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(54) Title: POWER PLANT STEAM CONDENSATION SYSTEM

(57) Abstract: According to an exemplary embodiment of the invention, a power plant steam condensation system 100, 200 is disclosed. The power plant steam condensation system 100, 200 includes a closed condensing well 106, 206. The condensing well 106, 206 is filled with water up to a predefined level. The condensing well 106, 206 has an inlet port 110, 210 with at least one or more spray nozzle arrangement 112, 212. The spray nozzles 112, 212 allows steam from a turbine 104, 204 to flow into the condensing well 106, 206. The condensing well 106, 206 in the power plant steam condensation system 100, 200 further has an outlet port 116, 216. The outlet port 116, 216 allows the water in the condensing well 106, 206 to flow out of the condensing well 106, 206 into a boiler 102, 202.

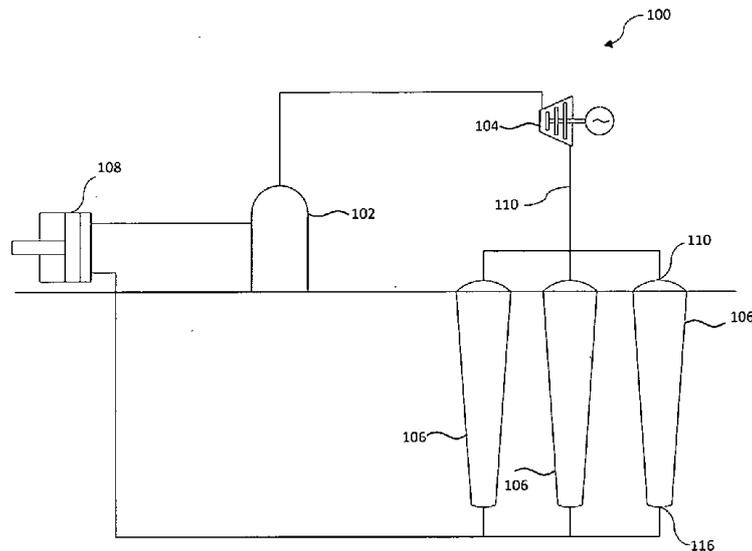


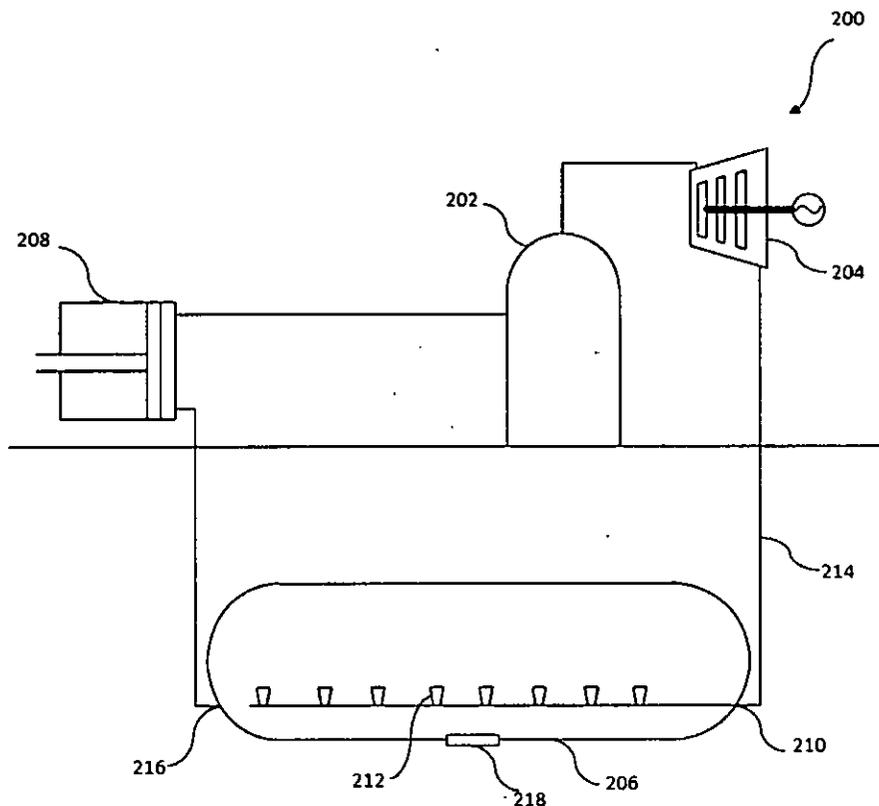
Figure 1

ABSTRACT



Power plant steam condensation system

According to an exemplary embodiment of the invention, a power plant steam condensation system 100, 200 is disclosed. The power plant steam condensation system 100, 200 includes a closed condensing well 106, 206. The condensing well 106, 206 is filled with water up to a predefined level. The condensing well 106, 206 has an inlet port 110, 210 with at least one or more spray nozzle arrangement 112, 212. The spray nozzles 112, 212 allows steam from a turbine 104, 204 to flow into the condensing well 106, 206. The condensing well 106, 206 in the power plant steam condensation system 100, 200 further has an outlet port 116, 216. The outlet port 116, 216 allows the water in the condensing well 106, 206 to flow out of the condensing well 106, 206 into a boiler 102, 202.



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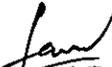
We claim:

1. A power plant steam condensation system 100, 200 comprising:
 - a closed condensing well 106, 206 filled with water up to a predefined level,
 - the condensing well 106, 206 having an inlet port 110, 210 with at least one spray nozzle arrangement 112, 212 for a steam to flow into the condensing well 106, 206 and an outlet port 116, 216 for the water to flow out of the condensing well 106, 206.
2. The power plant steam condensation system 100, 200 as claimed in claim 1, wherein the powerplant steam condensation system 100, 200 includes a feed pump 108, 208 between the condensing well 106, 206 and the boiler 102, 202.
3. The power plant steam condensation system 100, 200 as claimed in claim 1, wherein the spray nozzle 112, 212 is provided in proximity to a bottom of the condensing well 106, 206.
