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RECOVERY IN A GASIFICATION SYSTEM****Publication Classification**

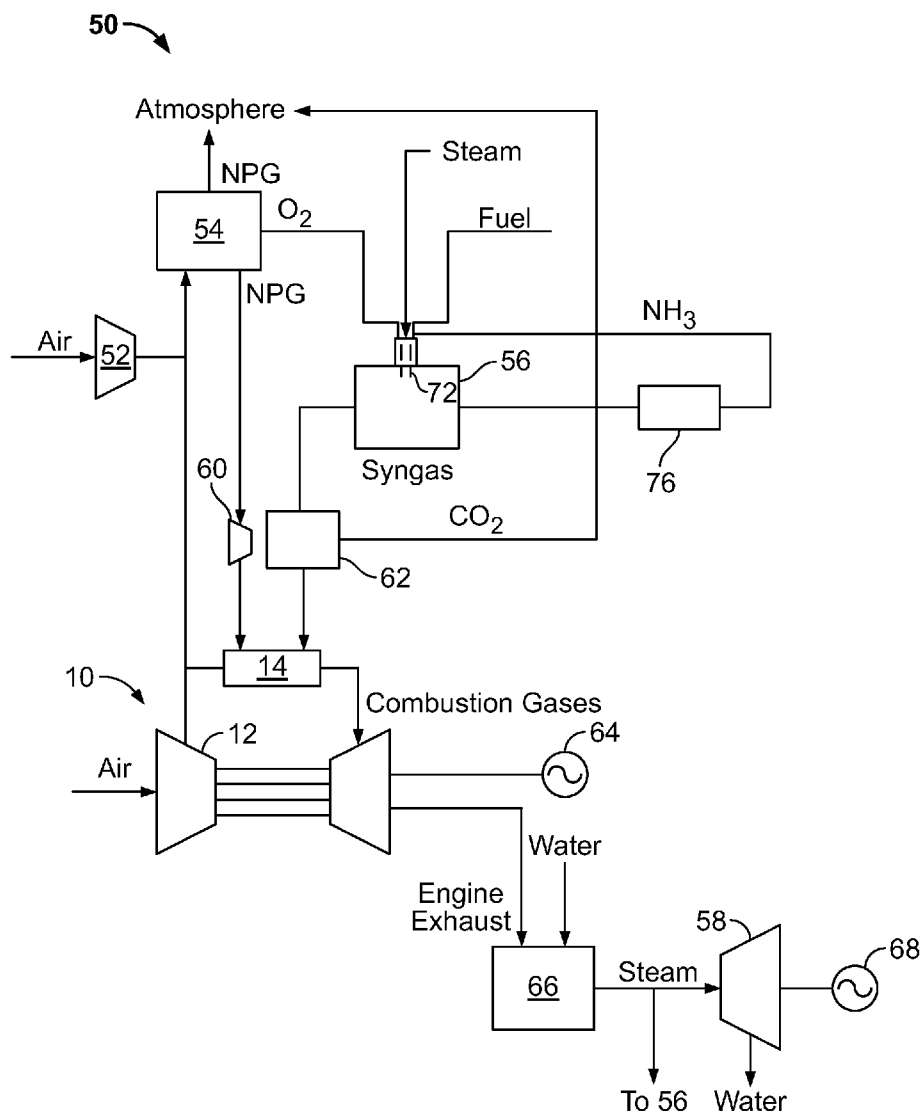
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(57) **ABSTRACT**

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A tube and shell heat exchanger for a gasification system is provided. The heat exchanger includes a first shell-side inlet positioned proximate to a heat exchanger tube-side inlet. The first shell-side inlet is configured to receive a first portion of a scrubbed syngas flow therethrough. This first scrubbed syngas portion facilitates substantially preventing fouling at the heat exchanger inlet. The heat exchanger also includes a second shell-side inlet positioned proximate to a heat exchanger tube-side outlet. The second shell-side inlet is configured to receive a second portion of a scrubbed syngas flow therethrough.



