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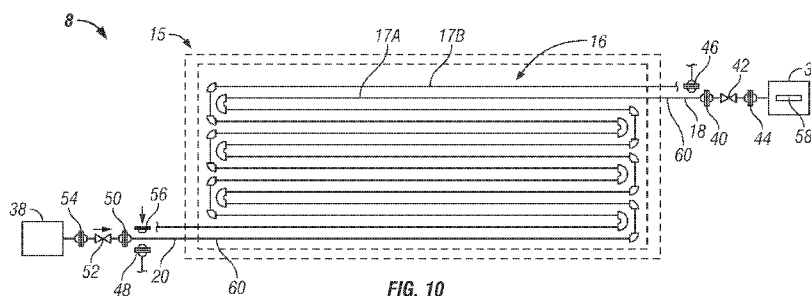


FIG. 10

(57) Abstract: The disclosure provides a heat transfer system having a tubing coil for heating fluid flowing therein, where the tubing coil can be pigged (descaled) while operationally online, instead of offline. The online system uses an assembly of valves and associated equipment to connect to a pig launcher and pig receiver while the system is online. A valve opens and the pig launches into the flow stream under pressure through the valve and travels along the tube with the fluid. The system continues to produce heated fluid with the pig in the flow path. A pig receiver receives the pig after the pigging, and then is isolated from the flow path of the heated fluid by another valve. The pig launcher, pig receiver, and pig are removed, and this process is repeated for any other passes in the tubing coil.



[0001] TITLE OF THE INVENTION**[0002]** Online Pigging System And Method**[0003] CROSS REFERENCE TO RELATED APPLICATIONS****[0004]** This international patent application claims priority to U.S. Application No. 13/013,232, filed January 25, 2011.**[0005] BACKGROUND OF THE INVENTION****[0006]** Field of the Invention.**[0007]** The disclosure relates generally to a method for cleaning heat transfer systems, and more specifically, to heat transfer systems having tubing coils for passing fluid therethrough to be heated by a heat source.**[0008]** Description of the Related Art.

[0009] Heat transfer systems having tubing coils are used in a number of applications. A heat source transfers heat through a heat exchanger generally having a chamber and a tubing coil therein. The heat source heats the tubing coil that in turn heats a fluid flowing through the tubing coil. The heat source can be, for example, a fuel combustion burner, radiant heat source, including infrared, hot fluids, including gases, or exhaust fluids from a turbine or engine, or other waste heat fluids. Figure 1 is a representative schematic diagram of a fire heater for heating hydrocarbon in a tubing coil. If the fluid is a hydrocarbon, the hydrocarbon in the tubing coil can be heated to change viscosity to improve flowability and handling. The system 100 can include a heat source, such as a burner 102, that provides heat into a chamber 104 having a tubing coil 106. The tubing coil 106 has an inlet 108 and an outlet 110 through which the hydrocarbon can flow in and out the tubing coil. An exhaust 112 allows exhaust gases to exit the chamber 104. If the temperature is sufficiently high, the hydrocarbon fluid can undergo a process known as "cracking," when the high-boiling, high-molecular weight hydrocarbon fractions of a hydrocarbon fluid are converted into lighter weight, more valuable, hydrocarbon fluids, such as gasoline and other products.

[0010] If the fluid is water, the water can be heated, for example, into steam. An exemplary typical heat transfer system for water is a once-through heat recovery steam generator (“OTHRSG”). Figure 2 is a representative schematic diagram of an OTHRSG system with a tubing coil. The OTHRSG system 200 uses a heat exchanger, having a chamber 204 with a tubing coil 206. The system 200 can include a heat source 202, such as gas turbine exhaust or waste heat, to transfer heat into water passing through the tubing coil 206 from an inlet 208 to an outlet 210. An exhaust 212 allows exhaust gases to exit the chamber 204. The resulting heated water, such as steam, be used in various processes, including to drive a steam turbine.

[0011] A specialized type of OTHRSG without boiler drums is known as a once-through steam generator (“OTSG”). Figure 3 is a representative schematic diagram of an OTSG system. The OTSG system 300 includes a chamber 304 with a tubing coil 306 therein. The system 300 can include a heat source 302, such as a burner, to transfer heat into water passing through the tubing coil 306 from an inlet 308 to an outlet 310. An exhaust 312 allows exhaust gases to exit the chamber 304.

[0012] More specifically, OTSG systems can be used, for example, to generate steam for oil sands for crude oil exploration, extraction, production, and related markets, including Steam Assisted Gravity Drainage (SAGD) projects. A representative OTSG system is shown in Figures 4 and 5 for use with an oil sands production facility. Figure 4 is a schematic perspective view of an OTSG facility for extraction of hydrocarbon from oil sands. Figure 5 is a schematic cross sectional side view of the OTSG unit producing steam for extraction of hydrocarbon from the oil sands. The figures will be described in conjunction with each other.

[0013] An OTSG system 2 includes water tanks 4 with OTSG units 8 located in a building 6. An OTSG unit 8 includes a heat source 10, such as a burner, that is used to generate heat inside a chamber 15 typically having a feedwater

preheat zone 12 and a steam generation zone 14. A supply line 13 provides feedwater to a tubing coil 16 through a tubing inlet 18. Heat is transferred from the heat source to the feedwater in the tubing coil 16 to generate steam. The steam exits a tubing outlet 20 of the tubing coil 16 into a steam pipeline 22 that transports the steam into geological strata 24 having an oil sands layer 26 and injects the steam through openings in the pipeline 22 in an injection zone 28. The process uses the steam heat to heat the hydrocarbons in the sand to a flowable consistency for extraction by flowing by gravity the hydrocarbons in a collection zone 30 into a collection pipeline 32. The collection pipeline flows the hydrocarbons into a processor unit 34 for extraction of the water from the hydrocarbons and other processing.

[0014] The tubing coil 16 of an OTSG unit typically has multiple tubing passes designed into its heat transfer system, and typically four or six passes. Each pass is a serpentine-arranged single tube with essentially one inlet 18, as a point of entry, and one outlet 20, as a point of exit, per pass. In addition to heating by convection from hot gases, the tube is typically disposed along a radiant wall in the OTSG unit to maximize heat transfer. For each tubing pass, feedwater enters the inlet 18 for the tube and mostly steam with some water (typically 80% steam and 20% saturated water) exits through the outlet 20 of the tube.

[0015] However, feedwater impurities naturally build up in the tubing coil 16 of the OTSG unit as the water is converted to steam. The impurities cause scaling along the tube walls (known as “tube fouling”) which reduces heat transfer effectiveness and may eventually lead to plugging of the tube. Over time, scaling adversely impacts steam production and fuel consumption with subsequent impact on unit operation and therefore oil production from the oil sands.

[0016] Most oil producers employing OTSG technology utilize multiple OTSG units mainly due to the scaling issue. The only currently available technology for descaling OTSG units is a process called “offline pigging.”