4. The power plant steam condensation system 100, 200 as claimed in claim 1, wherein the steam atomizes on entering into the condensing well 106, 206 from the spray nozzle 112, 212.
5. The power plant steam condensation system 100 as claimed in claim 1, wherein the condensing well 106 is a vertical condensing well 106.

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6. The power plant steam condensation system 200 as claimed in claim 1, wherein the condensing well 206 is a horizontal condensing well 206.
7. The power plant steam condensation system 100, 200 as claimed in claim 1, wherein the volume of the condensing well 106, 206 is directly proportional to a mass flow rate of steam flowing from the turbine 104 in the power plant.
8. The power plant steam condensation system 100 as claimed in claim 1, wherein the spray nozzle 112 is arranged on a helical tube 114 carrying the steam from the inlet port 110 into the condensing well 106.
9. The power plant steam condensation system 200 as claimed in claim 1, wherein the spray nozzle 212 is arranged on a tube 214 carrying the steam from a turbine 204 into the condensing well 206.

Dated this 13th day of January 2017


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FIELD OF INVENTION

The invention generally relates to a steam condensation system and more particularly to a power plant steam condensation system.

BACKGROUND

A conventional power plant typically comprises of a main feed pump to pump liquid to a boiler. The boiler is a steam generation unit in the power plant. The boiler converts the liquid into a high pressure and high temperature steam. The high pressure and high temperature steam enters into a turbine where the steam spins the turbine blades and drives an electric generator. The high pressure and high temperature steam leaves the turbine as a low pressure and low temperature steam. This low pressure and low temperature steam enters a condenser and transfer its heat to a condensate present in the condenser and forms a condensed steam. The condensed steam is further pumped into the boiler and the cycle is repeated. The heated condensate, on the other hand, is pumped to a cooling tower where the condensate losses its heat and is again pumped back to the condenser.

Cooling of the steam, in known power plant systems, takes place in the cooling tower and the condenser. Use of cooling towers and condensers reduces the overall efficiency of the power plant due to excessive power consumption. Furthermore, installing the condenser and building the cooling tower for steam condensation in power plant increases initial cost of the power plant systems.

Hence there is a need for an improved steam condensation system for power plants.

