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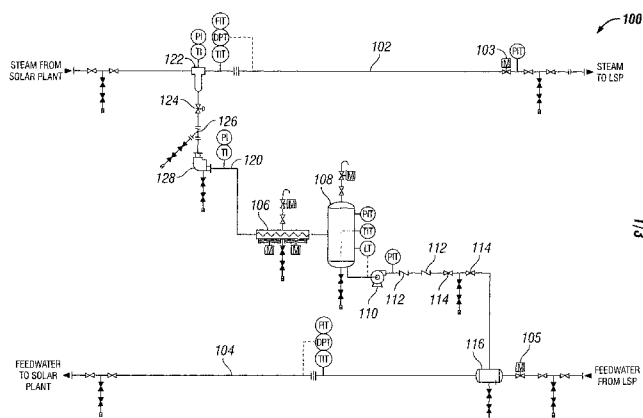


FIG. 1

(57) Abstract: The present invention is directed to a system for recovery and cooling of steam and high temperature condensate and disposed between a feed water source and a steam source comprising a fluid circulation loop between the steam source and the feed water source including a steam trap that receives a mixture of steam and high temperature condensate from the steam source, wherein the steam trap discharges high temperature condensate from the steam source, and a fluid cooling mechanism which receives the high temperature condensate from the steam trap and cools the high temperature condensate.



SYSTEM AND METHOD FOR RECOVERY AND COOLING OF STEAM AND HIGH TEMPERATURE CONDENSATE

FIELD OF THE INVENTION

5 The present invention generally relates to systems and methods for recovery and cooling of steam and high temperature condensate. More particularly, the present invention relates to condensate recovery and cooling in, for example, solar power and/or enhanced oil recovery applications.

BACKGROUND AND SUMMARY OF THE INVENTION

10 One of the most efficient and convenient alternative sources of green energy is solar energy. It is available in massive amounts, is environmentally friendly, and can provide an unlimited flow of energy at little to no cost. A solar powered steam generator makes uses of sunlight in order to heat up the water that will give off steam, which will then operate electrical turbines or other systems. A solar powered steam generator may
15 be more effective compared to photovoltaics and wind power, especially when it comes to large scale facilities. Of course, the effectiveness of the solar powered steam generator is still dependent on the availability of sunlight. Nevertheless, it can still be highly beneficial as a part of the general supply of energy. Solar energy does not have significant emissions nor does it have significant polluting effects.

20 One of the challenges of solar powered steam generation occurs overnight when condensate builds up in steam distribution lines due to cooling. Condensate is a by-product of heat transfer in a steam system. It may form in the distribution system due to unavoidable radiation. It may also form in heating and process equipment as a result of desirable heat transfer from the steam to the substance heated. Once the steam has
25 condensed and given up the majority of its valuable latent heat, the hot condensate

should be removed. Although the available heat in a pound of condensate is negligible as compared to a pound of steam, condensate is still valuable hot water and should be returned to the boiler in most cases.

Condensate lying in the bottom of steam lines can be the cause of one kind of water hammer. Steam travelling at up to 100 miles per hour makes “waves” as it passes over this condensate. If enough condensate forms, high-speed steam pushes it along, potentially creating a slug of water that grows larger and larger as it picks up liquid in front of it. Anything that changes direction of the steam (*e.g.*, pipe fittings, regulating valves, tees, elbows, blind flanges) may be harmed or even destroyed. In addition to damage from this “battering ram,” high-velocity water may erode fittings by chipping away at metal or other surfaces.

Another challenge of solar powered steam generation is the time required to come to full pressure and temperature from a warm or cold start. As these systems are often integrated with traditional, fired boilers, the system often must be completely warmed up before steam may be comingled. Accordingly, new systems and methods are desired to ameliorate or eliminate these problems. This system and method are directed to the recovery and processing of such steam and condensate for an enhanced oil recovery application, although it may also be used with any other high pressure steam distribution system.

In one aspect, embodiments disclosed herein relate to a system for recovery and cooling of steam and high temperature condensate and disposed between a feed water source and a steam source comprising a fluid circulation loop between the steam source and the feed water source, a steam trap that receives a mixture of steam and high temperature condensate from the steam source, wherein the steam trap discharges high

temperature condensate from the steam source, and a fluid cooling mechanism that receives the high temperature condensate from the steam trap and cools the high temperature condensate.

In other aspects, embodiments disclosed herein relate to a system for recovery
5 and cooling of steam and high temperature condensate and disposed between a feed water source and a steam source comprising a fluid circulation loop between the steam source and the feed water source including a condenser that receives steam and high temperature condensate from the steam source, wherein steam is condensed to a liquid state in the condenser and a second fluid cooling mechanism that receives the condensed
10 liquid from the condenser and cools the liquid.