[0017] Offline pigging requires taking the entire OTSG unit offline from a multi-OTSG unit configuration. The individual OTSG unit 8 is shut down and steam production is halted for that one unit. As the individual OTSG unit is taken offline, equipment from other portions of the OTSG unit that is connected to the inlet and outlet of the tubing coil, and particularly the tubing pass, is disconnected and removed. A pigging system is mounted to the inlet and outlet of the tubing pass. The pigging system includes a pig launcher, pig receiver, and a pig. The pig launcher is placed at the inlet of tubing pass and pig receiver is placed at the outlet of tubing pass. The pig is launched from the pig launcher into the tubing pass under water pressure particular to the offline pigging process. As the pig passes through the tubing pass, the pig removes scales from the tubing inside surfaces. The pig exits the outlet and is received by the pig receiver. Flush water follows the pig, and scale is carried away with water out of the system. One pass is pigged at a time. For units with multiple passes, each pass is descaled in turn by disconnecting and removing the equipment from the inlet and outlet of each pass, connecting a pigging system to the inlet and outlet, launching and receiving the pig, and flushing out the scale, then reconnecting. Once all the passes have been descaled, the unit is then turned back on for normal operation. This offline pigging practice is the current industry convention.

[0018] The pigging process is repeated for each OTSG unit on a rotation basis. It normally takes a few hours for an OTSG unit to cool down for descaling, and a few more hours to resume full capacity steam production once started up again to full operating temperatures. Further, when the OTSG unit is used for the oil sands, the production may be delayed for several days to even a month or more, while the production envelope restabilizes the heat and pressures underground. Thus, often a duplicate OTSG unit is available to maintain the

steam production, while the other OTSG unit is offline for descaling. However, the additional OTSG unit available for use when the other unit is offline is an intensive capital expenditure with operating expenditures as well.

[0019] Further, the turning off and on of the OTSG unit in the descaling process has a measurable impact on useful life on the tube or tubes and related equipment due to thermal stresses from transient conditions, thereby increasing maintenance with labor and material replacement costs over the life of the system.

[0020] Thus, there remains a need for an improved system and method for descaling an OTSG unit without having to force the OTSG unit offline.

[0021] BRIEF SUMMARY OF THE INVENTION

[0022] The disclosure provides a heat transfer system having a tubing coil for heating fluid flowing therein, where the tubing coil can be pigged (descaled) while operationally online, instead of offline. The online system uses an assembly of valves and associated equipment to connect to a pig launcher and pig receiver while the system is online. A valve opens and the pig launches into the flow stream under pressure through the valve and travels along the tube with the fluid. The system continues to produce heated fluid with the pig in the flow path. A pig receiver receives the pig after the pigging, and then is isolated from the flow path of the heated fluid by another valve. The pig launcher, pig receiver, and pig are removed, and this process is repeated for any other passes in the tubing coil. In at least one embodiment, the heat transfer system can include a heat recovery steam generator system, such as a once-through steam generator System ("OTSG").

[0023] The disclosure provides a heat transfer system, comprising: a heat source coupled to a chamber having a tubing coil disposed therein, the heat source adapted to heat at least a portion of a fluid in the tubing coil into a heated fluid, the tubing coil having an inlet and an outlet, the inlet adapted to

receive the fluid for flowing through a flow path in the tubing coil and the outlet adapted to allow the heated fluid to exit the tubing coil; a first inlet connection coupled to the inlet for coupling with a supply line to supply the fluid into the tubing coil; a second inlet connection coupled to the inlet and fluidically independent of the first inlet connection; an inlet valve coupled to the second inlet connection; a third inlet connection coupled to the inlet valve; a pig launcher coupled to the third inlet connection, the pig launcher adapted to launch a pig into the tubing coil through the inlet valve; a first outlet connection coupled to the outlet and adapted to allow the heated fluid to exit therethrough; a second outlet connection coupled to the outlet and fluidically independent of the first outlet connection; an outlet valve coupled to the second outlet connection; a third outlet connection coupled to the outlet valve; and a pig receiver coupled to the third outlet connection, the pig receiver adapted to receive the pig from the tubing coil through the outlet valve. The heat transfer system can include a heat recovery steam generator, where the fluid in the tubing coil includes feedwater, and the heated fluid includes steam.

[0024] The disclosure also provides a method of pigging a heat transfer system, the system having a heat source coupled to a chamber having a tubing coil disposed therein, the tubing coil having one or more tubing passes, the heat source adapted to heat at least a portion of a fluid in the tubing coil into a heated fluid, the tubing coil having an inlet and an outlet, the inlet adapted to receive the fluid for flowing through a flow path in the tubing coil, and the outlet adapted to allow the heated fluid to exit the tubing coil, the system further having: a first inlet connection coupled to the inlet for coupling with a supply line to supply the fluid into the tubing coil; an inlet valve coupled to the inlet fluidically independent of the first inlet connection; a pig launcher coupled to the inlet valve, the pig launcher adapted to launch a pig into the tubing coil through the inlet valve; a first outlet connection coupled to the outlet and adapted to allow the heated fluid to exit therethrough; an outlet valve coupled to the outlet fluidically independent of the first outlet connection; and a pig receiver coupled to

the outlet valve, the pig receiver adapted to receive the pig from the tubing coil through the outlet valve, the method comprising: maintaining operation of the system by continuing to supply the fluid through the first inlet connection into the tubing coil; opening the inlet valve; launching the pig into a tubing pass of the tubing coil through the inlet valve and into a flow path of the fluid; descaling tubing surfaces of the tubing pass while continuing to generate the heated fluid in the tubing pass; opening the outlet valve; ejecting the pig through the outlet valve into the pig receiver; and flowing the heated fluid generated upstream and downstream of the pig in the tubing pass through the outlet independent of the outlet valve.

[0025] BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0026] Figure 1 is a representative schematic diagram of a fire heater for heating hydrocarbon in a tubing coil.

[0027] Figure 2 is a representative schematic diagram of an OTHRSG system with a tubing coil.

[0028] Figure 3 is a representative schematic diagram of an OTSG system.

[0029] Figure 4 is a schematic perspective view of an OTSG facility for extraction of hydrocarbon from oil sands.

[0030] Figure 5 is a schematic cross sectional side view of the OTSG unit producing steam for extraction of hydrocarbon from the oil sands.

[0031] Figure 6 is a side schematic view of an OTSG unit adapted to be operated online.

[0032] Figure 7 is a top schematic view of the OTSG unit adapted to be operated online.

[0033] Figure 8 is a schematic view of an exemplary tubing coil having multiple passes.

[0034] Figure 9 is a schematic view of an exemplary tubing coil having a single pass.

[0035] Figure 10 is a schematic view of an exemplary tubing coil having multiple passes with valving and related connections adapted to allow online operation of the OTSG system.

[0036] Figure 11 is a schematic view of an exemplary tubing coil having a single pass with valving and related connections adapted to allow online operation of the OTSG system.