12-Jan-2018/2597/201741001454/Description(Complete)

SUMMARY OF THE INVENTION

According to embodiments of the invention, a power plant steam condensation system is disclosed. The disclosed power plant steam condensation system includes a closed condensing well. The condensing well may be filled with water up to a predefined level. The condensing well has an inlet port with at least one or more spray nozzle arrangement therein. The spray nozzle arrangement allows steam from a turbine to flow into the condensing well. The condensing well of the power plant steam condensation system further has an outlet port. The outlet port allows the water in the condensing well to flow out of the condensing well to a boiler.

BRIEF DESCRIPTION OF DRAWINGS

Other objects, features, and advantages of the invention will be apparent from the following description when read with reference to the accompanying drawings. In the drawings, wherein like reference numerals denote corresponding parts throughout the several views:

Figure 1 illustrates a schematic diagram of a power plant steam condensation system according to an exemplary embodiment of the invention.

Figure 2 illustrates a front view of a condensing well according to an exemplary embodiment of the invention.

Figure 3 illustrates a schematic diagram of a power plant steam condensation system according to another exemplary embodiment of the invention.

Figure 4 illustrates a front view of a condensing well according to another exemplary embodiment of the invention.

DETAILED DESCRIPTION OF DRAWINGS

The following description with reference to the accompanying drawings is provided to assist in a comprehensive understanding of exemplary embodiments. It includes various specific details to assist in that understanding but these are to be regarded as merely exemplary. Accordingly, those of ordinary skill in the art will recognize that various changes and modifications of the embodiments described herein can be made without departing from the scope and spirit of the invention. In addition, descriptions of well-known functions and constructions are omitted for clarity and conciseness.

Figure 1 illustrates a schematic diagram of an exemplary power plant steam condensation system 100 according to an embodiment of the invention. The power plant may include a boiler 102 and a turbine 104. The boiler 102 in the power plant may heat a water circulating in the power plant and convert the water into a high pressure and high temperature steam. The high pressure and high temperature steam then flows into the turbine 104 where the high pressure superheated steam rotates the turbine blades. The power plant may utilize the high pressure superheated steam and convert the heat energy into an electric energy. The power plant steam condensation system 100 may include a condensing well 106. The condensing well 106 may

be of a closed enclosure. The closed enclosure of the condensing well 106 may prevent the

water in the condensing well 106 to escape into the atmosphere. According to an embodiment, the condensing well 106 may be a pressure vessel. The function of the condensing well 106 is to condense low pressure steam flowing from the turbine 104 into water. According to an embodiment, the top surface of the condensing well 106 may be above ground level. According to another embodiment, the condensing well 106 may be completely under the ground. The power plant steam condensation system 100 may further include a makeup feed pump 108 between the condensing well 106 and a boiler 102. The feed pump 108 may pump the water from the condensing well 106 to the boiler 102. According to an embodiment, the water in the condensing well 106 may flow into the boiler 102 without the feed pump 108. According to another embodiment, when the pressure of the water in the condensing well 106 is not sufficient, the makeup feed pump 108 may be operated to pump the water from the condensing well 106 to the boiler 102. The boiler 102 may convert the water into a high pressure and high temperature steam. The steam flows into a turbine 104 where the steam spins the turbine blades and drive a generator. The turbine 104 converts the high pressure and high temperature steam into a low pressure and low temperature steam. The low pressure and low temperature steam flows into the condensing well 106. According to an embodiment, the power plant steam condensation system 100 may include only one condensing well 106. According to another embodiment, the power plant steam condensation system 100 may include more than one condensing well 106. The extra condensing wells 106 may be usable only when the temperature and pressure in the running condensing well 106 may reach up to a predefined temperature and pressure. The switching among the condensing wells 106 may be achieved through separate ports of each condensing well 106.