In still further aspects, embodiments disclosed herein relate to a method for recovery and cooling of steam and high temperature condensate, including operating a system disposed between a feed water source and a steam source, wherein the system may be operated in a first mode or a second mode, wherein said first mode comprises circulating
15 a mixture of steam and high temperature condensate from the steam source through a first fluid circulation loop to a steam trap; discharging high temperature condensate from the steam source in the steam trap; receiving the discharged high temperature condensate from the steam trap in a fluid cooling mechanism and further cooling the discharged high temperature condensate; and pumping the cooled condensate to the feed water source;
20 and wherein said second mode comprises circulating steam and high temperature condensate from a steam source through a second fluid circulation loop to a condenser; condensing the steam in the condenser to a liquid; receiving the condensed liquid from the condenser in a fluid cooling mechanism and cooling the condensed liquid; and pumping the cooled condensed liquid to the feed water source.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete appreciation of the subject matter of the present invention and the various advantages thereof can be realized by reference to the following detailed description in which reference is made to the accompanying drawings in which:

Figure 1 is a schematic view of a first or “overnight” circulation loop of a system for recovery of steam and high temperature condensate in accordance with one or more embodiments of the present disclosure;

Figure 2 is a schematic view of a second or “startup” circulation loop of a system for recovery of steam and high temperature condensate in accordance with one or more embodiments of the present disclosure;

Figure 3 is a schematic view of a system for recovery of steam and high temperature condensate in accordance with one or more embodiments of the present disclosure;

DETAILED DESCRIPTION OF THE INVENTION

The foregoing aspects, features, and advantages of the present invention will be further appreciated when considered with reference to the following description of preferred embodiments and accompanying drawings, wherein like reference numerals represent like elements. In describing embodiments of the invention illustrated in the appended drawings, specific terminology will be used for the sake of clarity. However, the invention is not intended to be limited to the specific terms used, and it is to be understood that each specific term may include equivalents that operate in a similar manner to accomplish a similar purpose.

Referring now to the drawings, Figure 1 shows a schematic view of a first or “overnight” circulation loop 120 of a system 100 for recovery of steam and high temperature condensate in accordance with one or more embodiments of the present disclosure. A steam line 102 extends from a steam source to a large scale pilot (LSP), or an enhanced oil recovery system, power plant, or other system in which steam is useful. The steam line 102 may have a diameter of at least 4 inches, 5 inches, or 6 inches, or up to a diameter of 8 inches, 9 inches, or 10 inches. The steam line 102 may include one or more valves 103, sized to fit with the line size of steam line 102, that are opened and closed (with or without motors) to regulate steam flow through steam line 102 and restrict flow of steam to the LSP or other system if closed. Steam in the steam line 102 may be at a temperature of about 300 degrees C, although steam temperatures may vary.

Additionally, a feed water line 104 extends from a feed water source back to the steam source. The feed water line 104 may have a diameter of at least 1 inch, 2 inches, or 3 inches, or up to a diameter of 4 inches, 5 inches, or 6 inches. The feed water line 104 may include one or more valves 105, sized to fit with the line size of feed water line 104, that are opened and closed (with or without motors) to regulate feed water flow through feed water line 104 and restrict feed water flow from the LSP of other system if closed. Additionally, the feed water source may be any number of systems that produce feed water, including, but not limited to, a boiler drum, condensate tanks and/or lines, and other feed water sources as will be understood by one of ordinary skill in the art.

The system 100 includes a first or “overnight” circulation loop 120 between the steam source and the feed water source that is useful for removal of water pockets that form in the steam line 102 during overnight cooling of the system 100. The circulation loop 120 has a line that extends from the steam line 102 to the feed water line 104. The

circulation loop 120 line may have a diameter of at least 1 inch, 2 inches, or 3 inches, or a diameter of up to 4 inches, 5 inches, or 6 inches. When the overnight circulation loop 120 is used, valves 103 in the steam line 102 and valves 105 in the feed water line 104 are closed such that the overnight circulation loop 120 is isolated from the LSP or other
5 system. A sump 122, or any device or low spot where liquid accumulates, may be disposed in the steam line 102 where the overnight circulation loop 120 is coupled to the steam line 102.

Further, the overnight circulation loop 120 includes a temperature control valve 124 disposed in the circulation line that is operable between an open position and a
10 closed position to allow steam flow through the overnight fluid circulation loop 120. The temperature control valve 124 may be automated and operated by, for example, a motor. Alternatively, the temperature valve 124 may be manually operated. Moreover, the temperature control valve 124 may be a ball valve, needle valve, or other type of valve commonly used by those skilled in the art.

15 The temperature control valve 124 may be operable between a closed position and an open position at a certain temperature. In certain embodiments, the temperature control valve 124 may be moved from a fully closed position to a fully open position. Alternatively, the temperature control valve 124 may be moved from a fully closed position to a partially open position. For example, above a certain temperature, the
20 temperature control valve 124 remains closed. However, below a set temperature (*i.e.*, when the system has cooled to or below a particular temperature), the temperature control valve 124 may be opened to allow a mixture of steam and high temperature condensate to pass through. The temperature control valve 124 includes a temperature sensor or other device to monitor temperature and sense when to open. For example, in

certain embodiments, the temperature control valve 124 may be opened at a temperature of at least about 150 degrees C, 160 degrees C, 170 degrees C, 180 degrees C, or 190 degrees C. Furthermore, the temperature control valve 124 may be opened at a temperature of up to 210 degrees C, 220 degrees C, 230 degrees C, 240 degrees C, or
5 250 degrees C.

