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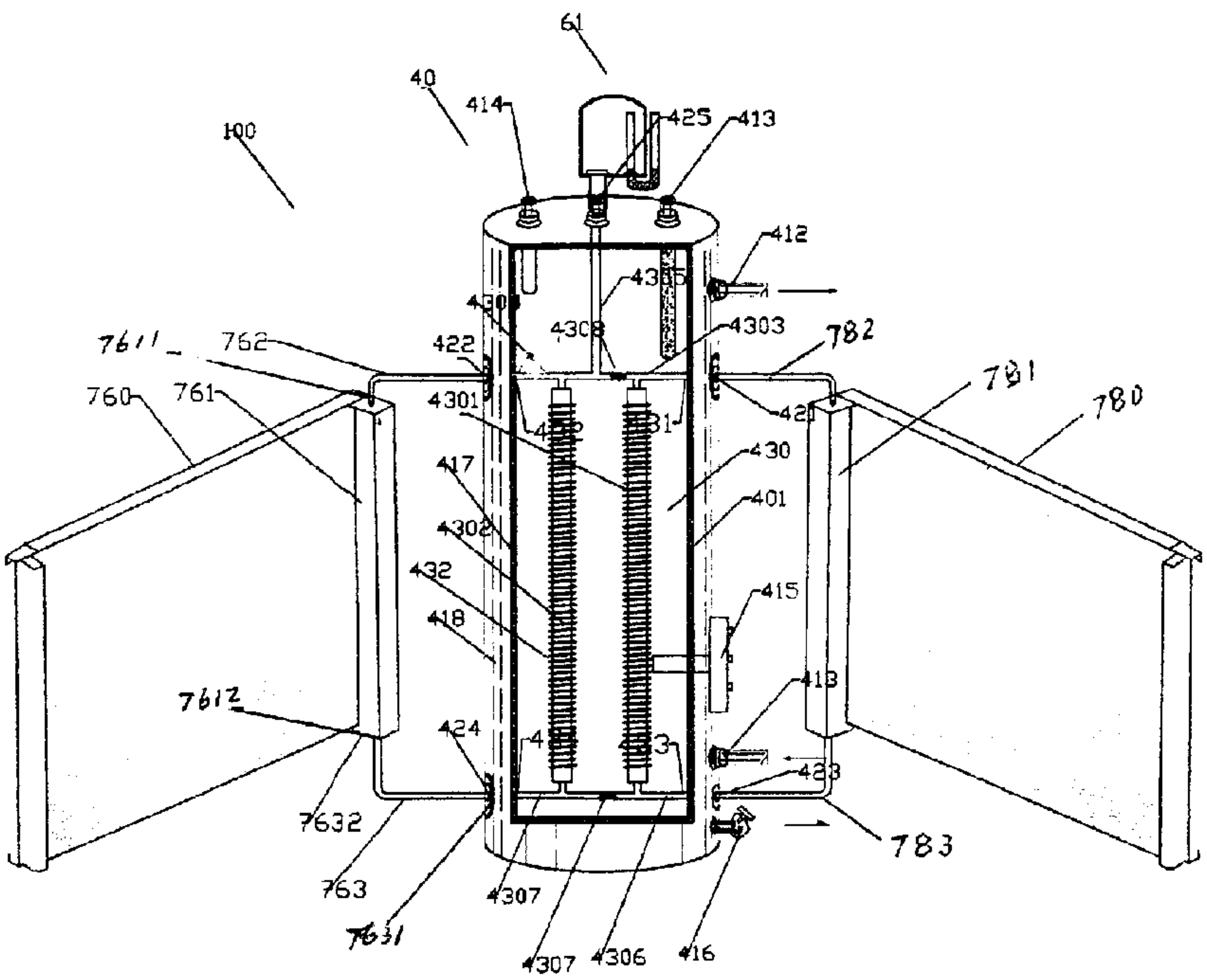
(54) **Titre :** RESERVOIR DE STOCKAGE ET SYSTEME DE CHAUFFAGE DE FLUIDE

(54) **Title:** FLUID HEATING AND STORAGE TANK AND SYSTEM



(57) **Abrégé/Abstract:**
A fluid heating and storage tank with an interior-installed heat exchanger is provided. The tank comprises two pairs of inlets and outlets for second fluid, and at least one breathing port, which are connected to the heat exchanger. One apparatus for condensing and reclaiming of the liquid vapor is mounted at the breathing port. A heat driven self-circulated fluid heating and storage system incorporating the fluid heating and storage tank is provided to use with one or two heaters. The heaters may use solar and other different energy resources. The system can have the double solar heat collectors orientated in any angle, typically in 90 degrees and 180 degrees. These solar heating systems may be used to form the module units of the building roofs, fences and verandas etc.