Figure 2 illustrates a front view of the condensing well 106 according to an exemplary

~~embodiment of the invention, the condensing well 106 may be a vertical cooling well.~~

According to an embodiment, the volume of the condensing well 106 may depend on a mass flow rate of steam flowing from the turbine 104. The volume of the condensing well 106 may be directly proportional to the mass flow rate of steam flowing from the turbine 104. The condensing well 106 may be filled with water up to a predefined level. According to an embodiment, the condensing well 106 may be filled with water up to $\frac{3}{4}$ volume of the condensing well 106. According to another embodiment, the water level in the condensing well 106 may depend on the cooling required in the power plant. The condensing well 106 may include an inlet port 110 with one spray nozzle 112 for the steam to flow into the condensing well 106 from the turbine 104. The spray nozzle 112 may be arranged on an end of a helical tube 114 carrying the steam from the inlet port 110 into the condensing well 106. The tube 114 and the spray nozzle 112 may be arranged in such a way that the spray nozzle 112 is in proximity to the bottom part of the condensing well 106. The spray nozzle 112 may be immersed in the water in the condensing well 106 and atomizes the steam discharging from the spray nozzle 112 into the condensing well 106. The arrangement of the spray nozzle 112 in the cooling well 106 may cause the steam to dissolve and condense into water when the steam comes in contact with the water in the condensing well 106. The condensing well 106 in the power plant steam condensation system 100 may further have an outlet port 116. The outlet port 116 may allow the water in the condensing well 106 to flow out of the condensing well 106 into the boiler 102. The outlet port 116 provided in the condensing well 106 may be kept closed during the condensation process. The closed outlet port 116 may increase the pressure and temperature of the water in the condensing well 106. According to an embodiment, the outlet port 116 may be opened for the water to flow out of the condensing well 106 when the pressure and temperature in the condensing well 106 reaches a predefined limit. The condensed water may flow from the condensing well 106 to the boiler 102 when the outlet port 116 is opened. According to an embodiment, the makeup feed pump 108 may be used when the

pressure is not sufficient for water to flow from condensing well 106 to the boiler 116. The condensing well 106 may further include a manhole to perform service operations inside the condensing well 106. A passage may be provided to the manhole in the condensing well for workers to safely reach the condensing well 106 and conduct cleaning and repair of the condensing well 106 components.

Figure 3 illustrates a schematic diagram of an exemplary power plant steam condensation system 200 according to another embodiment of the invention. The power plant steam condensation system 200 includes a closed condensing well 206. According to an embodiment, the top surface of the condensing well 206 may be above ground level. According to another embodiment, the condensing well 206 may be completely under the ground. The power plant may further include a makeup feed pump 208 to pump the water from the condensing well 206 to the boiler 202. The boiler 202 may convert the water into a high pressure and high temperature steam. The steam may flow into a turbine 204 where the steam spins the turbine blades and drive a generator. The turbine 204 may convert the high pressure and high temperature steam into a low pressure and low temperature steam. The low pressure and low temperature steam flows into the condensing well 206.

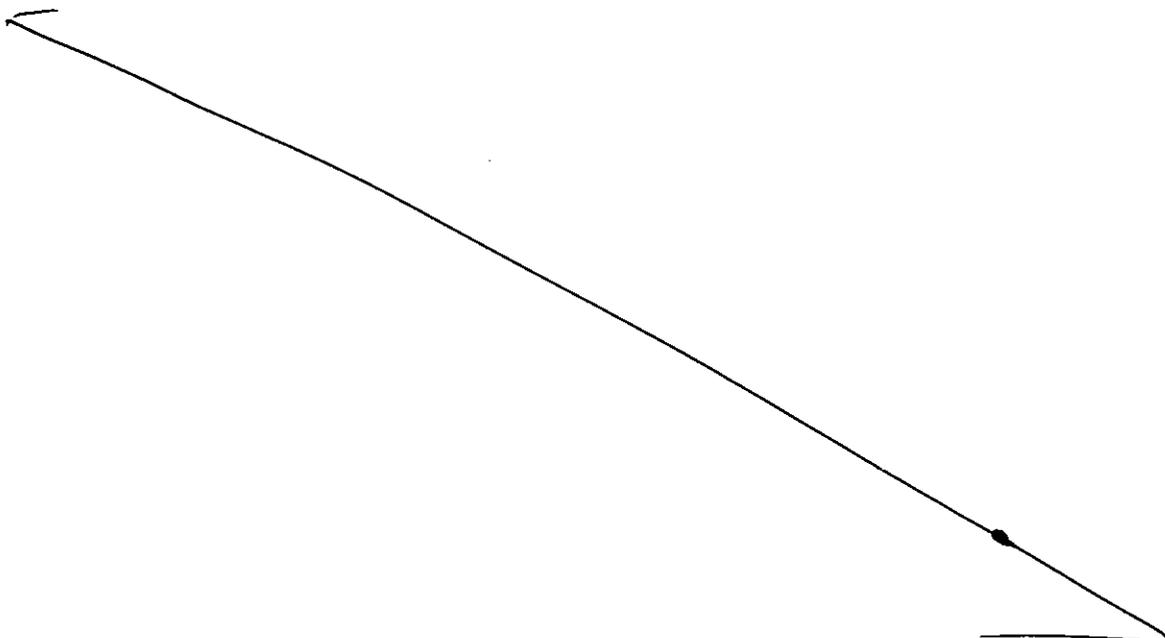
Figure 4 illustrates a front view of the condensing well 206 according to another exemplary embodiment of the invention. The condensing well 206 may be a horizontal cooling well. According to an embodiment, the volume of the condensing well 206 may depend on the mass flow rate of steam flowing from the turbine 104. The condensing well 206 may be filled with water up to a predefined level. According to another embodiment, the water level in the condensing well 206 may depend on the cooling capacity required in the power plant. The condensing well 206 has an inlet port 210 with at least one or more spray nozzle arrangement