Still further, the overnight circulation loop 120 includes a steam trap 128 that removes high temperature condensate from the steam line 102 as it accumulates. Steam trap 128 may be any type of steam trap as will be understood by one of ordinary skill in the art and available from any number of commercial suppliers. The steam trap 128 may
10 discharge high temperature condensate from the steam line 102 with negligible consumption of loss of live steam. The steam trap 128 may open, close, or modulate automatically, and may have one or more pressure indicators and temperature indicators located proximate thereto. Thus, high temperature condensate exits the steam trap 128 while steam is trapped in the steam line 102 above the steam trap 128. In addition, in
15 certain embodiments, a strainer 126 may be installed ahead of or upstream of the steam trap 128 to eliminate or reduce premature failures of the steam trap due to corrosion and/or sedimentation. Alternatively, a steam trap may be installed with an integral strainer. The strainer may be installed with or without a blow-off valve.

The overnight circulation loop 120 further includes a sub-cooler 106, or second
20 fluid cooling mechanism that receives the high temperature condensate from the steam trap 128 and cools the high temperature condensate to a lower temperature. The sub-cooler 106 may be any type of air-cooled heat exchanger or shell and tube heat exchanger as will be understood by one of ordinary skill in the art. For example, in certain embodiments, the sub-cooler 106 may lower the temperature of the high

temperature condensate to a temperature of about 10 degrees C, 20 degrees C, 30 degrees C, or 40 degrees C. Furthermore, the sub-cooler 106 may lower the temperature of the high temperature condensate to a temperature of up to 50 degrees C, 60 degrees C, 70 degrees C, or 80 degrees C. In still further embodiments, the sub-cooler may lower the temperature of the high temperature condensate to an ambient temperature of the region in which the system 100 is located. The sub-cooler 106 may be operated with one or more motors, or no motors.

The system 100 further includes a fluid storage device 108 that receives cooled fluid from the sub-cooler 106. The fluid storage device 108 may be an accumulator drum, or any other type of pressure storage reservoir in which non-compressible fluid is held under pressure. For example, the fluid storage device may be any type of vertical cylindrical carbon steel pressure vessel as will be understood by one of ordinary skill in the art. The accumulator drum may vary in size. For example, in certain instances, the accumulator drum may have a diameter of at least 18 inches, 20 inches, or 24 inches, or a diameter of at least 30 inches, 36 inches, or 40 inches. Moreover, the accumulator drum may have a height of at least 6 feet, 8 feet, or 10 feet, or a height of up to 12 feet, 14 feet, or 16 feet. Further, the accumulator drum may include indicators and transmitters, including, but not limited to, pressure indicator transmitters, temperature indicator transmitters, and level transmitters.

Placing the fluid storage device 108 proximate to and downstream from the sub-cooler 106 may be useful in the circulation loop 120 by allowing the sub-cooler 106 to cool high temperature condensate (received from the steam trap 128) at a rate that is different from the rate the condensate is pumped from the fluid storage device 108 back to the feed water line 104. This allows for adequate cooling of the high temperature

condensate in the sub-cooler 106 to the temperature desired. Fluid is accumulated or stored in the fluid storage device 108 until, in certain embodiments, the fluid storage device 108 is at least about half full, at which time the fluid may be released from the fluid storage device 108. In other embodiments, fluid may be released from the fluid storage device 108 when at least about two-thirds full. In still further embodiments, fluid may be released from the fluid storage device 108 when at least about three-fourths full.

The system 100 further includes a pump 110 that receives cooled fluid from the fluid storage device 108 and pushes the cooled fluid from the circulation loop 120 back to the feed water source. The cooled fluid may leave the fluid storage device 108 at a rate of about 0% of maximum system capacity (*i.e.*, fluid is not leaving), or at least about 5%, 10%, or 15% maximum system capacity, or at a rate of up to 20%, 25%, or 30% of maximum system capacity. Maximum system capacity may vary among systems and will be understood by one of ordinary skill in the art. The pump 110 is used to compensate for the pressure drop that occurs through the overnight circulation loop 120, and thus pumps the fluid from the fluid storage device 108, through one or more check valves 112 and valves 114, to a mixing tank 116 in feed water line 104. The check valves 112 prevent substantial backflow of fluid back into the pump 110 and fluid storage device 108. The mixing tank 116 is disposed between the overnight circulation loop 120 and the feed water line 104 for integrating condensed liquid pumped from the fluid storage device 108 and feed water from the feed water in the feed water line 104.

Referring still to the drawings, Figure 2 shows a schematic view of a second or “startup” circulation loop 130 of a system 100 for recovery of steam and high temperature condensate in accordance with one or more embodiments of the present disclosure. A steam line 102 extends from a steam source to a large scale pilot (LSP), or

an enhanced oil recovery system, power plant, or other system in which steam is useful.