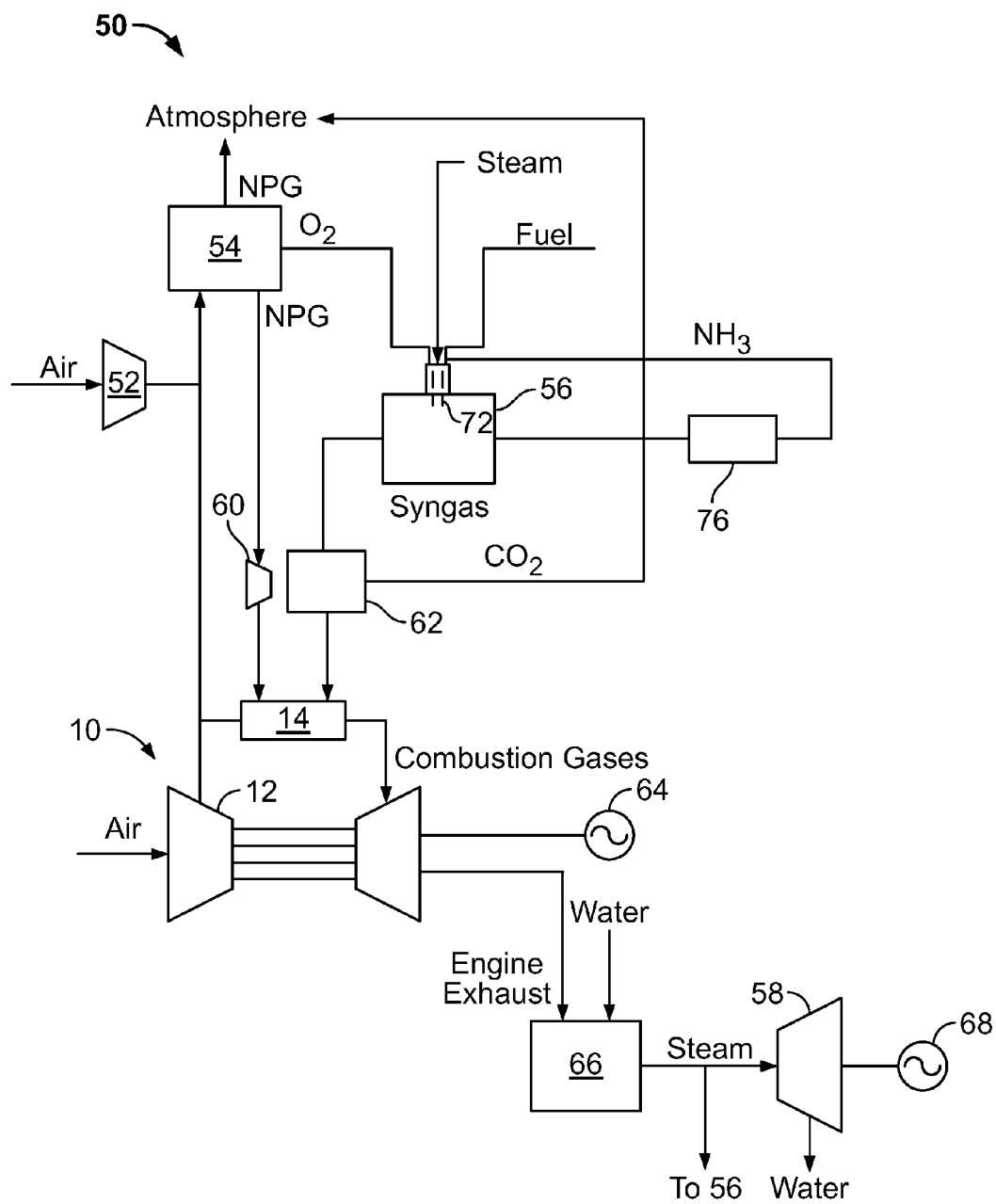


FIG. 1

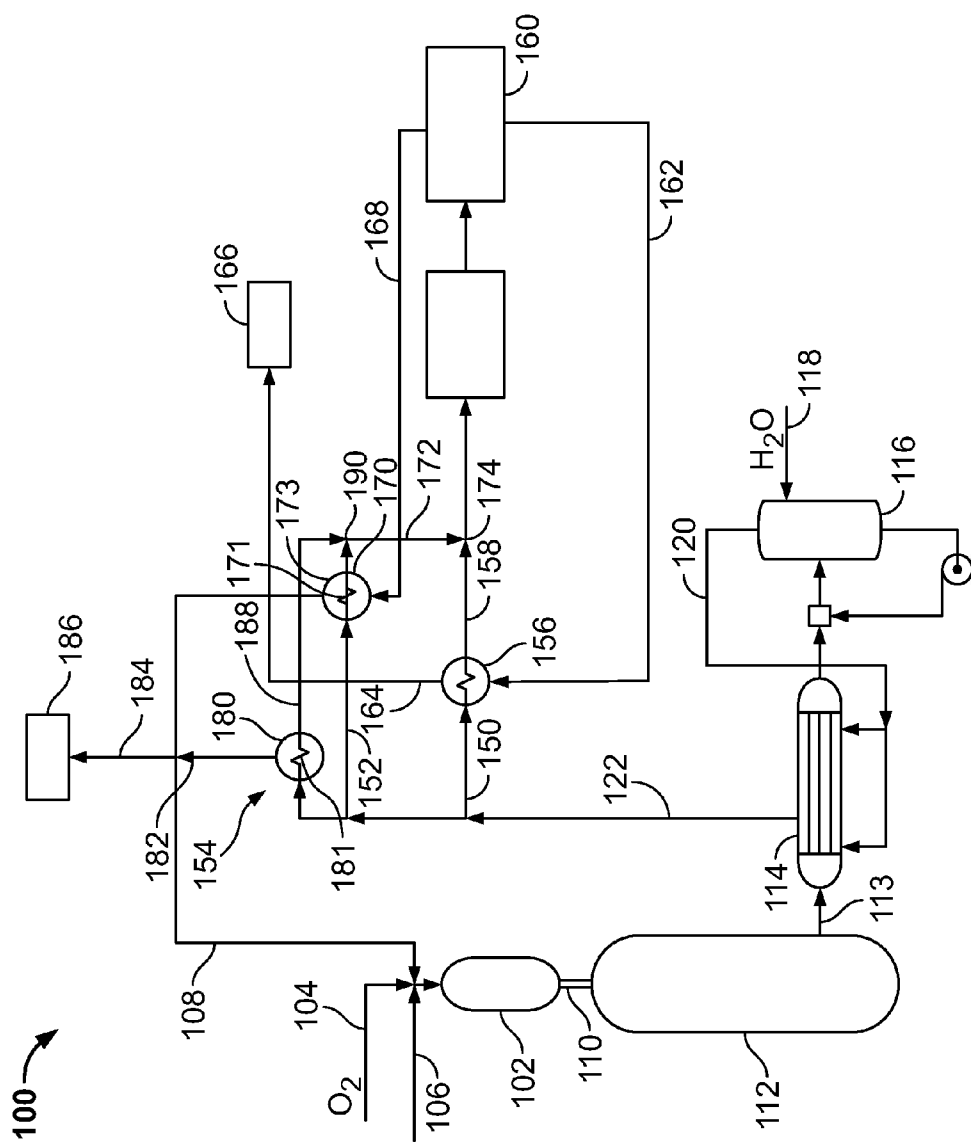


FIG. 2

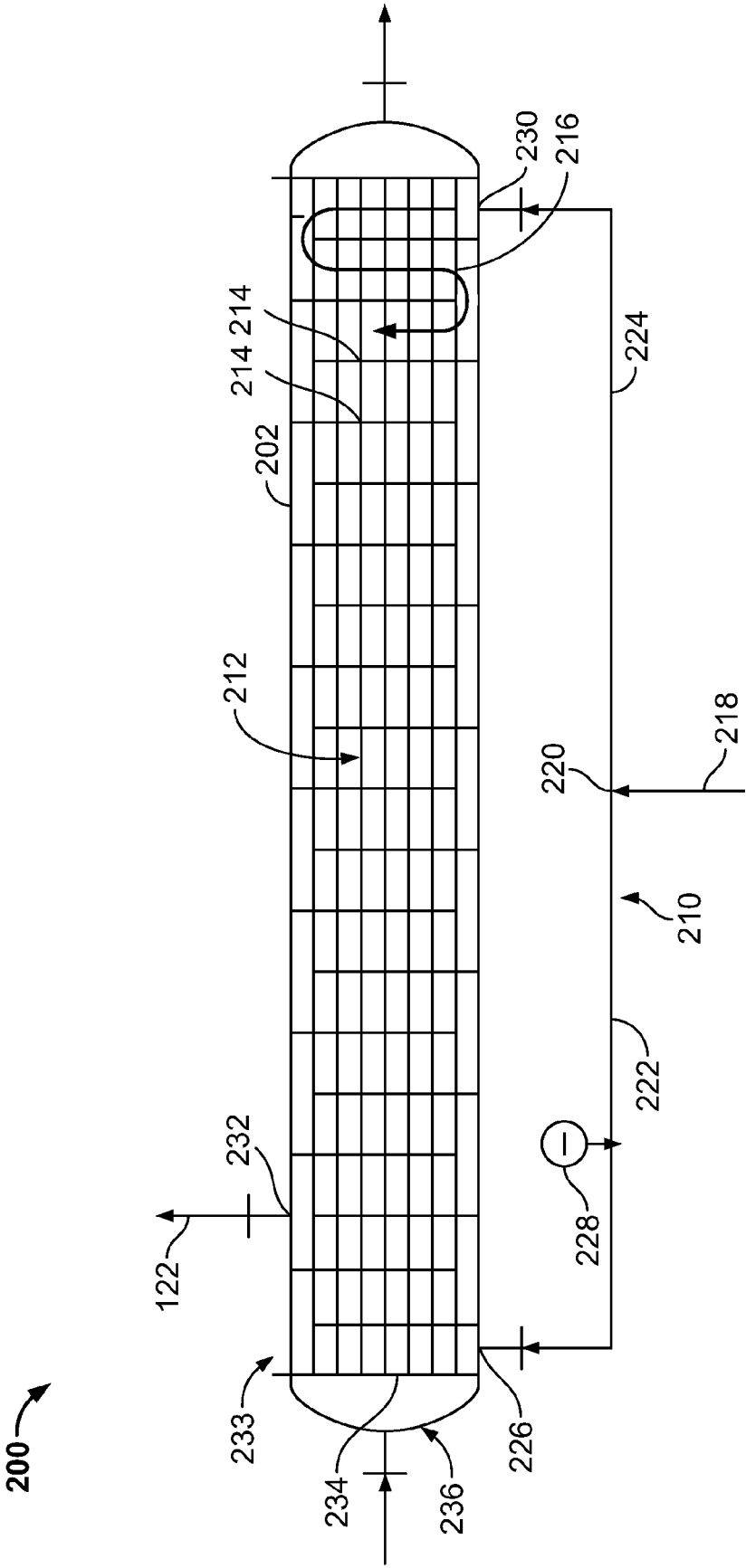


FIG. 3

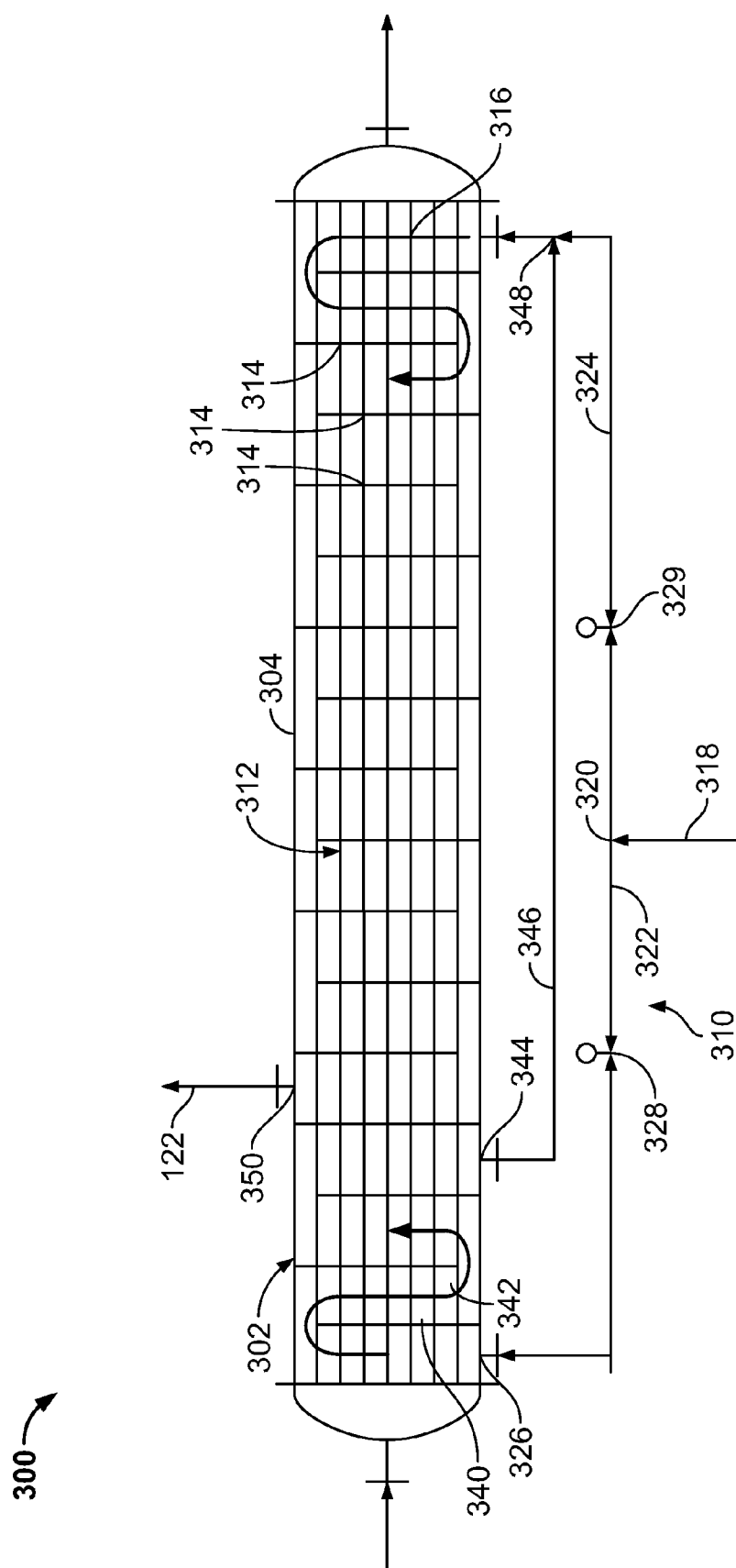


FIG. 4

METHODS AND SYSTEM FOR HEAT RECOVERY IN A GASIFICATION SYSTEM

BACKGROUND OF THE INVENTION

[0001] The field of the invention relates generally to integrated gasification combined-cycle (IGCC) power generation systems, and more specifically to methods and systems for heat recovery in IGCC systems.

[0002] At least some known IGCC systems include a gasification system that is integrated with at least one power producing turbine system. For example, known gasifiers convert a mixture of fuel, air or oxygen, steam, limestone, and/or other additives into an output of partially combusted gas, sometimes referred to as "syngas." The hot combustion gases are supplied to the combustor of a gas turbine engine, which powers a generator that supplies electrical power to a power grid. Exhaust from at least some known gas turbine engines is supplied to a heat recovery steam generator that generates steam for driving a steam turbine. Power generated by the steam turbine also drives an electrical generator that provides electrical power to the power grid.

[0003] In some known IGCC plants, hydro-carbonaceous feeds that include coal, petroleum coke and high-ash residual oils, are reacted with high purity oxygen (typically 95% oxygen purity) to produce syngas in a temperature range of 2200° F. to 2700° F. Most of the heat in this syngas is recovered as the syngas is channeled from a radiant syngas cooler (RSC) to a convective syngas cooler (CSC). Known radiant syngas coolers, wherein the primary heat transfer mechanism is by radiation, cool the syngas to a range of about 1000° F. to about 1300° F. and