212 for the steam to flow into the condensing well 206 from the turbine 204. The spray nozzles 212 may be arranged on a tube 214 carrying the steam from the turbine 204 into the condensing well 206. The tube 214 and the spray nozzles 212 may be arranged in proximity to the bottom part of the condensing well 206. The spray nozzle 212 may be immersed in the water in the condensing well 206 and atomizes the steam discharging from the spray nozzle 212 into the condensing well 206. The arrangement of the spray nozzles 212 in the condensing well 206 may cause the steam to dissolve and condense into water when the steam come in contact with the water in the condensing well 206. The condensing well 206 in the power plant steam condensation system 200 further has an outlet port 216. The outlet port 216 may allow the water in the condensing well 206 to flow out of the condensing well 206 into the boiler 202. The outlet port 216 provided in the condensing well 206 is kept closed during the condensation process. The closed outlet port 216 may help in increasing the pressure and temperature of the water in the condensing well 206. When sufficient pressure and temperature is generated in the condensing well 206, the outlet port 216 may be opened so that the water may be allowed to flow out of the condensing well 206. The water at a predefined pressure and temperature may flow from the condensing well 206 to the boiler 202 when the outlet port 216 is opened. According to an embodiment, the makeup feed pump 208 may be used when the pressure is not sufficient for water to flow from condensing well 206 to the boiler 202. The condensing well 206 may further include a manhole 218 to perform service operations inside the condensing well 206. A passage may be provided to the manhole in the condensing well for workers to safely reach the condensing well 206 and conduct cleaning and repair of the condensing well 206 components.

The above invention has several advantages with respect to the prior arts available. In the power plant steam condensation system 100, 200, the condenser and the cooling tower are replaced

by the cooling well 106, 206. Since the cooling well 106, 206 does not need power to operate, the use of cooling well 106, 206 in the power plant eliminates the cost of power and saves energy. The other advantage of replacing condenser and cooling tower with cooling well 106, 206 is that lesser components optimizes the efficiency of the power plant. Furthermore, the water flowing from the condensing well 106, 206 to the boiler 102, 202 may be of higher temperature, which may further increase the efficiency of the boiler 102, 202 thereby increasing the efficiency of the power plant.

It is understood that the above description is intended to be illustrative, and not restrictive. It is intended to cover all alternatives, modifications and equivalents as may be included within the spirit and scope of the invention as defined in the appended claims. Many other embodiments will be apparent to those of skill in the art upon reviewing the above description. The scope of the invention should, therefore, be determined with reference to the appended claims, along with the full scope of equivalents to which such claims are entitled. In the appended claims, the terms "including" and "in which" are used as the plain-English equivalents of the respective terms "comprising" and "wherein," respectively.