[0037] DETAILED DESCRIPTION

[0038] The Figures described above and the written description of specific structures and functions below are not presented to limit the scope of what Applicant has invented or the scope of the appended claims. Rather, the Figures and written description are provided to teach any person skilled in the art how to make and use the inventions for which patent protection is sought. Those skilled in the art will appreciate that not all features of a commercial embodiment of the inventions are described or shown for the sake of clarity and understanding. Persons of skill in this art will also appreciate that the development of an actual commercial embodiment incorporating aspects of the present inventions will require numerous implementation-specific decisions to achieve the developer's ultimate goal for the commercial embodiment. Such implementation-specific decisions may include, and likely are not limited to, compliance with system-related, business-related, government-related and other constraints, which may vary by specific implementation, location, and from time to time. While a developer's efforts might be complex and time-consuming in an absolute sense, such efforts would be, nevertheless, a routine undertaking for those of ordinary skill in this art having benefit of this disclosure. It must be understood that the inventions disclosed and taught herein are susceptible to numerous and various modifications and alternative forms. The use of a singular term, such as, but not limited to, "a," is not intended as limiting

of the number of items. Also, the use of relational terms, such as, but not limited to, “top,” “bottom,” “left,” “right,” “upper,” “lower,” “down,” “up,” “side,” and the like are used in the written description for clarity in specific reference to the Figures and are not intended to limit the scope of the invention or the appended claims. Where appropriate, some elements have been labeled with an alphabetic character after a number to reference a specific member of the numbered element to aid in describing the structures in relation to the Figures, but is not limiting in the claims unless specifically stated. When referring generally to such members, the number without the letter is used. Further, such designations do not limit the number of members that can be used for that function.

[0039] The disclosure provides a heat transfer system having a tubing coil for heating fluid flowing therein, where the tubing coil can be pigged (descaled) while operationally online, instead of offline. The online system uses an assembly of valves and associated equipment to connect to a pig launcher and pig receiver while the system is online. A valve opens and the pig launches into the flow stream under pressure through the valve and travels along the tube with the fluid. The system continues to produce heated fluid with the pig in the flow path. A pig receiver receives the pig after the pigging, and then is isolated from the flow path of the heated fluid by another valve. The pig launcher, pig receiver, and pig are removed, and this process is repeated for any other passes in the tubing coil.

[0040] As discussed above, heat transfer systems having tubing coils are used in a number of applications. For the purposes of illustration, a heat transfer system will be described in terms of an OTHRSG system, and particularly, an OTSG system. However, it is understood that the examples herein are non-limiting, as the inventive concept and technical solution can be applied to other heat transfer systems having a tubing coil for heating a fluid disposed therein. Thus, for example, while the heat source can be described as a burner that heats from fuel combustion, as is generally used in an OTSG system, the heat

source can also include a turbine exhaust, a turbine exhaust coupled to a burner, electrical heating through resistive heating or induction heating, combinations thereof, and any other type of heating that can provide heat to a tubing coil for fluid therein. Similarly, while the fluid is described in terms of feedwater and the heated fluid as steam, as is generally used in an OTSG system, the fluid can also include any flowable substance that can be flowed in a tubing coil, including without limitation hydrocarbons and other organic fluids, and other flowable substances. Thus, while the OTSG is described in some detail relevant to the inventive concepts, the exemplary components described herein should be understood to encompass similar functional components in other heat transfer systems. For example, the heat source in the following figures, shown as a burner, should be understood to also include other known types of heat sources, such as, but not limited to, the types of heat sources in the above list and shown as a block diagram in Figure 5 above.

[0041] Figure 6 is a side schematic view of an OTSG unit adapted to be operated online. Figure 7 is a top schematic view of the OTSG unit adapted to be operated online. Figure 8 is a schematic view of an exemplary tubing coil having multiple passes. Figure 9 is a schematic view of an exemplary tubing coil having a single pass. The figures will be described in conjunction with each other.

[0042] A heat transfer system, such as an OTSG system, 2 includes an OTSG unit 8 generally described above with additional valving and other associated equipment adapted to allow the OTSG unit to operate online while pigging. A heat source 10, such as a burner, produces heat that is directed into the OTSG unit heating chamber 15 that generally includes a heated fluid zone, such as a steam generation zone 14, and a fluid preheat zone 12, such as for incoming feedwater. A tubing coil 16 is disposed in one or more portions of the chamber 15. The tubing coil 16 can include multiple tubing passes, such as tubing passes 17A, 17B, 17C, illustrated in Figure 8, or a single tubing pass 17, illustrated in Figure 9, generally referenced as tubing pass 17. Each tubing

pass 17 generally includes an accessible inlet 18 and outlet 20 with an inlet valve and outlet valve coupled thereto, described in more detail in reference to Figures 10 and 11 below.

[0043] Figure 10 is a schematic view of an exemplary tubing coil having multiple passes with valving and associated equipment adapted to allow online operation of the OTSG system. The chamber 15 contains a majority of the tubing coil 16 that is used to heat the fluid, such as feedwater, into a heated fluid, such as principally steam. The tubing coil generally includes one or more tubing passes 17, such as tubing passes 17A, 17B. This portion of the OTSG system is prone to developing the scale on the tube walls of the tubing passes and need periodic descaling.

[0044] The portion of the online OTSG system 8 shown in Figure 10 includes valving and associated equipment arranged and coupled to the inlet 18 and the outlet 20 of the tubing coil 16 to allow the online OTSG system to continue to operate while pigging. For example, the tubing pass 17A includes an inlet 18 is fluidically coupled to an inlet connection 46 for the supply of fluid, such as the feedwater, into the tubing pass. However, in the exemplary illustrated online OTSG system, the tubing pass 17A, and more generally the tubing coil 16, is also fluidically coupled independent of the first inlet connection to a second inlet connection 40 for coupling to a removable pig launcher 36, known in the art. The connection 40 is coupled to an inlet valve 42. The valve 42 is coupled to another inlet connection 44. The connection 44 can be coupled during operation of the OTSG system to the removable pig launcher 36. Thus, the connection 46 for the feedwater and the connection 40 for the pigging form two distinct points of access into the inlet 18 of the tubing coil 16. One or more of the pig launcher 36, valve 42, and connections 40, 44 can be longitudinally aligned with a longitudinal axis 60 of the tubing pass 17A at the inlet 18, and more generally that portion of the tubing coil adjacent the connection 40, to facilitate the pig 58 being injected into the flow path of the tubing pass 17. In at least one embodiment, the inlet connection 46 for the supply of feedwater into

the tubing pass 17A will be nonaligned with the longitudinal axis. The connections can be a flange, threaded connection, quick disconnect, or other means of coupling two elements together. Further, the connections can be separate or integral with another element, such as a valve or spool having a connection on each end.

[0045] Similarly, the tubing pass 17A includes an outlet 20 fluidically coupled to an outlet connection 48 for allowing the steam and any remaining heated feedwater to exit from the tubing pass. In the exemplary illustrated online OTSG system, the tubing pass 17A, and more generally the tubing coil 16, is also fluidically coupled independent of the first outlet connection 48 to a second outlet connection 50 for coupling to a pig receiver 38, known in the art. The connection 50 is coupled to an outlet valve 52. The valve 52 is coupled to another outlet connection 54. The connection 54 can be coupled during operation of the OTSG system to the pig receiver 38. Thus, the connection 48 and the connection 50 form two distinct points of exit from the outlet 20 of the tubing coil 16. One or more of the pig receiver 38, valve 52, and connections 50, 54 can be longitudinally aligned with a longitudinal axis 60 of the tubing pass 17A at the outlet 20, and more generally that portion of the tubing coil adjacent the connection 50, to facilitate the pig being ejected from the tubing pass and received into the pig receiver. In at least one embodiment, the outlet connection 48 for the exit of steam from the tubing pass 17A will be nonaligned with the longitudinal axis. Another connection 56 can be used as an additional access point to the tubing pass.