generate high pressure steam therefrom. Known convective syngas coolers, where the primary heat transfer mechanism is by convection, generate high-pressure and some medium-pressure steam. Some known IGCC plants include a cooled connection line that couples the two syngas coolers to one another for use in generating medium-pressure steam.

[0004] However, some known IGCC plants have experienced a tendency for fouling with particulate matter at some hot surfaces, particularly in the region of the entrance to the CSC. In such IGCC plants, the presence of hot surfaces results in the particulate within the fuel gas impacting and adhering to the hot surfaces along the interiors of the connection lines.

BRIEF DESCRIPTION OF THE INVENTION

[0005] In one aspect, a tube and shell heat exchanger for a gasification system is provided. The heat exchanger includes a first shell-side inlet positioned proximate to a heat exchanger inlet. The first shell-side inlet is configured to receive a first portion of a scrubbed syngas flow therethrough. This first scrubbed syngas portion facilitates substantially preventing fouling at the heat exchanger inlet. The heat exchanger also includes a second shell-side inlet positioned proximate to a heat exchanger outlet. The second shell-side inlet is configured to receive a second portion of a scrubbed syngas flow therethrough.

[0006] In another aspect, a gasification system is provided. The system includes a gasifier configured to produce a flow of syngas, a syngas cooler configured to receive said flow of syngas from said gasifier and reduce a temperature associated with said flow of syngas; and a tube and shell heat exchanger. The heat exchanger includes a first shell-side inlet positioned