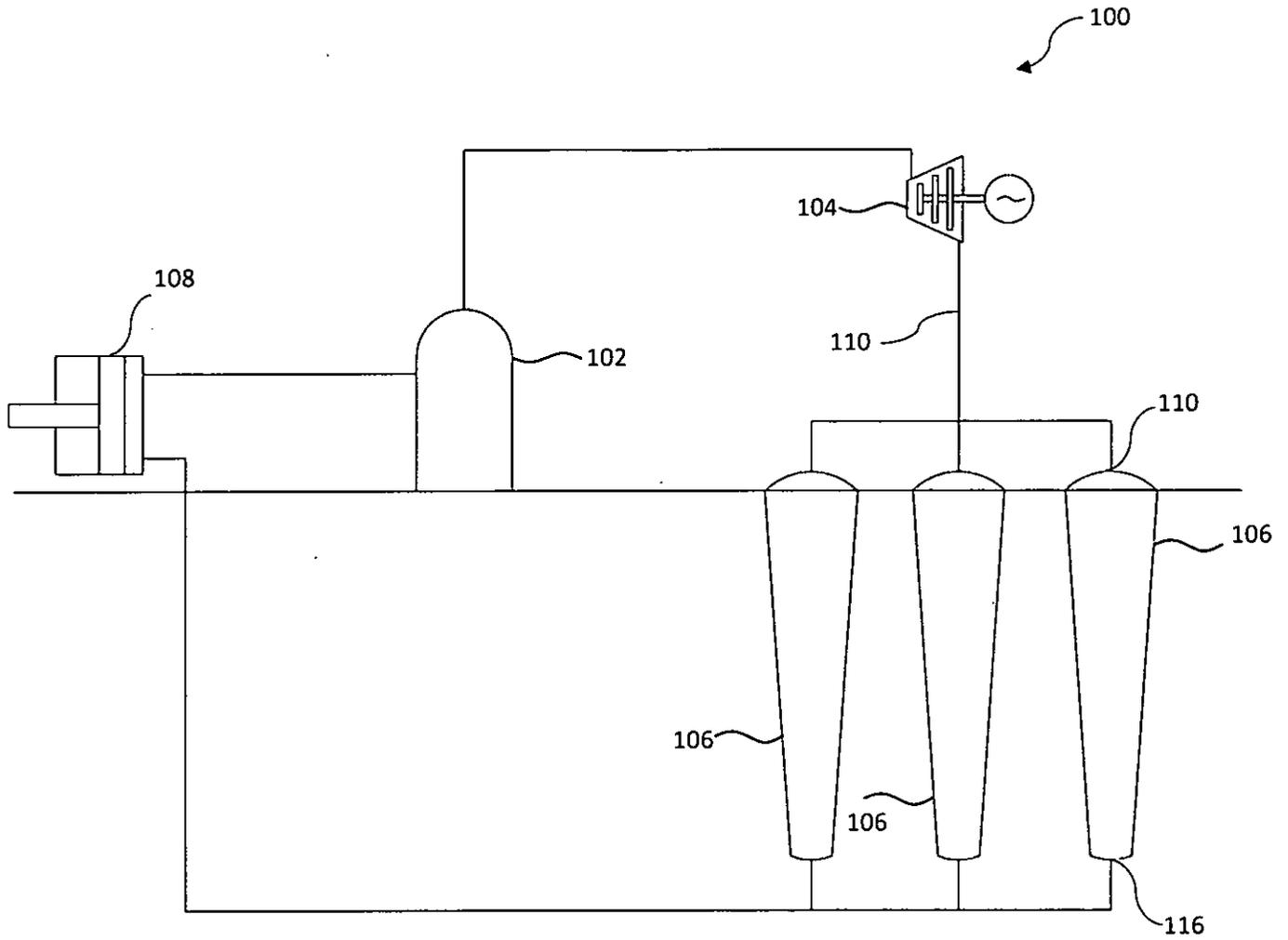


Figure 1

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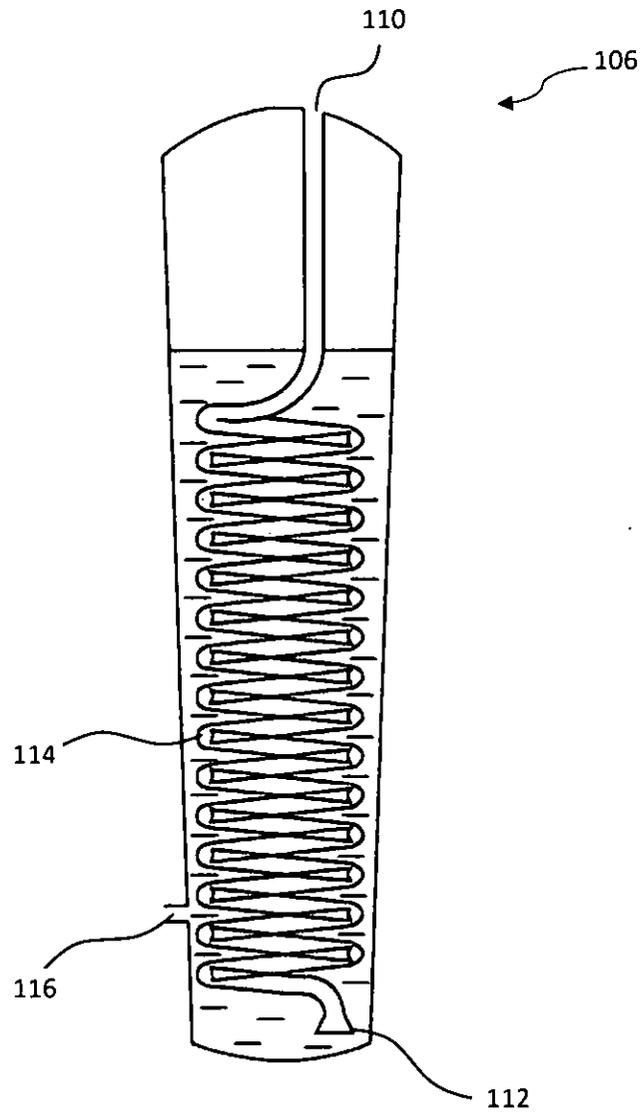


