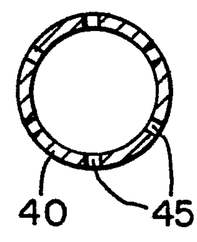

FIG.5.