ABSTRACT

A fluid heating and storage tank with an interior-installed heat exchanger is provided. The tank comprises two pairs of inlets and outlets for second fluid, and at least one breathing port, which are connected to the heat exchanger. One apparatus for condensing and reclaiming of the liquid vapor is mounted at the breathing port. A heat driven self-circulated fluid heating and storage system incorporating the fluid heating and storage tank is provided to use with one or two heaters. The heaters may use solar and other different energy resources. The system can have the double solar heat collectors orientated in any angle, typically in 90 degrees and 180 degrees. These solar heating systems may be used to form the module units of the building roofs, fences and verandas etc.

FLUID HEATING AND STORAGE TANK AND SYSTEM

FIELD OF TECHNOLOGY

The present disclosure relates to fluid heating and storage tanks, especially relates to the fluid heating and storage tanks having an interior-installed heat exchanger. It also relates to heat driven self-circulated fluid heating and storage systems using the tanks and having multiple energy sources, especially the solar heat collectors.

BACKGROUND

At present the solar heat application is becoming more and more popular. To reduce the hardware, software, installation, operation and maintenance costs, the applicant of this application disclosed a self-powered pump and liquid heat drive and self-circulation technology in the Canadian patent No. CA2628605. In another patent application CA2678584, the applicant of this application further disclosed several liquid heat driven self-circulated systems. All these systems need the basic equipment of fluid heating and storage tank. The tanks described in the above-mentioned patent applications are different in construction from the above-mentioned systems. It is not convenient for manufacture and installation. One purpose of this application is to develop tanks for the heat driven self-circulating solar heating and storage systems by standardized and modularized manufacture.

The solar energy varies in different seasons, locations and weather. Thus the solar energy in the solar heat collected in a solar heating system is not steady. It is expected by solar energy customers that a fluid heating and storage tank can be used not only for solar energy, but also for other energy sources.
Many efforts have been made to integrate the solar heating system with the building in the last few decades. The liquid heat driven self-circulated technology has made the integration of the solar heating system with the buildings much easier. It is the third purpose of this invention to make the solar heating systems an integral structural part of the module units of the building.

The fluid heating and storage tanks with an interior-installed heat exchanger have been used for a long time. However the existing tank can not be used as a heat driven and self-circulation system when the tank is not located higher than the heater. The existing tank for multi-energy sources also can't be used in a heat driven and self-circulation system.

The vaporizing and escaping of the heating liquid is a risk for the continued safe operation of a heat driven and self-circulation liquid heating and storage system. Some solutions for such problems have been developed in the above-mentioned patent applications. This disclosure provides an improved and more efficient liquid vapor condensing and reclaiming apparatus.

SUMMARY OF THE INVENTION

The present disclosure aims at the new requirements of solar heat applications and also includes the improvement to the technologies shown in the above pending patent applications.

In one aspect, the present disclosure is to provide the fluid heating and storage tank with interior installed heat exchanger for the heat driven self-circulated solar heating and storage systems by standard and modularization manufacture.

In another aspect, the present disclosure is to provide the heat driven self-circulating fluid heating and storage systems employing above-mentioned fluid heating and storage tank.

In the third aspects, the present disclosure is to provide the solar heat driven self-circulated solar heating and storage system that can be used as the units of the building walls, fences and verandas etc.

Following is a brief summary of the present invention:

1. A fluid heating and storage tank with an interior-installed heat exchanger comprises a storage container for a primary fluid in which the storage container has an inlet and an outlet for the primary fluid, a first inlet fitting and a first outlet fitting, a second inlet fitting and a second outlet fitting for a secondary fluid, and at least one breathing fitting; and a heat exchanger is disposed within the fluid heating and storage tank for conducting the secondary fluid through the fluid heating and storage tank in isolation from the primary fluid. The heating and storage tank has a first inlet and a first outlet, a second inlet and a second outlet for said secondary fluid and at least one breathing port. Each of the inlets, outlets and breathing ports is connected to a respective corresponding fitting of the fluid heating and storage tank. The two secondary fluid inlet fittings are located not lower than two of the outlet fittings, and the breathing fitting is located not lower than the inlet fitting; and at least one apparatus for condensing and reclaiming the secondary fluid vapor, which has a breathing and condensing pipe and a breathing pipe connected to the breathing port fitting of the fluid heating and storage tank.

2. The fluid heating and storage tank of the heat exchanger has a separable space, and it comprises an inner liquid separating tool separating the separable space into a first sub-space and a second sub-space. Both the first inlet and first outlet are connected to the first sub-space, and the second inlet and second outlet are connected to the second sub-space.