Figure 2

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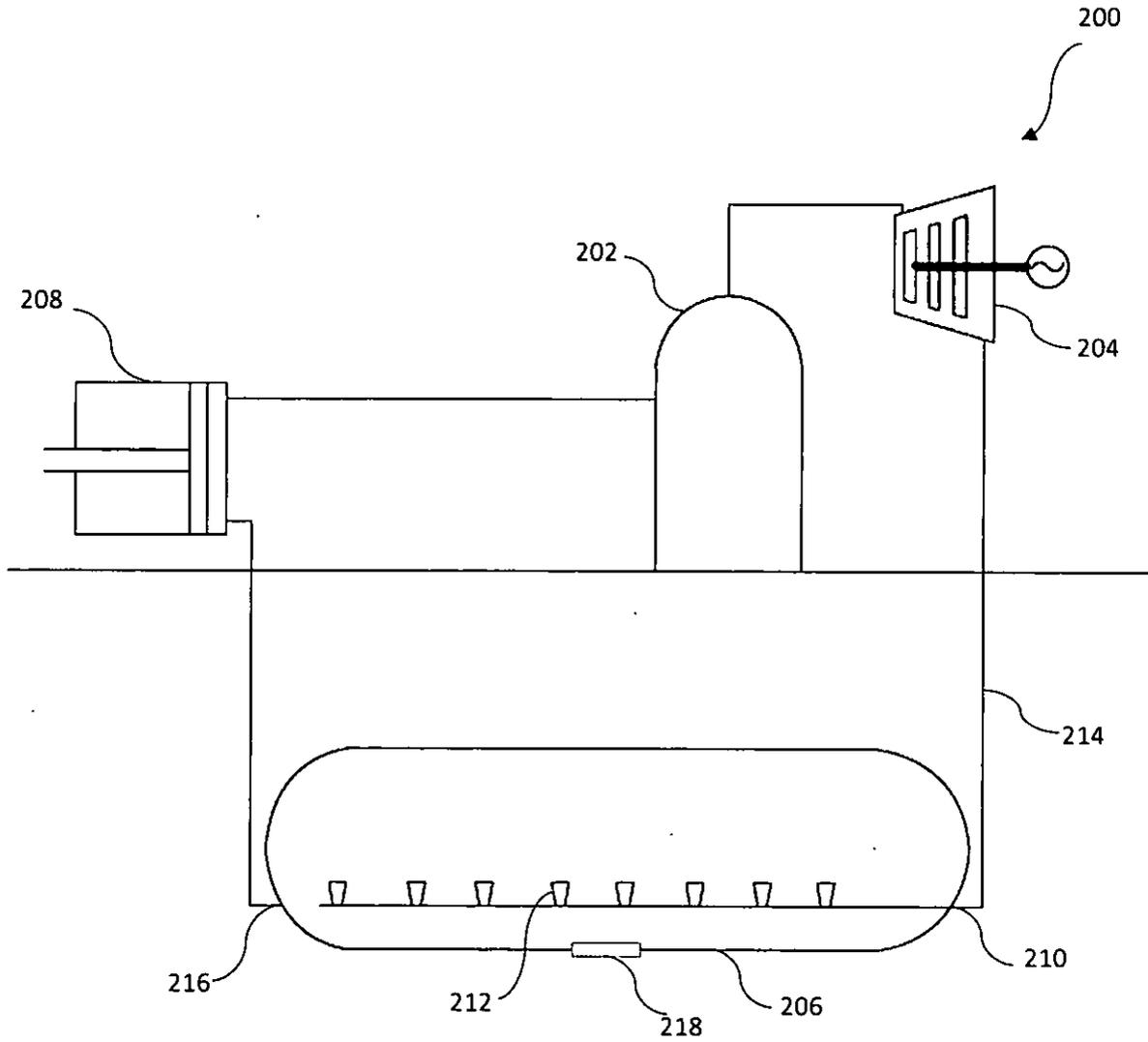