proximate to a heat exchanger inlet. The first shell-side inlet is configured to receive a first portion of a scrubbed syngas flow therethrough. This first scrubbed syngas portion facilitates substantially preventing fouling at the heat exchanger inlet. The heat exchanger also includes a second shell-side inlet positioned proximate to a heat exchanger outlet. The second shell-side inlet is configured to receive a second portion of a scrubbed syngas flow therethrough.

[0007] In yet another aspect, a method for operating a gasification system is provided. The method includes scrubbing a first stream of raw syngas to facilitate removing impurities therefrom, producing a stream of scrubbed syngas from the scrubbed first stream, transferring heat from a second stream of raw syngas to the stream of scrubbed syngas to produce a cooled raw syngas stream and a heated scrubbed syngas stream. The method also includes channeling at least a portion of the stream of scrubbed syngas to facilitate substantially preventing fouling from the first stream of raw syngas.

[0008] Various refinements exist of the features noted in relation to the above-mentioned aspects of the present invention. Further features may also be incorporated in the above-mentioned aspects of the present invention as well. These refinements and additional features may exist individually or in any combination. For instance, various features discussed below in relation to any of the illustrated embodiments of the present invention may be incorporated into any of the above-described aspects of the present invention, alone or in any combination.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Non-limiting and non-exhaustive embodiments are described with reference to the following figures, wherein like reference numerals refer to like parts throughout the various views unless otherwise specified.