3. The apparatus for condensing and reclaiming the secondary fluid vapor, comprises an airtight container for containing escaped heated secondary liquid and vapor from a fluid vapor source; and the airtight container has a base, a top and an inner tool for condensing the liquid vapor; a breathing pipe with one end extending upwardly into the airtight container mounted at the bottom of the airtight container and having an opposite end connected to the fluid vapor source; a flexural breathing and condensing pipe extending upwardly into the airtight container, and it has an end located within the airtight container and it is located lower than the interior top side of the airtight container and also having an opposite end located outside of the airtight container for condensing the escaped vapor and temporally storing the liquid of condensed vapor for reclaiming.

4. The fluid heating and storage tank further comprises one or more release valve, a drain valve, a protective anode and one or more electric heaters.

5 . The heat exchanger of the fluid heating and storage tank is made of a material selected from the group consisting of ceramic, metal, copper, stainless steel, steel plated by porcelain enamel and glass.

6. The first and second outlets of the fluid heating storage tank are arranged on a wall of the storage container at 180 degrees relative to one another; and the first and second inlets are also arranged on the wall of the storage container at 180 degrees relative to another.

7. The first and second outlets of the fluid heating and storage tank are provided on the wall of storage container and are located at 90 degrees relative to one another; and the first and second inlets are also arranged at the wall of storage container and located at 90 degrees relative to one another.

8. The fluid heating and storage tank further includes back up bolt caps for capping the inlet, outlet and breathing fittings when these fittings are not being used.

9. The heat exchanger of the fluid heating and storage tank may alternatively be in the form of a tube heat exchanger, a plate heat exchanger, a coil heat exchanger, a fin tube heat exchanger, a helix tube heat exchanger, or any hybrid combination of these heat exchangers.

10. If a plate heat exchanger is employed in the fluid heating and storage tank, the liquid separating structure in the heat exchanger is a separator installed in the chamber of the heat exchanger separating the secondary fluid space into two sub-spaces, and the inlet and outlet pairs are provided on the walls of the two sub-spaces respectively. At least one the sub-space has a breathing fitting on the top wall of the sub-spaces.

11. The heat exchanger of the fluid heating and storage tank of the present invention may be in the form alternatively a tube heat exchanger, a plate heat exchanger, a coil heat exchanger, a fin tube heat exchanger, a helix tube heat exchanger, or any hybrid combination of these heat exchangers. The heat exchanger has two separable sub-spaces separated by two removable stoppers at two joint points of two connected tubes.

12. The heat driven self-circulated fluid heating and storage system of the present invention may comprise: a fluid heating and storage tank with an interior-installed heat exchanger which includes a storage container for a primary fluid having an inlet and an outlet for a primary fluid, a first inlet fitting and a first outlet fitting, a second inlet fitting and a second outlet fitting for a secondary fluid, and at least one breathing fitting. A heat exchanger is disposed within the fluid heating and storage tank for conducting a secondary fluid through the storage tank in isolation from the primary fluid. The heat exchanger has a first inlet and a first outlet, a second inlet and a second outlet for said secondary fluid and at least one breathing port in which each one of the inlets, outlets and breathing ports is connected to one of the corresponding fitting of the storage tank respectively. The first and second inlet fittings are located not lower than the first and second outlet fittings. The breathing fitting is located not lower than the corresponding inlet fitting. The system also includes at least one apparatus for condensing and reclaiming the secondary fluid vapour. The apparatus has a breathing and condensing pipe and a breathing pipe connected to the breathing fitting of the fluid heating and storage tank; a heater for heating secondary fluid having a heater inlet and a heater outlet and the heater inlet is located not higher

than the heater outlet; a first conduit having one end connected to the heater outlet and an opposite end connected to the first inlet of the fluid heating and storage tank and located not lower than the heater outlet; a second conduit having one end connected to the heater inlet and an opposite end connected to the first outlet of the fluid heating and storage tank; two caps for closing said second inlet and second outlet of the fluid heating and storage tank.