The steam line 102 may include one or more valves 103 that are opened and closed (with or without motors) to regulate steam flow through steam line 102 and restrict flow of steam to the LSP if closed. Additionally, a feed water line 104 extends from a feed water

5 source back to the steam source. The feed water line 104 may include one or more valves 105 that are opened and closed (with or without motors) to regulate feed water flow through feed water line 104 and restrict flow of feed water from the LSP if closed.

The system 100 includes a startup fluid circulation loop 130 between the steam source and the feed water source that is useful for removing steam during startup of the

10 solar power plant to allow the plant to adequately warm up prior to comingling steam.

The circulation loop 130 has a line that extends from the steam line 102 to the feed water line 104. The circulation loop 130 line may have a diameter of at least 1 inch, 2 inches, or 3 inches, or a diameter of up to 4 inches, 5 inches, or 6 inches. When the startup

circulation loop 130 is used, valves 103 in the steam line 102 and valves 105 in the feed

15 water line 104 are closed such that the startup circulation loop 130 is isolated from the LSP. The startup fluid circulation loop 130 includes a valve 132 disposed in the

circulation line that is operable between an open position and a closed position to allow steam flow through the startup circulation loop 130. The valve 132 may be automated

and operated by, for example, a motor. Alternatively, the valve 132 may be manually

20 operated. Moreover, the valve 132 may be a ball valve, gate valve, or other valves commonly used by those skilled in the art.

Further, the startup fluid circulation loop 130 includes a condenser 134 that receives steam and high temperature condensate from the steam source and condenses the steam to a liquid state. The condenser 134 may be any type of air-cooled heat

exchanger or shell and tube heat exchanger as will be understood by one of ordinary skill in the art. The condenser 134 may be operated with one or more motors, or no motors. Additionally, one or more pressure indicators, temperatures indicators, and/or pressure indicator transmitters and temperature indicators transmitters may be disposed in the fluid circulation loop 130 proximate the condenser 134.

The startup fluid circulation loop 130 includes a sub-cooler 106, or second fluid cooling mechanism that receives the condensed liquid from the condenser 134 and cools the condensed liquid to a lower temperature. Additional description of sub-cooler 106 is provided above in reference to Figure 1. For example, in certain embodiments, the sub-cooler 106 may lower the temperature of the high temperature condensate to a temperature of about 10 degrees C, 20 degrees C, 30 degrees C, or 40 degrees C. Furthermore, the sub-cooler 106 may lower the temperature of the high temperature condensate to a temperature of up to 50 degrees C, 60 degrees C, 70 degrees C, or 80 degrees C. In still further embodiments, the sub-cooler may lower the temperature of the high temperature condensate to an ambient temperature of the region in which the system 100 is located. The sub-cooler 106 may be operated with one or more motors, or no motors.

The system 100 further includes a fluid storage device 108 that receives cooled fluid from the sub-cooler 106. The fluid storage device 108 may be an accumulator drum, or any other type of pressure storage reservoir in which non-compressible fluid is held under pressure. Additional description of the fluid storage device 108 is provided above in reference to Figure 1. Further, the accumulator drum 108 may include indicators and transmitters, including, but not limited to, pressure indicator transmitters, temperature indicator transmitters, and level transmitters. As previously described,

placing the accumulator drum 108 proximate and downstream from the sub-cooler 106 may be useful in the system 100 by allowing the sub-cooler 106 to cool condensed liquid (received from condenser 134) at a rate that is different from the rate the liquid is pumped from the startup circulation loop 130 back to the feed water line 104.

5 The system 100 further includes a pump 110 that receives cooled fluid from the fluid storage device 108 and pushes the cooled fluid from the startup circulation loop 130 to the feed water source. The cooled fluid leaves the fluid storage device 108 at a rate of at least 5%, 10%, or 15% of maximum system capacity, or at a rate of up to about 20%, 25%, or 30% of maximum system capacity. Maximum system capacity may vary among
10 systems and will be understood by one of ordinary skill in the art. The pump 110 is used to compensate for the pressure drop that occurs through the startup circulation loop, and thus pumps the fluid from the accumulator drum 108, through one or more check valves 112 and valves 114, to a mixing tank 116 in feed water line 104. The check valves 112 prevent substantial backflow of fluid back into the pump 110 and fluid storage device
15 108. The mixing tank 116 is disposed between the startup circulation loop 130 and the feed water line 104 for integrating condensed liquid pumped from the fluid storage device 108 and feed water from the feed water in the feed water line 104.

Figure 3 shows a system 100 having both an overnight fluid circulation loop 120 and a startup fluid circulation loop 130 integrated therein. The overnight fluid
20 circulation loop 120 and startup fluid circulation loop 130 may be used independently, without requirement to use both simultaneously or consecutively. In certain embodiments, a control system may be used to operate the overnight fluid circulation loop and the startup fluid circulation loop 130. The control system may include a device or set of devices to manage, command, direct or regulate the behavior of various

components in the overnight fluid circulation loop and/or the startup fluid circulation loop. For example, industrial control systems may be used, which may include supervisory control and data acquisition (SCADA) systems, distributed control systems (DCS), and other smaller control system configurations such as programmable logic controllers (PLC).