[0046] Each tubing pass can have an inlet valve and outlet valve coupled thereto so that the pig launcher and pig retriever can be coupled to the valves while the OTSG system is online. Thus, the OTSG system 8 can remain online producing the heated fluid, such as the steam, during set up and assembly operations of the pig launcher 36 and pig receiver 38 in preparation for a pigging operation to the tubing pass 17A. When the equipment is assembled and the pigging is about to be initiated, the valve 42 can be opened to expose

the pig launcher 36 and a pig 58 in the pig launcher to the inlet 18 of the tubing pass 17A. Similarly, the valve 52 can be opened to expose the pig receiver 38 to the outlet of the tubing pass 17A.

[0047] The pig 58 is launched into the flow path of the feedwater/steam in the inlet 18. The launch can be actuated by higher pressure water or the forces on the pig into the flow path. The pig 58 travels along the tubing pass 17A to descale the tubular internal surfaces with the feedwater pressure pushing the pig. The OTSG system is continuing to heat the tubing pass and produce steam downstream and upstream of the pig 58 in the normal course of operation. As the pig 58 ends the travel in the tubing pass 17A, the pig enters a portion of the tubing pass that is aligned with the valve 52 and pig receiver 52. The mass of the pig 58 along the flow path provides inertia to the pig to continue generally straight through the valve 52 and into the pig receiver 38. However, the steam in the tubing pass 17A exits the outlet 20 to continue to provide steam to the underground oil sands for production thereof. The valves 42, 52 can be closed to isolate the pig launcher 36, pig receiver 38, and pig 58 in the pig receiver 38 from the flow path of the feedwater and steam through the tubing pass 17A.

[0048] For tubing coils having multiple tubing passes, generally each tubing pass has an inlet, an outlet, an inlet valve coupled to the inlet, and an outlet valve coupled to the outlet. The pig launcher 36, pig receiver 38, and pig 58 can be removed from the valves on the tubing pass 17A, and assembled in similar manner to valves on the tubing pass 17B for pigging the tubing pass 17B, and so forth until all tubing passes for the OTSG unit are descaled.

[0049] Thus, the OTSG unit can remain online with all tubing passes operating at full or substantially full load producing steam at significantly less expense to the overall system in maintaining operational throughput.

[0050] Figure 11 is a schematic view of an exemplary tubing coil having a single pass with valving and related connections adapted to allow online operation of

the OTSG system. In a similar fashion as described above for Figure 10, the online OTSG system can be pigged without requiring the OTSG system to stop operation in an offline mode. The valving and connections are mounted with the tubing coil to allow the pig launcher 36 and pig receiver 38 to be connected to the tubing coil 16 having a tubing pass 17 while the tubing coil is operational. The valve 42 can be opened and the pig 58 injected into the flow path of the feedwater through the tubing pass 17 and is energized by the feedwater behind the pig to push the pig through the internal portions of the tubing pass 17 while steam is generated through the pass. The pig receiver 38 receives the pig 58 through an open valve 52, and the steam exits the tubing coil 16. The valves 42 and 52 can be closed to isolate the pig launcher 36 and pig receiver 38 from the flow path through the tubing coil and the pig launcher and pig receiver disconnected to be used on another tubing pass or tubing coil of another OTSG unit.

[0051] Some of the potential advantages of the online OTSG system include:

- reduced capital expenditures and operational expenditures, at least in part, due to a reduced need of having extra OTSG units to operate while an OTSG unit is placed offline for pigging;

- potentially reduced footprint without a need for an extra OTSG unit to maintain steam production while an OTSG unit is offline;

- potentially more flexibility in design without the extra OTSG unit as restraints on the design, placement, piping, controls, and other factors associated with an additional unit;

- increased steam production for existing systems having extra OTSG units by having all OTSG units online without having to be offline for pigging; and

potentially reduced maintenance, including labor and materials, with the long term impact of additional thermal stresses on shutting down and restarting OTSG units.

[0052] Other and further embodiments utilizing one or more aspects of the invention described above can be devised without departing from the spirit of the invention. For example, the exemplary heat transfer system can be used in other environments besides production from oil sands. Further, the heat transfer system can be used for different types of fluids including hydrocarbons and other organic fluids, including gases. Thus, the invention applies to any heat transfer system having a tubing coil used for any application. Further, different connections and equipment can be used for a variety of connections and valves for the invention and the embodiments of connections and valves are exemplary without limitation. Other variations in the system are possible.

[0053] Further, the various methods and embodiments described herein can be included in combination with each other to produce variations of the disclosed methods and embodiments. Discussion of singular elements can include plural elements and vice-versa. References to at least one item followed by a reference to the item may include one or more items. Also, various aspects of the embodiments could be used in conjunction with each other to accomplish the understood goals of the disclosure. Unless the context requires otherwise, the word “comprise” or variations such as “comprises” or “comprising,” should be understood to imply the inclusion of at least the stated element or step or group of elements or steps or equivalents thereof, and not the exclusion of a greater numerical quantity or any other element or step or group of elements or steps or equivalents thereof. The device or system may be used in a number of directions and orientations. The term “coupled,” “coupling,” “coupler,” and like terms are used broadly herein and may include any method or device for securing, binding, bonding, fastening, attaching, joining, inserting therein, forming thereon or therein, communicating, or otherwise associating, for example, mechanically, magnetically, electrically, chemically, operably, directly

or indirectly with intermediate elements, one or more pieces of members together and may further include without limitation integrally forming one functional member with another in a unitary fashion. The coupling may occur in any direction, including rotationally.

[0054] The order of steps can occur in a variety of sequences unless otherwise specifically limited. The various steps described herein can be combined with other steps, interlineated with the stated steps, and/or split into multiple steps. Similarly, elements have been described functionally and can be embodied as separate components or can be combined into components having multiple functions.

[0055] The invention has been described in the context of preferred and other embodiments and not every embodiment of the invention has been described. Apparent modifications and alterations to the described embodiments are available to those of ordinary skill in the art given the disclosure contained herein. The disclosed and undisclosed embodiments are not intended to limit or restrict the scope or applicability of the invention conceived of by the Applicant, but rather, in conformity with the patent laws, Applicant intends to protect fully all such modifications and improvements that come within the scope or range of equivalent of the following claims.

WHAT IS CLAIMED IS:

1. A heat transfer system, comprising:
 - a heat source coupled to a chamber having a tubing coil disposed therein, the heat source adapted to heat at least a portion of a fluid in the tubing coil into a heated fluid by providing heat to the tubing coil, the tubing coil having an inlet and an outlet, the inlet adapted to receive the fluid for flowing through a flow path in the tubing coil and the outlet adapted to allow the heated fluid to exit the tubing coil;
 - a first inlet connection coupled to the inlet for coupling with a supply line to supply the fluid into the tubing coil;
 - a second inlet connection coupled to the inlet and fluidically independent of the first inlet connection;
 - an inlet valve coupled to the second inlet connection;
 - a third inlet connection coupled to the inlet valve;
 - a pig launcher coupled to the third inlet connection, the pig launcher adapted to launch a pig into the tubing coil through the inlet valve;
 - a first outlet connection coupled to the outlet and adapted to allow the heated fluid to exit therethrough;
 - a second outlet connection coupled to the outlet and fluidically independent of the first outlet connection;
 - an outlet valve coupled to the second outlet connection;
 - a third outlet connection coupled to the outlet valve; and
 - a pig receiver coupled to the third outlet connection, the pig receiver adapted to receive the pig from the tubing coil through the outlet valve.
- 2 The system of claim 1, wherein the heat transfer system comprises a steam generator, the fluid in the tubing coil comprises feedwater, and the heated fluid comprises steam.