13. The heat driven self-circulated fluid heating and storage system of the present invention may also compreses a fluid heating and storage tank with an interior-installed heat exchanger, a storage container for a primary fluid having an inlet and an outlet for the primary fluid, a first inlet fitting and a first outlet fitting, a second inlet fitting and a second outlet fitting for a secondary fluid and at least one breathing fitting; a heat exchanger disposed within the fluid heating and storage tank for providing the secondary fluid through the storage tank in isolation from the primary fluid. The heat exchanger comprises a first inlet and a first outlet, a second inlet and a second outlet for the secondary fluid and at least one breathing port. Each one of the inlets, outlets and breathing ports is connected to one of the corresponding fitting of the fluid heating and storage tank. The first and second secondary fluid inlet fittings are located not lower than the first and second outlet fittings, and the breathing fitting is located not lower than the corresponding inlet fitting. The system also includes at least one apparatus for condensing and reclaiming the secondary fluid vapour, and it has a breathing and condensing pipe and a breathing pipe connected to the breathing fitting of the fluid heating and storage tank; a first heater having a first heater inlet and a first heater outlet; a second heater having a second heater inlet and an second heater outlet, wherein the first heater inlet is located not higher than the first heater outlet and thesecond heater inlet is located not higher than the second heater outlet; a first conduit having one end connected to the first heater outlet and an opposite end connected to the first inlet fitting of the fluid heating and storage tank,; and the first inlet is located not lower than the first heater outlet; a second conduit having one end connected to the first heater inlet and an opposite end connected to the first outlet of the fluid heating and storage tank; a third conduit having one end connected to the second heater outlet and an opposite end connected to the second inlet of the fluid heating and storage tank, in which the second inlet is located not lower than the second heater outlet; a fourth conduit having one end connected to second heater inlet and an opposite end connected to second outlet of the fluid heating and storage tank.

14. A heat driven self-circulated fluid heating and storage system of the present invention may comprise: a fluid heating and storage tank with an interior-installed heat exchanger which comprises a storage container for a primary fluid having an inlet and an outlet for the primary fluid, a first inlet fitting and a first outlet fitting, a second inlet fitting and a second outlet fitting for a secondary fluid, and at least one breathing fitting; a heat exchanger disposed within the fluid heating and storage tank for providing a secondary fluid through the storage tank in isolation from the primary fluid. The heat exchanger has a first inlet and a first outlet, a second inlet and a second outlet for the secondary fluid, and at least one breathing port, wherein each of the inlets, outlets and breathing ports is connected to one of the corresponding fittings of the storage tank, and the first and second inlet fittings is located not lower than the first and second outlet fittings, and

the breathing fitting is located not lower than the inlet fitting; at least one apparatus for condensing and reclaiming the secondary fluid vapor, which includes a breathing and condensing pipe and a breathing pipe connected to the breathing fitting of the fluid heating and storage tank, a heater for heating the secondary fluid, which has a heater inlet and a heater outlet, wherein the heater inlet is located not higher than the heater outlet; a heat appliance having a heat appliance inlet and a heat appliance outlet connected to the outlet and inlet of the fluid heating and storage tank respectively; a first conduit having one end connected to the heater outlet and an opposite end connected to the first inlet of the fluid heating and storage tank, and the first inlet being located not lower than the heater outlet; a second conduit having one end connected to the heater inlet and an opposite end connected to the first outlet of said fluid heating and storage tank; a third conduit having one end connected to the heat appliance inlet and an opposite end connected to the second outlet of the fluid heating and storage tank, a fourth conduit having one end connected to the heat appliance outlet and an opposite end connected to the second inlet of the fluid heating and storage tank.

15. The heater for heating the secondary fluid in the heat driven self-circulated fluid heating and storage system is a solar heat collector may alternatively be a plate solar heat collector, a plate solar heat collector with heat tubes, an evacuated tube solar heat collector, an evacuated tube solar heat collector with a heat tube, or a U-shaped pipe solar heat collector.

16. The heater of the heat driven self-circulated fluid heating and storage system may alternatively employ fossil fuel, biomes, nature gas, earth, air and electricity as an energy heating source. The heater comprises an airtight container for a secondary fluid and it has a lower inlet, an upper outlet located in a heat insulator, and the energy heating source being located at the lower and inner part of the heat insulator for heating the secondary liquid in the airtight container, wherein the airtight container is made of a heat conductive material such as ceramic, glass or metal alternatively.

17. The heater for heating the secondary fluid in the heat driven self-circulated fluid heating and storage system of the present invention may further comprises a power pump for pumping the secondary liquid. The second container for secondary liquid has at least one space being connected to the heater, and the breathing fitting may be closed by a cap.

18. A solar heat collector may be employed as heating module units for various building elements for the heat driven self-circulated fluid heating and storage system according to the present invention In which the various building elements include building walls, fences and verandas. The module units are provided with two solar heat collectors arranged at 180 degrees in the plane of the building elements. Furthermore, module units with two solar heat collectors may be arranged in less than 180 degrees relative to one another to form the corner units of the building elements.