5 The system 100 is operable in a number of modes. Referring back to Figure 1, operating the system 100 in a first mode includes circulating a mixture of steam and high temperature condensate from the steam source through the overnight fluid circulation loop 120. Temperature control valve 124, disposed in the fluid circulation loop between
10 the steam source and the steam trap 128, may be opened at a temperature of at least about 150 degrees C, 160 degrees C, 170 degrees C, 180 degrees C, or 190 degrees C. Furthermore, the temperature control valve 124 may be opened at a temperature of up to 210 degrees C, 220 degrees C, 230 degrees C, 240 degrees C, or 250 degrees C.

From the steam trap 128, high temperature condensate is discharged to the sub-cooler 106, where the sub-cooler 106 may lower the temperature of the high temperature
15 condensate to a temperature of about 10 degrees C, 20 degrees C, 30 degrees C, or 40 degrees C. Furthermore, the sub-cooler 106 may lower the temperature of the high temperature condensate to a temperature of up to 50 degrees C, 60 degrees C, 70 degrees C, or 80 degrees C. Or further, the sub-cooler 106 may lower the temperature of the high
20 temperature condensate to within about 5-10 degrees C of an ambient temperature of a region in which system 100 is located.

From the sub-cooler, the cooled liquid is pumped to fluid storage device 108. The cooled liquid accumulates in the fluid storage device 108 until a particular fluid level is reached, at which time the fluid is released from the fluid storage device. The

fluid leaves the fluid storage device 108 at a rates previously described. From the fluid storage device 108, the fluid is pumped to the feed water line 104, where it is mixed into the feed water line 104 with mixing tank 116. One or more check valves 112 regulate the fluid flow in one direction as the fluid leaves the pump 110.

5 Referring now to Figure 2, operating the system in a second mode includes circulating a mixture of steam and high temperature condensate from a steam source through the startup loop during startup of a solar power plant. The mixture of steam and high temperature condensate is sent to a condenser where the fluid is condensed to a liquid. From the condenser 134, the liquid is discharged to the sub-cooler 106, where the
10 sub-cooler 106 may lower the temperature of the high temperature condensate to a temperature of about 10 degrees C, 20 degrees C, 30 degrees C, or 40 degrees C. Furthermore, the sub-cooler 106 may lower the temperature of the high temperature condensate to a temperature of up to 50 degrees C, 60 degrees C, 70 degrees C, or 80 degrees C. Or further, the sub-cooler 106 may lower the temperature of the high
15 temperature condensate to within about 5-10 degrees C of an ambient temperature of a region in which system 100 is located.

From the sub-cooler, the cooled liquid is pumped to fluid storage device 108. The cooled liquid accumulates in the fluid storage device 108 until a particular fluid level is reached, at which time the fluid is released from the fluid storage device. The
20 fluid leaves the fluid storage device 108 at a rates previously described. From the fluid storage device 108, the fluid is pumped to the feed water line 104, where it is mixed into the feed water line 104 with mixing tank 116. One or more check valves 112 regulate the fluid flow in one direction as the fluid leaves the pump 110.

Operating the system 100 in a third or “normal” mode includes flowing steam through the steam line 102 from the solar power plant to the LSP (or other systems), and returning feed water through feed water line 104 from the LSP (or other systems) to the solar power plant. Neither the overnight fluid circulation loop nor the startup fluid
5 circulation loop are in operation during normal operating mode of system 100. For example, the system 100 may be run in normal mode during the day when the solar power plant is producing steam at full capacity, or after startup once the solar power plant is running at maximum power and is completely warmed up.

An advantage of the present invention over the prior art is the fact that in the
10 overnight mode, condensate formed overnight due to cooling of the system is removed from the steam line so that pockets of water do not form in the steam line. Instead, water is evacuated from the system overnight such that startup is not delayed and no damage to components of the system occurs. Further, in the startup mode, steam is removed from the system during startup of the solar power plant to allow the solar power plant to
15 completely warm up prior to sending steam to the LSP, or enhanced oil recovery system, or any other system for which steam is useful. The system disclosed in one or more embodiments herein may be useful when coupled with any enhanced oil recovery systems, geothermal systems, any periodic power output plants, combined cycle power plants, and steam and other liquid gas systems.

20 Although the invention herein has been described with reference to particular embodiments, it is to be understood that these embodiments are merely illustrative of the principles and applications of the present invention. It is therefore to be understood that numerous modifications may be made to the illustrative embodiments and that other

arrangements may be devised without departing from the spirit and scope of the present invention.

WHAT IS CLAIMED IS:

1. A system for recovery and cooling of steam and high temperature condensate and disposed between a feed water source and a steam source, the system comprising:

a fluid circulation loop between the steam source and the feed water source

5 including:

a steam trap that receives a mixture of steam and high temperature condensate from the steam source, wherein the steam trap discharges high temperature condensate from the steam source; and

a fluid cooling mechanism which receives the high temperature condensate from the steam trap and cools the high temperature condensate.