Figure 3

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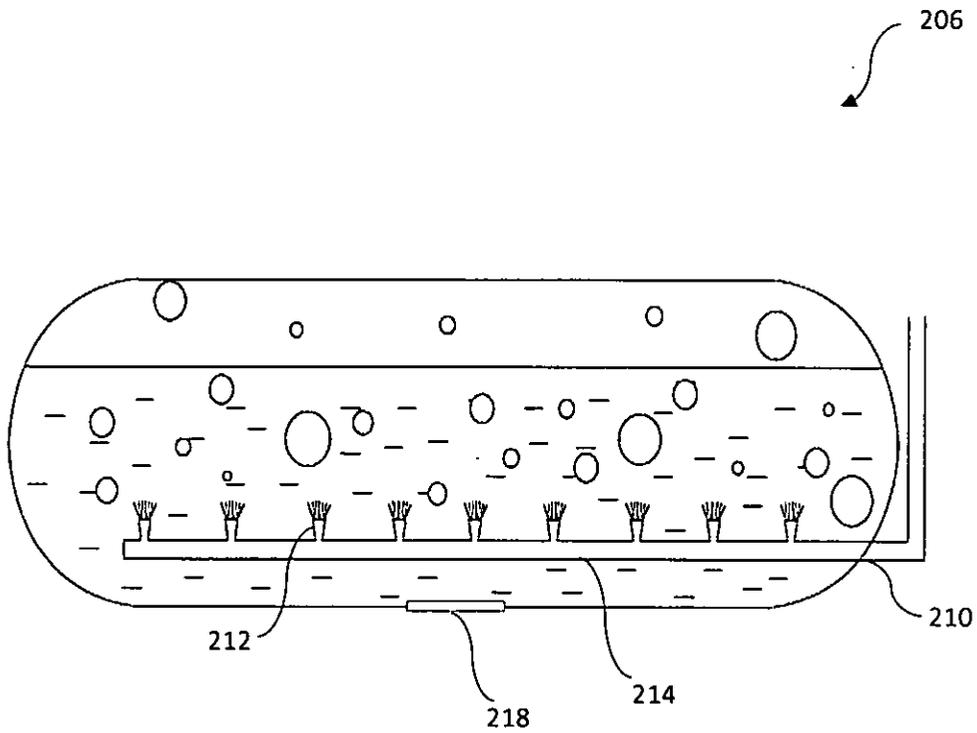


Figure 4

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