- 3 The system of claims 2, wherein the steam generator comprises a once-through steam generator, and the heat source comprises a burner.
4. The system of claim 2, wherein the steam generator comprises a once through heat recovery steam generator, and the heat source comprises a gas turbine, a burner, or a combination thereof.
5. The system of claim 1, wherein the fluid comprises feedwater, the heated fluid comprises steam, and further comprising;
a steam pipeline coupled to the outlet of the tubing coil and disposed in a geologic stratum having hydrocarbons, the steam pipeline having an injection portion with openings to allow the steam to be injected into the geologic stratum;
a collection pipeline disposed in the geologic stratum and having a collection portion with openings to allow heated hydrocarbons from the steam to flow into the collection pipeline; and
a processor adapted to process the heated hydrocarbons after collection.
6. The system of claim 1, wherein one or more of the pig launcher, inlet valve, and second inlet connection and third inlet connection are longitudinally aligned with a longitudinal axis of the tubing coil adjacent the inlet.
7. The system of claim 6, wherein the first inlet connection is nonaligned with the longitudinal axis of the tubing coil adjacent the inlet.
8. The system of claim 1, wherein one or more of the pig receiver, outlet valve, and second outlet connection and third outlet connection are longitudinally aligned with a longitudinal axis of the tubing coil adjacent the outlet.
9. The system of claim 8, wherein the first outlet connection is nonaligned with the longitudinal axis of the tubing coil adjacent the outlet.

10. The system of claim 1, wherein the tubing coil comprises multiple tubing passes, and wherein at least two of the tubing passes each have an inlet and an outlet and an inlet valve coupled to the inlet and an outlet valve coupled to the outlet for coupling each of the at least two tubing passes to the pig launcher and the pig receiver.
11. A method of pigging a heat transfer system, the system having a heat source coupled to a chamber having a tubing coil disposed therein, the tubing coil having one or more tubing passes, the heat source adapted to heat at least a portion of the fluid in the tubing coil into a heated fluid by providing heat to the tubing coil, the tubing coil having an inlet and an outlet, the inlet adapted to receive the fluid for flowing through a flow path in the tubing coil, and the outlet adapted to allow the heated fluid to exit the tubing coil,

the heat transfer system further having: a first inlet connection coupled to the inlet for coupling with a supply line to supply the fluid into the tubing coil; an inlet valve coupled to the inlet fluidically independent of the first inlet connection; a pig launcher coupled to the inlet valve, the pig launcher adapted to launch a pig into the tubing coil through the inlet valve; a first outlet connection coupled to the outlet and adapted to allow the heated fluid to exit therethrough; an outlet valve coupled to the outlet fluidically independent of the first outlet connection; and a pig receiver coupled to the outlet valve, the pig receiver adapted to receive the pig from the tubing coil through the outlet valve, the method comprising:

maintaining operation of the heat transfer system by continuing to supply fluid through the first inlet connection into the tubing coil;
opening the inlet valve;
launching the pig into a tubing pass of the tubing coil through the inlet valve and into a flow path of the fluid;
descaling tubing surfaces of the tubing pass while continuing to generate the heated fluid in the tubing pass;

opening the outlet valve;
ejecting the pig through the outlet valve into the pig receiver; and
flowing the heated fluid generated upstream and downstream of the pig
in the tubing pass through the outlet independent of the outlet
valve.

12. The method of claim 11, further comprising closing the inlet valve and the outlet valve and continuing to flow the fluid into the inlet and the heated fluid out of the outlet.

13. The method of claim 11, wherein the tubing coil comprises multiple tubing passes, and wherein at least two of the tubing passes each have an inlet and an outlet and an inlet valve coupled to the inlet and an outlet valve coupled to the outlet, and further comprising removing the pig launcher and the pig receiver from a first tubing pass and assembling the pig launcher and pig receiver to an inlet valve and an outlet valve on a second tubing pass.

14. The method of claim 13, further comprising pigging the second tubing pass while maintaining operation of the second tubing pass.

15. The method of claim 11, wherein the fluid comprises feedwater, the heated fluid comprises steam, and the outlet is coupled to a steam pipeline disposed in a geologic stratum containing hydrocarbons, and further comprising injecting the steam through the steam pipeline into the geologic stratum to heat the hydrocarbons and collecting at least a portion of the heated hydrocarbon into a collection pipeline.

16. The method of claim 11, wherein the pig launcher is longitudinally aligned with a longitudinal axis of the tubing coil adjacent the inlet, and further comprising launching the pig from the pig launcher in alignment with the longitudinal axis of the tubing coil.

17. The method of claim 11, wherein the pig receiver is longitudinally aligned with a longitudinal axis of the tubing coil adjacent the outlet, and further

comprising receiving the pig into the pig receiver in alignment with the longitudinal axis of the tubing coil.

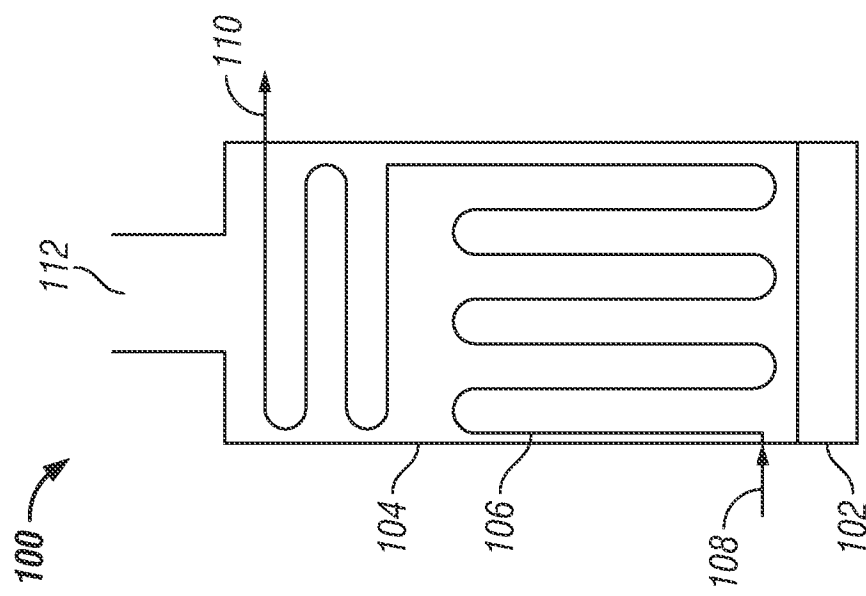
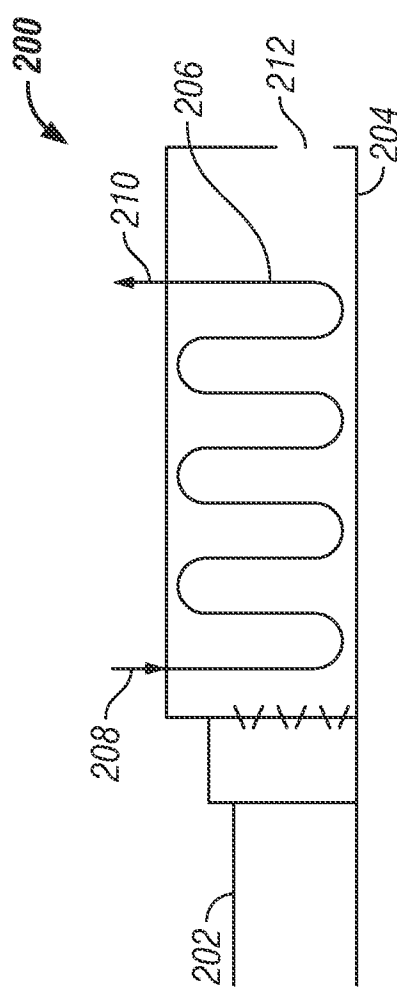