2. The system of claim 1, further comprising a fluid storage device that receives cooled condensate from the fluid cooling mechanism.

3. The system of either of claims 1 or 2, further comprising a pump for pushing cooled condensate leaving the fluid storage device to the feed water source.

15 4. The system of either of claims 1 or 2, further comprising a mixing tank disposed between the fluid circulation loop and the feed water source for integrating cooled condensate from the fluid storage device and feed water from the feed water source.

5. The system of claim 1, further comprising a temperature control valve that controls flow of steam and high temperature condensate from the steam source to the steam trap, wherein the temperature control valve moves from a closed position to an open position below a certain temperature.

6. The system of claim 5, wherein the temperature control valve can be set to move from the closed position to the open position at a steam temperature of between 150 to 250 degrees C.

7. The system of claim 1, wherein the fluid cooling mechanism cools the high temperature condensate to a temperature between about 10 degrees C and 80 degrees C.

8. A system for recovery and cooling of steam and high temperature condensate and disposed between a feed water source and a steam source comprising:

a fluid circulation loop between the steam source and the feed water source including:

a condenser that receives steam and high temperature condensate from the steam source, wherein steam is condensed to a liquid state in the condenser; and

a fluid cooling mechanism that receives the condensed liquid from the condenser and cools the liquid.

9. The system of claim 8, further comprising a fluid storage device that receives cooled fluid from the fluid cooling mechanism.

10. The system of claim 8, further comprising a pump that receives cooled fluid from the fluid storage device and pushes the cooled fluid to the feed water source.

11. The system of claim 8, further comprising a mixing tank disposed between the fluid circulation loop and the feed water source for integrating condensed liquid from the fluid storage device and feed water from the feed water source.

12. The system of claim 8, further comprising at least one valve disposed in the fluid circulation loop between the steam source and the condenser that allow steams flow from the steam source to the condenser.

13. The system of claim 8, wherein the fluid cooling mechanism cools the condensed liquid to a temperature between about 10 degrees C and 80 degrees C.

14. A method for recovery and cooling of steam and high temperature condensate, including operating a system disposed between a feed water source and a steam source, wherein the system may be operated in a first mode or a second mode,
5 wherein said first mode comprises:

circulating a mixture of steam and high temperature condensate from the steam source through a first fluid circulation loop to a steam trap;

discharging high temperature condensate from the steam source in the steam trap;

10 receiving the discharged high temperature condensate from the steam trap in a fluid cooling mechanism and further cooling the discharged high temperature condensate with the fluid cooling mechanism; and

pumping the cooled condensate to the feed water source; and wherein said second mode comprises:

15 circulating steam and high temperature condensate from a steam source through a second fluid circulation loop to a condenser;

condensing the steam in the condenser to a liquid;

receiving the condensed liquid from the condenser in a fluid cooling mechanism and cooling the condensed liquid with the fluid cooling mechanism; and

20 pumping the cooled condensed liquid to the feed water source.

15. The method of claim 14, wherein operating in a first mode further comprises opening a temperature control valve disposed in the first fluid circulation loop between the steam source and the steam trap at between 150 to 250 degrees C, wherein the mixture of steam and condensate from the steam source is circulated to the steam trap.