[0010] FIG. 1 is a schematic diagram of an exemplary integrated gasification combined-cycle (IGCC) power generation system.

[0011] FIG. 2 is a schematic illustration of an exemplary raw syngas/scrubbed syngas heat exchanger used with the IGCC power generation system shown in FIG. 1.

[0012] FIG. 3 is a schematic illustration of an asymmetrical split-flow heat exchanger used with the IGCC power generation system shown in FIG. 2.

[0013] FIG. 4 is a schematic illustration of an alternative split flow heat exchanger with an isolated entrance section that may be used with the IGCC power generation system shown in FIG. 2.

DETAILED DESCRIPTION OF THE INVENTION

[0014] FIG. 1 is a schematic diagram of an exemplary integrated gasification combined-cycle (IGCC) power generation system 50. In the exemplary embodiment, IGCC system 50 generally includes a main air compressor 52, an air separation unit 54 coupled in flow communication to compressor 52, a gasifier 56 coupled in flow communication to air separation unit 54, a gas turbine engine 10 coupled in flow communication to gasifier 56, and a steam turbine 58. In operation, compressor 52 compresses ambient air that is then channeled to air separation unit 54. In some embodiments, in addition to or in the alternative to compressor 52, compressed air from gas turbine engine compressor 12 is supplied to air separation unit 54. Air separation unit 54 uses the compressed air to generate oxygen for use by gasifier 56. More specifically, air

separation unit **54** separates the compressed air into separate flows of oxygen and a gas by-product, sometimes referred to as a "process gas". The process gas generated by air separation unit **54** includes nitrogen and is referred to herein as "nitrogen process gas". The nitrogen process gas may also include other gases such as, but not limited to, oxygen and/or argon. For example, in some embodiments, the nitrogen process gas includes between about 95% and about 100% nitrogen.

[0015] The oxygen flow from air separation unit **54** is channeled to gasifier **56** for use in generating partially combusted gases, referred to herein as "syngas" for use by gas turbine engine **10** as fuel, as is described in more detail herein. In some embodiments, at least some of the nitrogen process gas flow, a by-product of air separation unit **54**, is vented to the atmosphere. Moreover, in other embodiments, some of the nitrogen process gas flow is injected into a combustion zone (not shown) within gas turbine engine combustor **14** to facilitate controlling emissions generated within engine **10**, and more specifically to facilitate reducing the combustion temperature and nitrous oxide emissions from engine **10**. In the exemplary embodiment, IGCC system **50** also includes a compressor **60** for compressing the nitrogen process gas flow before it is injected into the combustion zone.

[0016] Gasifier **56** converts a mixture of fuel, the oxygen supplied by air separation unit **54**, and recycle solids, and/or liquid water and/or steam, and/or a slag additive into an output of syngas for use by gas turbine engine **10** as fuel. Although gasifier **56** may use any fuel, in some embodiments, gasifier **56** uses coal, petroleum coke, residual oil, oil emulsions, tar sands, and/or other similar fuels. In the exemplary embodiment, the syngas generated by gasifier **56** includes carbon dioxide. As such, in the exemplary embodiment, the syngas generated by gasifier **56** is cleaned in a clean-up device **62** before being channeled to gas turbine engine combustor **14** for combustion thereof. Carbon dioxide may be separated from the syngas during clean-up and, in the exemplary embodiment, the carbon dioxide is vented to the atmosphere. In the exemplary embodiment, a gasifier blowdown connection is coupled to a waste treatment system (not shown in FIG. 1).

[0017] Power output from gas turbine engine **10** is used to drive a generator **64** that supplies electrical power to a power grid (not shown). Exhaust gases from gas turbine engine **10** are supplied to a heat recovery steam generator **66** that generates steam for use by steam turbine **58**. Power generated by steam turbine **58** drives an electrical generator **68** that supplies electrical power to a power grid. In the exemplary embodiment, steam from heat recovery steam generator **66** is supplied to gasifier **56** for generating the syngas.

[0018] In the exemplary embodiment, IGCC system **50** includes a syngas condensate stripper **76** that receives condensate from a stream of syngas discharged from gasifier **56**. The condensate typically includes a quantity of ammonia that is dissolved in the condensate. At least a portion of the dissolved ammonia is formed in gasifier **56** from a combination of nitrogen gas and hydrogen in gasifier **56**. To remove the dissolved ammonia from the condensate the condensate is boiled. Stripped ammonia is discharged from stripper **76** and is channeled to a waste treatment system (not shown in FIG. 1). In an alternative embodiment, the stripped ammonia is returned to gasifier **56**, at a pressure that is higher than that of the gasifier, to be decomposed in a high temperature region of the gasifier **56** proximate a nozzle tip **72**. The ammonia is

injected into the gasifier **56** such that the flow of ammonia in the vicinity of the high temperature region proximate nozzle tip **72** facilitates cooling nozzle tip **72**.

[0019] FIG. 2 is a schematic of an exemplary raw syngas/scrubbed syngas heat exchanger assembly **100** used with the IGCC power generation system **50**, shown in FIG. 1. In the exemplary embodiment, a gasifier **102** is provided that is configured to receive a flow of oxygen **104**, a flow of feedstock **106**, e.g. a coal slurry, and a flow of recycled carbon dioxide within conduit **108**. As described in more detail herein, syngas produced in gasifier **102** is channeled via conduit **110** to a radiant syngas cooler (RSC) **112**. The temperature of the syngas upon entry to RSC **112** ranges from about 2300° F. to about 2500° F., but may range from about 2100° F. to about 2700° F. The syngas is cooled in RSC **112** and upon exiting RSC **112** is about 1100° F., but may range from about 1000° F. to about 1300° F.