FIG. 2
(Prior Art)



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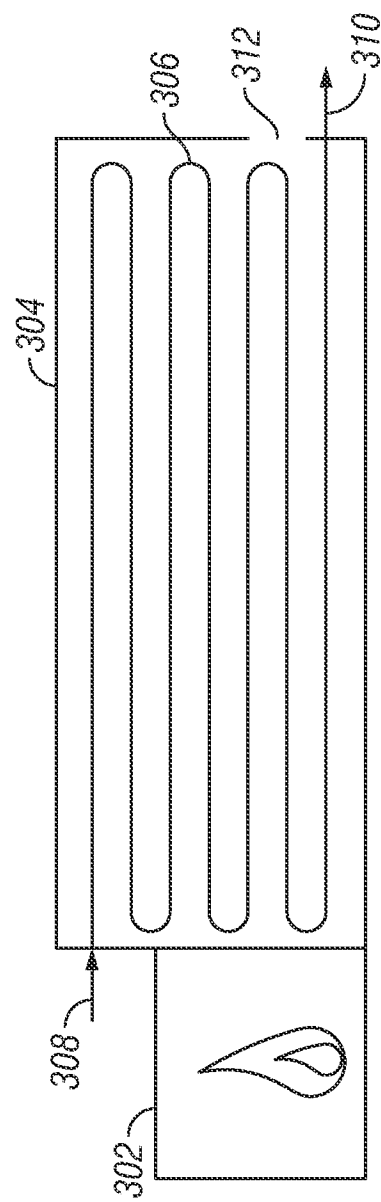


FIG. 3
(Prior Art)

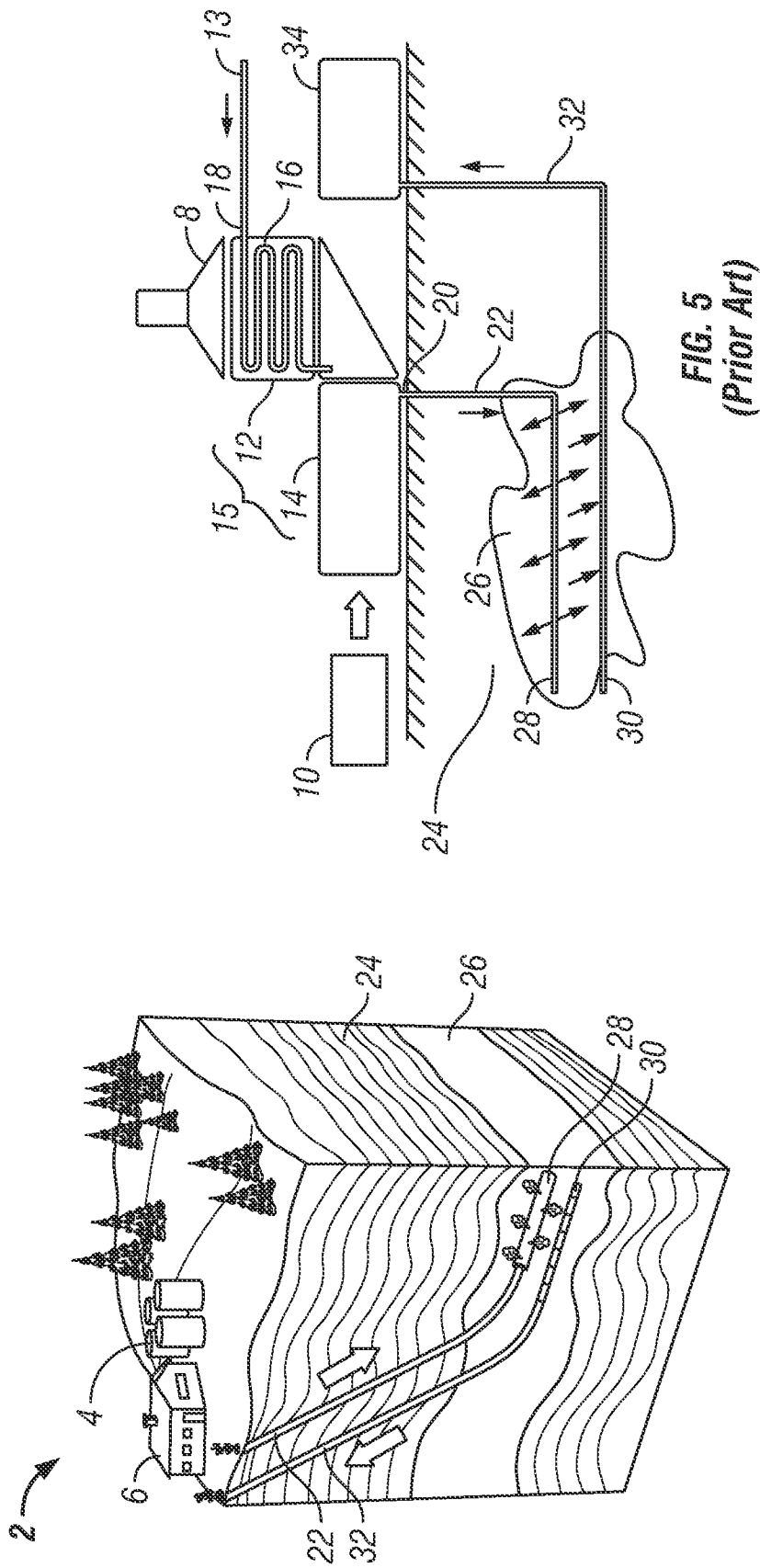
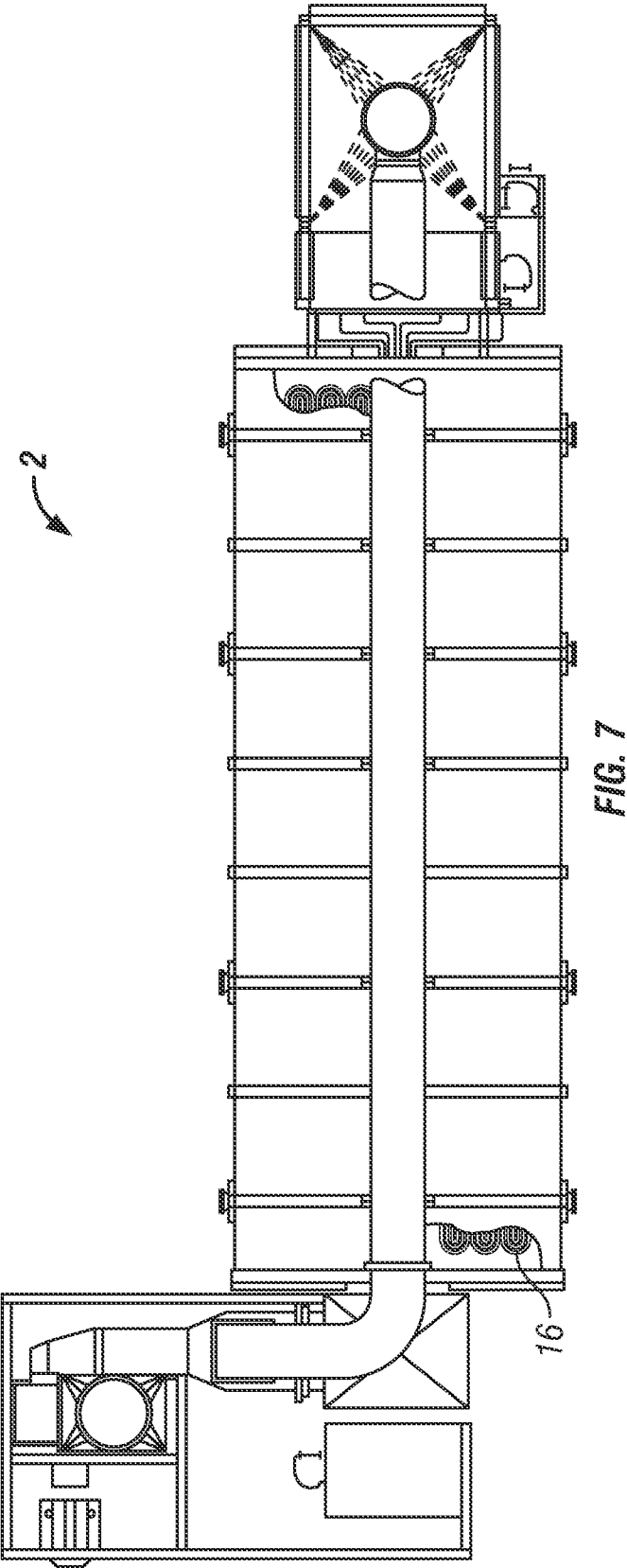
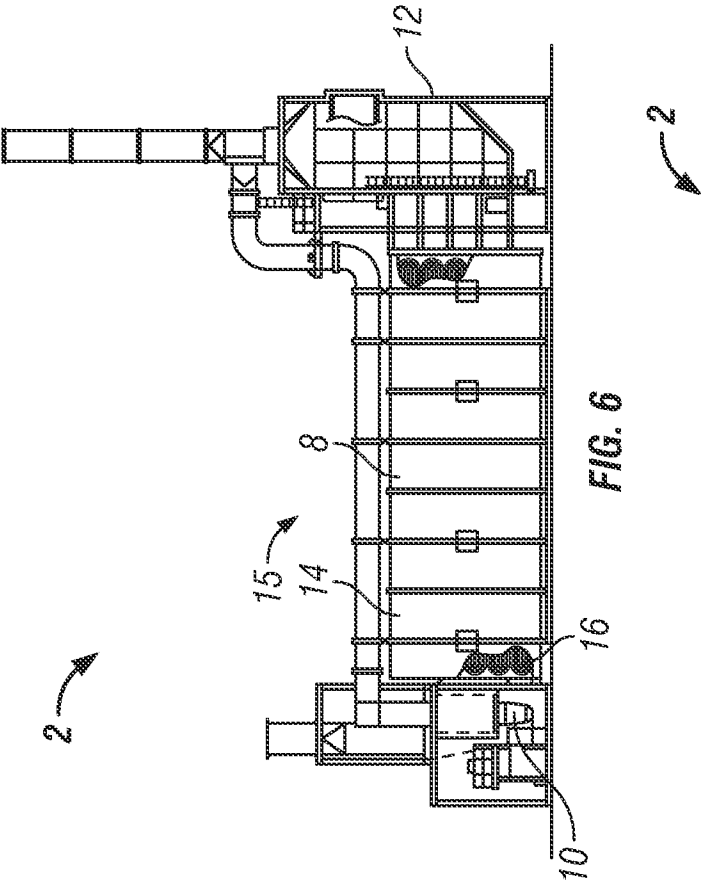