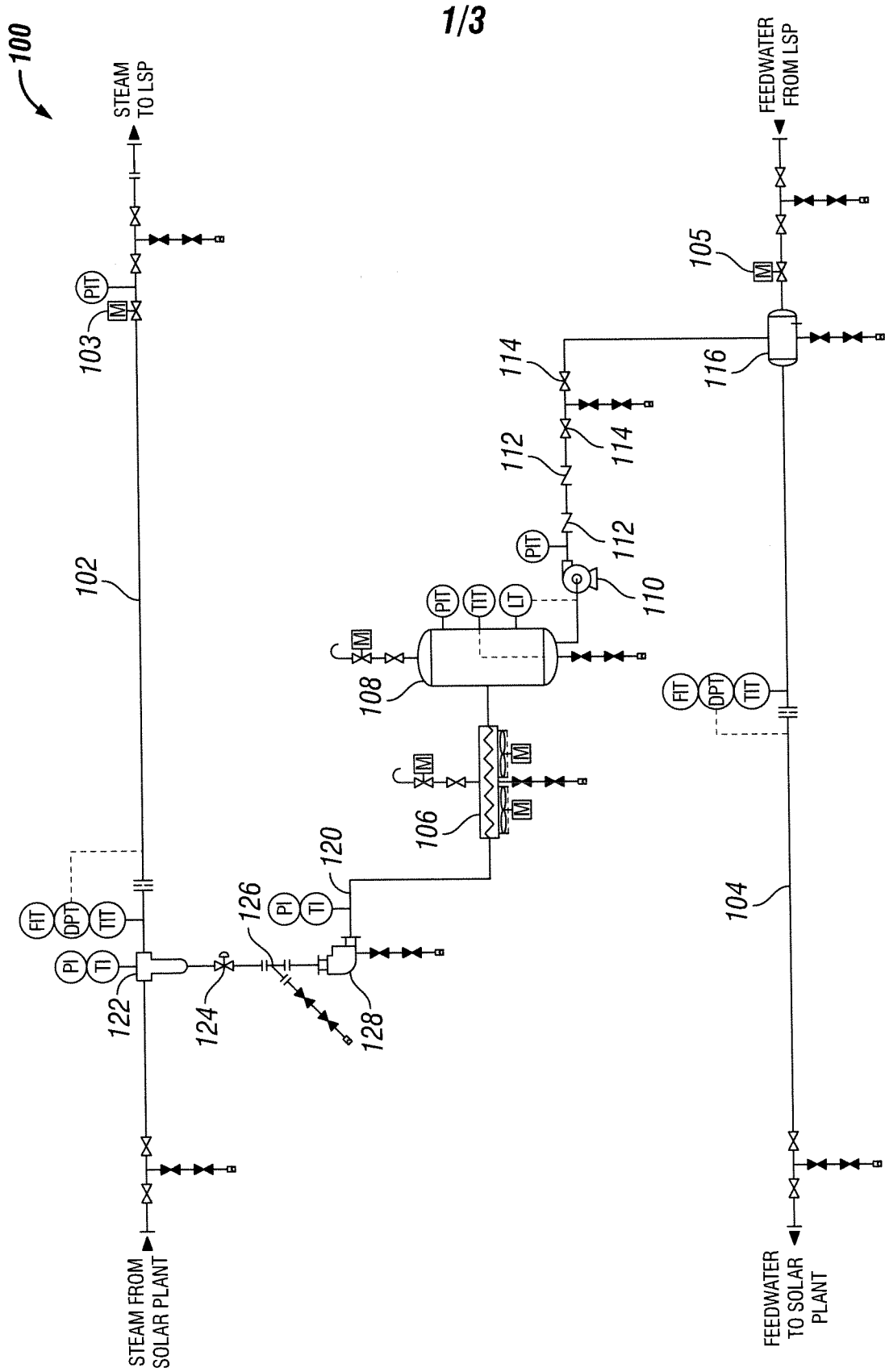


FIG. 1

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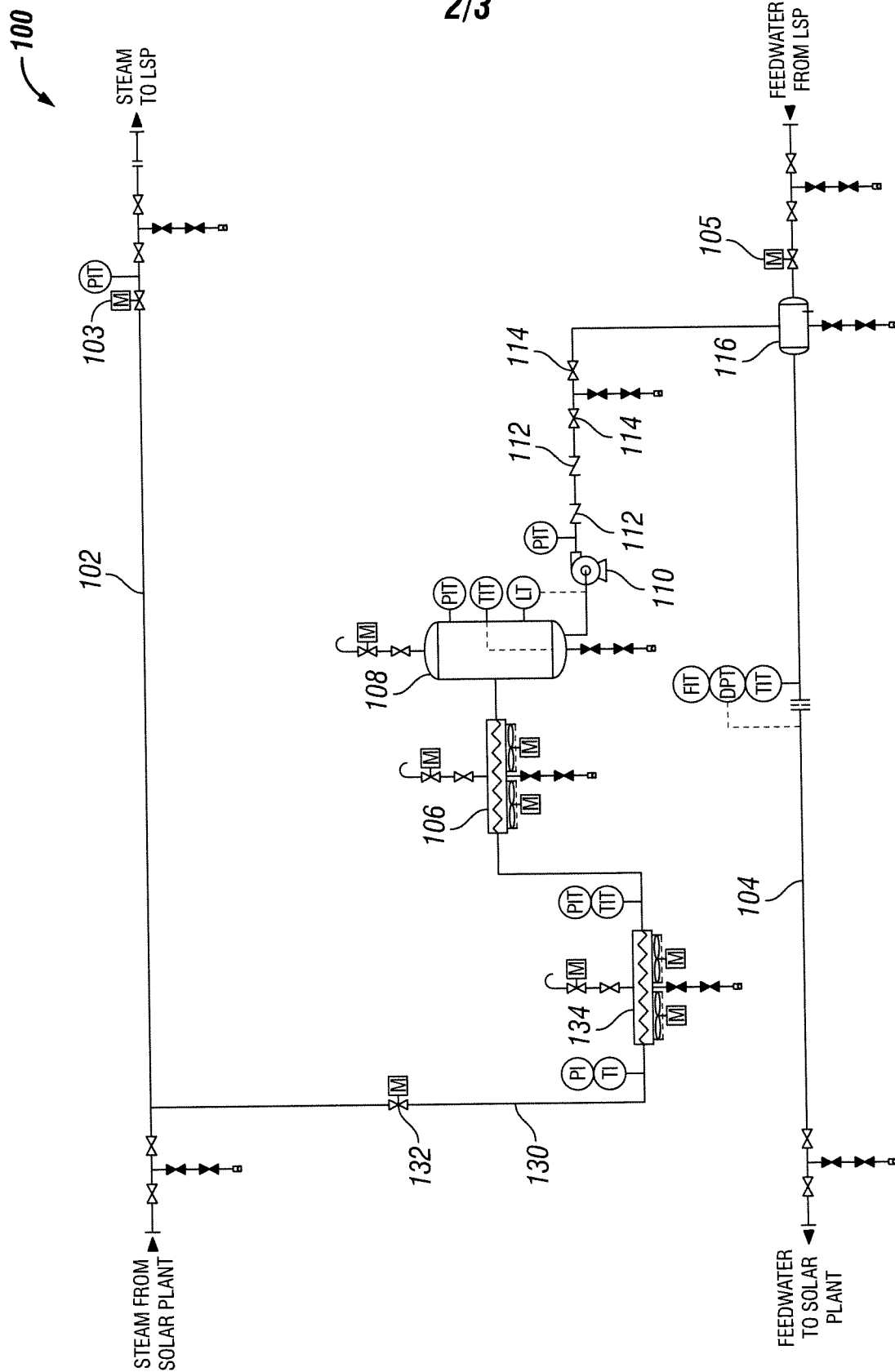