[0020] Upon exiting RSC **112**, syngas is then channeled via a conduit **113** through a heat exchanger **114** where it is cooled and facilitates forming a raw syngas stream (not shown) at a temperature of about 350° F., but may range from about 350° F. to about 500° F. In the exemplary embodiment, heat exchanger **114** is a convective syngas cooler (CSC) used for transferring heat from the raw syngas exiting RSC **112** to a recycled scrubbed syngas stream, as described herein. More specifically, in the exemplary embodiment, heat exchanger **114** includes a tube and shell configuration, as described in more detail herein. The raw syngas stream is then channeled to a syngas scrubber **116** wherein any remaining particulate material (not shown) within the raw syngas stream is removed, forming a scrubbed syngas stream. More specifically, scrubbed syngas is formed when raw syngas from heat exchanger **114** has been contacted with a flow of water **118** in scrubber **116** to wet and remove any contained particulates. The scrubbing water is separated from the syngas, and the scrubbed syngas is channeled through a recycling conduit **120** into heat exchanger **114** to cool heat exchanger internal surfaces (not shown in FIG. 2) and facilitate reducing the potential for fouling caused by the deposit of particulate material, as described in more detail herein.

[0021] More specifically, and in the exemplary embodiment, heat exchanger **114** further facilitates heating the recycled, scrubbed syngas received from conduit **120** before the syngas is channeled combustor **14** of gas turbine engine **10** (shown in FIG. 1) via a conduit **122**, which powers a generator that supplies electrical power to a power grid (not shown). In this embodiment, following heat transfer from the entering raw syngas stream, the scrubbed syngas temperature will be increased to a temperature of about 850° F., but may range from about 700° F. to about 900° F. This reheated stream of scrubbed syngas is next channeled in parallel with two cooler streams in the IGCC plant to recover heat from the syngas flow to obtain a higher overall IGCC efficiency via conduits **150**, **152**. The first stream is processed to remove sulfur, and the second stream channels carbon dioxide recovered from the syngas to be recycled for use by gasifier **102**.

[0022] Syngas exits heat exchanger **114** via conduit **122** and, in the exemplary embodiment, is channeled to a downstream cooling system **154** that recovers heat from the syngas and further increases the overall efficiency of the IGCC system **50**. Syngas is channeled via conduit **150** to a first heat exchanger **156** having a tube and shell configuration. The syngas exits first heat exchanger **156** and is channeled via a conduit **158** to a sulfur removal system **160** that further cleans

the syngas stream. Clean syngas exits sulfur removal system **160** and is channeled via a conduit **162** to the shell side of first heat exchanger **156** and is further heated therein by heat transferred from the syngas being channeled through the tube side of first heat exchanger **156**. Clean syngas is then channeled from first heat exchanger **156** via conduit **164** to a combustion turbine **166** for use as a fuel source. In the exemplary embodiment, CO₂ produced as a waste product within sulfur removal system **160** is via a conduit **168** to a shell side of a second heat exchanger **170**, as described in more detail herein.

[0023] More specifically and in the exemplary embodiment, syngas exiting heat exchanger **114** is channeled via conduits **122** and **152** to second heat exchanger **170**. More specifically, conduit **152** is coupled to a tube side **171** of second heat exchanger **170** and syngas is channeled therethrough. Waste CO₂ is channeled through a shell side **173** of second heat exchanger **170** and heated therein, which further cools syngas being channeled through tube side **171**. Waste CO₂ exits shell side **173** of second heat exchanger **170** and is channel via conduit **108** to gasifier **102**, as described in more detail herein. Syngas exiting tube side **171** of second heat exchanger **170** is channeled via a conduit **172** and mixes with syngas in conduit **158** at a junction **174**.

[0024] In the exemplary embodiment, syngas exiting heat exchanger **114** is channeled via conduit **122** to a third heat exchanger **180**. A temperature of syngas being channeled through a tube side **181** of third heat exchanger **180** produces a medium pressure steam **182** that may be channeled via a conduit **184** to a steam turbine **186** for use in powering steam turbine **186**. Syngas exiting tube side **181** of third heat exchanger **180** is channeled via a conduit **188** to join syngas being channeled within conduit **172** at a junction **190**.

[0025] FIG. 3 is a schematic of an asymmetrical split-flow heat exchanger **200** used with the IGCC power generation system **50** shown in FIG. 1. In the exemplary embodiment, heat exchanger **200** includes a tube and shell configuration including a shell **202**, a split-feed shell-side tube system **210** and a single-pass tube-side system **212**. Exchanger also includes a plurality of baffles **214** positioned within shell **202** that are configured to channel airflow therethrough, e.g. along a path **216**. Low temperature scrubbed syngas (in the temperature range of about 350° F. to about 400° F., as described herein) is channeled via a conduit **218** from scrubber **116** (shown in FIG. 2) into shell-side tube system **210**. Scrubbed gas flow is divided therein at a junction **220** that includes a first flow conduit **222** and a second flow conduit **224** downstream from junction **220**. A portion of the low temperature scrubbed syngas stream is channeled via first flow conduit **222** to a heat exchanger shell-side inlet on the hot gas end (tube-side) **226**. A restriction orifice **228** positioned along first flow conduit **222** regulates the flow of scrubbed syngas therethrough. In the exemplary embodiment, about 10% of the scrubbed syngas that is channeled from scrubber **116** via conduit **218** is channeled to the shell-side inlet on the hot gas end **226**. Alternatively, about 5% to about 25% of the scrubbed syngas may be channeled to the shell-side inlet on the hot gas end **226**.