FIG. 4
(Prior Art)



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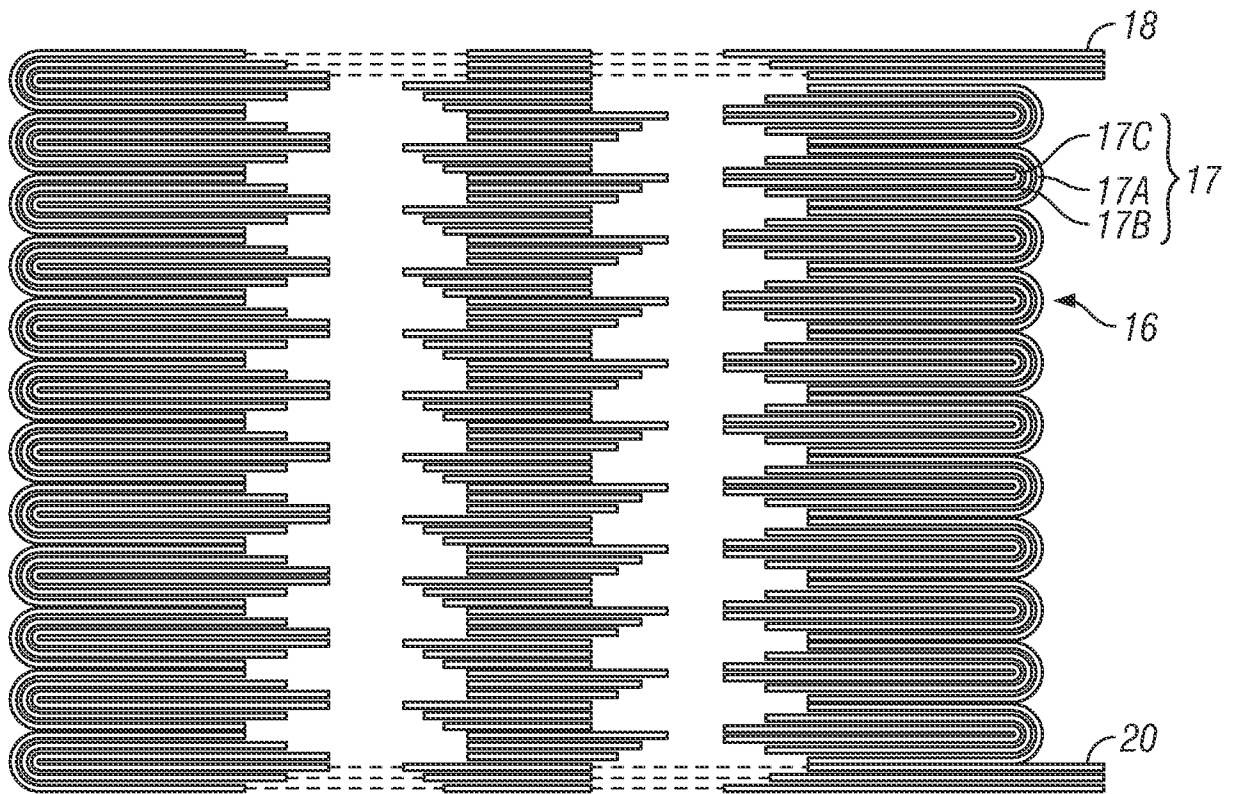