FIG. 2

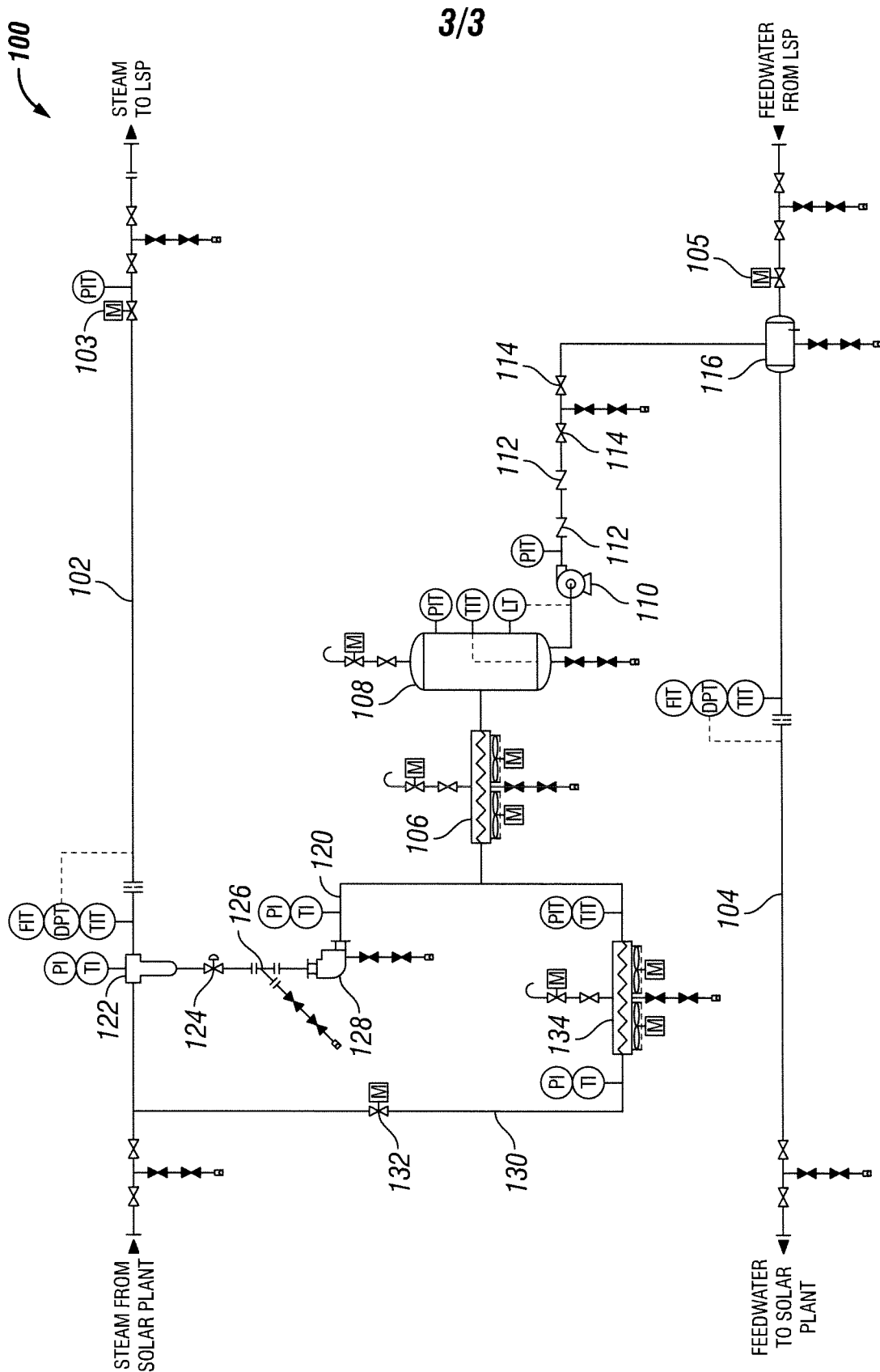


FIG. 3