[0026] The remaining portion of the low temperature scrubbed syngas stream is then channeled via second flow conduit **224** to a shell side entrance on the tube-side outlet end **230** of heat exchanger **200**. In the exemplary embodiment, about 90% of the scrubbed syngas flow is channeled to shell side entrance **230** of heat exchanger **200**. Alternatively, about

75% to about 95% of the scrubbed syngas may be channeled to shell side entrance **230**, dependent upon the amount of syngas channeled via first flow conduit **222** to the shell-side inlet on the hot gas end **226** as regulated by restriction orifice **228**. In the exemplary embodiment, the syngas stream within second flow conduit **224** is channeled counter to the flow of hot syngas within the tube-side system **212**. Such a flow maximizes the counter-current flow effect, resulting in a lower raw syngas outlet temperature, i.e. the scrubbed syngas exit temperature may be substantially higher than the hot syngas exit temperature. The hot scrubbed syngas exit nozzle positioned downstream at a location **233** where the flow pattern inside the tubes has become streamlined.

[0027] During operation, an interior surface **234** of an inlet area of heat exchanger **200** is particularly prone to fouling as particulate within the raw syngas stream impacts and adheres to interior surface **234** due to a turbulent flow pattern of the hot syngas flowing into heat exchanger **200**. The insertion of a flow of relatively cooler scrubbed syngas, i.e., through heat exchanger hot gas end **226**, cools the heat exchanger inlet tube surfaces substantially prevents the accumulation of particulate within heat exchanger inlet tube walls, and facilitates streamlining the syngas flow pattern immediately downstream from inlet area **236** so that particles no longer impinge against the tube wall surface.

[0028] FIG. 4 is a schematic illustration of an alternative split flow heat exchanger **300** with an isolated entrance section **302** that may be used with the IGCC power generation system **50**, shown in FIG. 2. In the illustrated embodiment, heat exchanger **300** includes a tube and shell configuration including a shell **304**, a split-feed shell-side tube system **310** and a single-pass tube side system **312**. Exchanger also includes a plurality of baffles **314** positioned within shell **304** that are configured to channel airflow therethrough, e.g. along a path **316**. Low temperature scrubbed syngas (in the temperature range of about 350° F. to about 400° F., as described herein) is channeled via a conduit **318** from scrubber **116** (shown in FIG. 2) into shell-side tube system **310**. Scrubbed syngas flow is divided therein at a junction **320** that includes a first flow conduit **322** and a second flow conduit **324** downstream from junction **320**. A portion of the low temperature scrubbed syngas stream is channeled via first flow conduit **322** to a heat exchanger hot gas end **326**. A control valve **328** positioned along first flow conduit **322** regulates the flow of scrubbed syngas therethrough. In the exemplary embodiment, about 10% of the scrubbed syngas that is channeled from scrubber **116** via conduit **318** is channeled to hot gas end **326**. Alternatively, about 5% to about 25% of the scrubbed syngas may be channeled to hot gas end **326**.

[0029] The remaining portion of the low temperature scrubbed syngas stream is then channeled via second flow conduit **324** to a shell-side, cold-end entrance **330** of heat exchanger **300**. Control valve **329** that is positioned along first flow conduit **324** regulates the flow of scrubbed syngas therethrough. In the exemplary embodiment, about 90% of the scrubbed syngas flow is channeled to shell side cold end entrance **330** of heat exchanger **300**. Alternatively, about 75% to about 95% of the scrubbed syngas may be channeled along conduit **324** to shell-side entrance **330**, dependent upon the amount of syngas channeled via first flow conduit **322** to hot gas end **326**. In the exemplary embodiment, the syngas stream within second flow conduit **324** is channeled counter to the flow of hot syngas along path **316** within tube side system **312**.

[0030] In the illustrated alternative embodiment, syngas that is channeled to hot gas end 326 traverses a plurality of baffles 340 within isolated entrance section 302 and exits heat exchanger 300 at an outlet 344. The syngas is then channeled via a conduit 346 to second flow conduit 324, wherein the flow within conduit 346 remixes with the syngas flow within second flow conduit 324 at a junction 348. Syngas channeled along path 316 exits heat exchanger at an outlet and is channel downstream therefrom via conduit 122. This arrangement allows the total scrubbed syngas stream to be in counter-current flow, increasing the possible temperature exchange.

[0031] During operation, depending on the amount of heating of the first portion of scrubbed syngas, it may be beneficial to feed this stream into a separate nozzle in the counter-current portion of the shell side of the exchanger. Optimally, the temperature on the shell side matches the temperature of the first portion after it has been preheated.

[0032] Described herein is a heat exchanger that may be utilized in IGCC plants that provides a highly efficient and reliable means facilitating lowering tube wall temperatures in the proximity of the heat exchanger inlet by recycling a quantity of scrubbed, cooled syngas. In each embodiment, the heat exchanger system diverts a small portion of the cooler, scrubbed syngas from the syngas cooler back to the heat exchanger inlet. Since the flow pattern in the hot syngas is turbulent and the interior surface of the inlet tube is prone to fouling, this action facilitates the prevention of particulate impingement of the heat exchanger inlet tube wall. Further, in each embodiment, the reheated clean syngas produced following this recycling leads to a direct reduction in the syngas rate required by the gas turbine. As a result, an increase in the overall efficiency of the IGCC plant is realized. Moreover, the heating of carbon dioxide prior to recycling to the gasifier increases the amount of carbon dioxide that can be recycled, thereby substantially reducing adverse cooling of the reactor effluent. This higher carbon dioxide recycle maximizes the beneficial effects on carbon conversion and cold gas efficiency. Accordingly, the beneficial effects on carbon conversion and cold syngas efficiency are maximized.

[0033] Although the foregoing description contains many specifics, these should not be construed as limiting the scope of the present invention, but merely as providing illustrations of some of the presently preferred embodiments. Similarly, other embodiments of the invention may be devised which do not depart from the spirit or scope of the present invention. Features from different embodiments may be employed in combination. The scope of the invention is, therefore, indicated and limited only by the appended claims and their legal equivalents, rather than by the foregoing description. All additions, deletions and modifications to the invention as disclosed herein which fall within the meaning and scope of the claims are to be embraced thereby.