FIG. 8

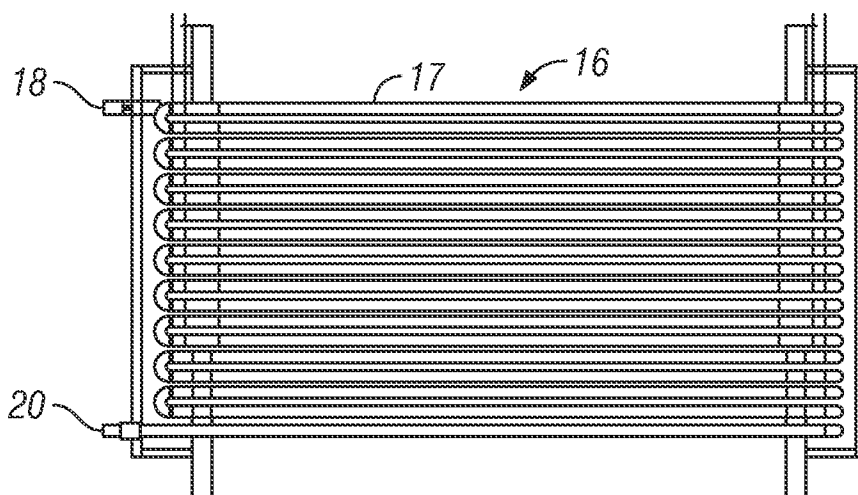


FIG. 9

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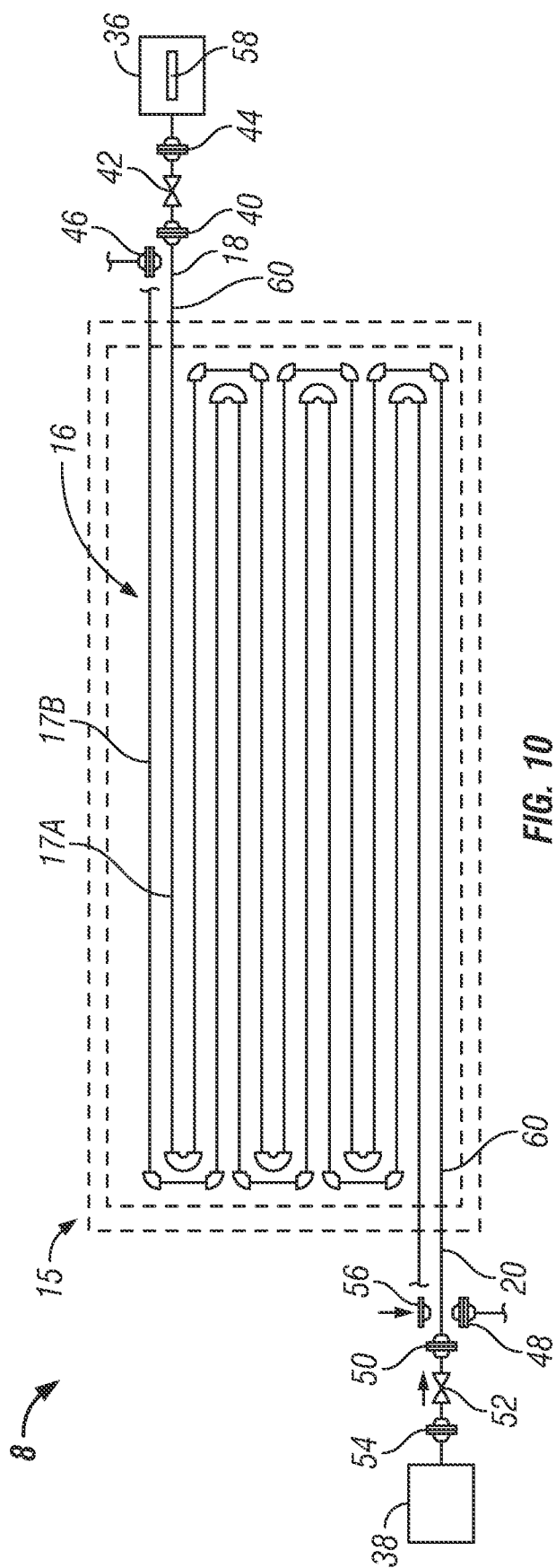


FIG. 10

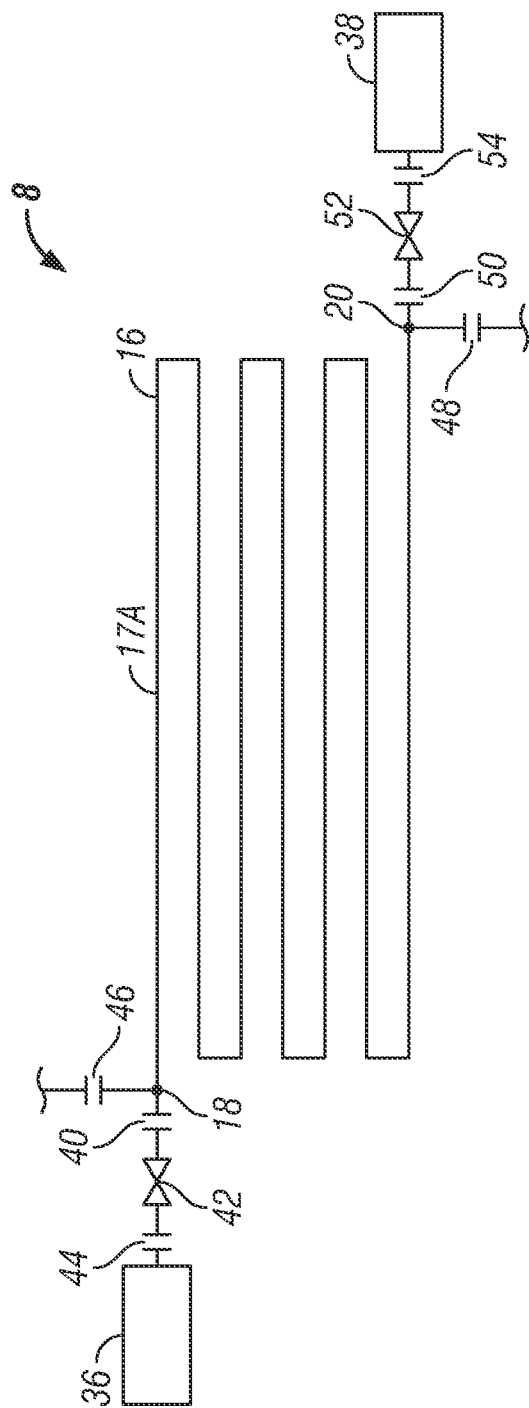


FIG. 11