[0034] Although the apparatus and methods described herein are described in the context of IGCC plant heat exchangers, it is understood that the apparatus and methods are not limited to such systems. Likewise, the system components illustrated are not limited to the specific embodiments described herein, but rather, system components can be utilized independently and separately from other components described herein.

[0035] As used herein, an element or step recited in the singular and proceeded with the word "a" or "an" should be understood as not excluding plural elements or steps, unless such exclusion is explicitly recited. Furthermore, references

to "one embodiment" of the present invention are not intended to be interpreted as excluding the existence of additional embodiments that also incorporate the recited features.

[0036] This written description uses examples to disclose the invention, including the best mode, and also to enable any person skilled in the art to practice the invention, including making and using any devices or systems and performing any incorporated methods. The patentable scope of the invention is defined by the claims, and may include other examples that occur to those skilled in the art. Such other examples are intended to be within the scope of the claims if they have structural elements that do not differ from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences from the literal languages of the claims.

What is claimed is:

1. A tube and shell heat exchanger for a gasification system, said heat exchanger comprising:

- a first shell-side inlet positioned proximate to a heat exchanger tube-side inlet, said first shell-side inlet configured to receive a first portion of a scrubbed syngas flow therethrough, wherein said first scrubbed syngas portion facilitates substantially preventing fouling at said heat exchanger tube-side inlet; and
- a second shell-side inlet positioned proximate to a heat exchanger tube-side outlet, said second shell-side inlet configured to receive a second portion of a scrubbed syngas flow therethrough.

2. A tube and shell heat exchanger in accordance with claim 1, further comprising a plurality of shell-side baffles positioned within said heat exchanger configured to channel said first and second syngas flow portions to a shell side outlet.

3. A tube and shell heat exchanger in accordance with claim 2, wherein said heat exchanger comprises at least one of a convective syngas cooler and an asymmetrical split flow exchanger.

4. A tube and shell heat exchanger in accordance with claim 2, further comprising a split-feed shell-side tube system comprising a first flow path for channeling said first portion of a scrubbed syngas to said first shell-side inlet.

5. A tube and shell heat exchanger in accordance with claim 4, wherein said split-feed shell-side tube system further comprises a second flow path configured to channel said second portion of a scrubbed syngas to said second shell-side inlet.

6. A tube and shell heat exchanger in accordance with claim 2, further comprising a conduit configured to channel a quantity of carbon dioxide into said heat exchanger to facilitate subsequent cooling of at least a portion of the scrubbed syngas and facilitate recovering heat from the gasification system.

7. A tube and shell heat exchanger in accordance with claim 2, wherein said heat exchanger is configured to produce a cooled raw syngas stream and a heated scrubbed syngas stream.

8. A gasification system comprising:

- a gasifier configured to produce a flow of syngas;
- a syngas cooler configured to receive said flow of syngas from said gasifier and reduce a temperature associated with said flow of syngas; and
- a tube and shell heat exchanger comprising:

- a first shell-side inlet positioned proximate to a heat exchanger tube-side inlet, said first shell-side inlet

configured to receive a first portion of a scrubbed syngas flow therethrough, wherein said first scrubbed syngas portion facilitates substantially preventing fouling at said heat exchanger tube-side inlet; and a second shell-side inlet positioned proximate to a heat exchanger tube-side outlet, said second shell-side inlet configured to receive a second portion of a scrubbed syngas flow therethrough.

9. A gasification system in accordance with claim 8, further comprising a split-feed shell-side tube system comprising a first flow path for channeling said first portion of a scrubbed syngas to said first shell-side inlet.

10. A gasification system in accordance with claim 9, wherein said split-feed shell-side tube system further comprises a second flow path configured to channel said second portion of a scrubbed syngas to said second shell-side inlet.

11. A gasification system in accordance with claim 10, further comprising a syngas scrubber configured to channel a stream of scrubbed syngas to said split-feed shell-side tube system for distribution into said heat exchanger.

12. A gasification system in accordance with claim 8, further comprising a plurality of shell-side baffles positioned within said heat exchanger to channel said first and second syngas flow portions to a shell side outlet.

13. The gasification system in accordance with claim 8, further comprising a conduit configured to channel a quantity of carbon dioxide into said heat exchanger to facilitate subsequent cooling of at least a portion of the scrubbed syngas and facilitate recovering heat from said gasification system.

14. A method for operating a gasification system comprising:

scrubbing a first stream of raw syngas to facilitate removing impurities therefrom;

producing a stream of scrubbed syngas from said scrubbed first stream;

transferring heat from a second stream of raw syngas to the stream of scrubbed syngas to produce a cooled raw syngas stream and a heated scrubbed syngas stream; and channeling at least a portion of said stream of scrubbed syngas to facilitate substantially preventing fouling from the first stream of raw syngas.

15. The method in accordance with claim 14 wherein the first and second raw syngas streams are raw syngas.

16. The method in accordance with claim 15 further comprising:

producing the first stream of raw syngas in a gasifier; and cooling the first stream of raw syngas in a radiant syngas cooler prior to scrubbing.

17. The method in accordance with claim 14 wherein transferring heat is carried out in a convective syngas cooler.

18. The method in accordance with claim 17 wherein transferring heat is carried out in an asymmetrical split flow exchanger.

19. The method in accordance with claim 17 wherein transferring heat is carried out in a split flow exchanger with an isolated entrance section.

20. The method in accordance with claim 14 further comprising subsequently cooling of at least a portion of the scrubbed syngas heated in said tube and shell heat exchanger by heat exchange with recycled carbon dioxide to facilitate recovering heat from said gasification system.

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