19. The heat appliance of the driven self-circulated fluid heating and storage system of the present invention may comprise a heated air generator having a fluid heat radiator having a set of tubes, an inlet and an outlet for the secondary fluid with at least one control valve. The fluid heat radiator may further

comprise a crust with a window for directing the heated air to a certain direction and one or more fans with controller for transmission of the heated air directionally. The outlet and inlet of the fluid heat radiator are connected to the inlet and the outlet of the fluid heating and storage.

20. The apparatus for condensing and reclaiming the secondary fluid fluid vapor in the heat driven self-circulated fluid heating and storage tank according to the present invention may comprise a flexural breathing and condensing pipe in the form of either a U-shaped pipe or a W-shaped pipe; and the breathing pipe having an inner tool for condensing the liquid vapor includes an inner heat conductive wall and a set of condensing pieces installed therein.

BRIEF DISCRIPTION OF THE DRAWINGS:

The following figures illustrate the exemplary embodiments of the present invention, in which

Fig.1 is a schematic diagram illustrating the fluid heating and storage tank with an interior-installed coil heat exchanger.

Fig.2 is a schematic diagram illustrating the fluid heating and storage tank with an interior-installed double fin tube heat exchanger.

Fig.3 is a schematic diagram illustrating an apparatus for the liquid vapor condensing and reclaiming.

Fig.4 is a schematic diagram illustrating another kind of apparatus for the liquid vapor condensing and reclaiming.

Fig.5 is a schematic diagram illustrating a heat driven self-circulated fluid heating and storage system employing one solar heat collector and a fluid heating and storage tank with an interior-installed heat exchanger.

Fig.6 is a schematic diagram illustrating the heat driven self-circulated fluid heating and storage system employing two solar heat collectors and a fluid heating and storage tank with an interior-installed heat exchanger;

Fig.7 is a schematic diagram illustrating the heat driven self-circulated fluid heating and storage system employing a solar heater, a liquid heaters and a fluid heating and storage tank with an interior-installed heat exchanger; and

Fig.8 is a schematic diagram illustrating the heat driven and self-circulation fluid heating and storage system employing one solar heat collector and a radiator and a fluid heating and storage tank with an interior-installed heat exchanger.

DETAILED DESCRIPTION

Fig. 1 illustrates a fluid heating and storage tank, which is a hot water tank 30. The tank has a container 301 for storing water. There is an inlet 313 for cold water and an outlet 312 for hot water. On the top wall, there is a protective anode 319 and a release valve 314. At the side wall there is a drain valve 316 and electric heater 315. Outside of the container there are the heat insulation 317 and a crust 318.

At the wall 301 of the tank 30, there are two inlet fittings 321 and 322 and two outlet fittings 323 and 324 are also arranged. Further there is a breathing port 325 at the top of the tank.

A heat exchanger 330 is disposed within the fluid heating and storage tank 30 for flowing secondary fluid, which is a liquid through the storage tank in isolation from the water. The heat exchanger has first inlet 321, first outlet 323, second inlet 322 and second outlet 324 for secondary fluid and at least one breathing port 325. The two secondary fluid inlets 321 and 322 are located higher than the two outlets 323 and 324.The breathing fitting is located not lower than said inlet fittings.

The heat exchanger 330 is combined with a coil tube 3301 and some straight tubes. The coil tube can be a fin tube, a helix tube, or a straight tube. The heat exchanger also can be a flat plate heat exchanger having square shape or ellipse shape, etc. The ports 321, 322, 323, 324, 325 are liquidly communicated. The inlets 321 and 322 are higher than outlets 323 and 324 to ensure the self-circulating of the heated liquid. A second fluid condensing and reclaiming apparatus 51 is connected at the fitting 325. Fig.3 is a schematic diagram illustrating the apparatus 51.

The apparatus 51 is an airtight container. It has a top 511 and a bottom 512 and sidewall 513. An inlet pipe 52 having its one end extending upwardly from the bottom into the container and is mounted to the bottom 521 of the container. In Fig. 3, the inlet pipe 52 is a hollow bolt. Its opposite end 522 can be revolved directly into the breathing fitting at the top of the tank.

A flexural U-shaped pipe 53 (it may be pipe of other shapes, e.g. W-shaped etc.) has one end 531 extending from the sidewall of the container 51 into the container and under the tope wall 511. Its upper end is spaced from the top wall. The other parts including its lower part of the pipe are located outside of the tank. The pipe extends its opposite end downwardly first and then upwardly, so that the opposite end of pipe 53 is facing upwardly and its lower part 533 is located near the bottom of the container.

Referring to Fig. 4, an alternative fluid vapor condensing and reclaiming apparatus is illustrated. Except the U-shaped tube 63, other parts of this second embodiment are similar to apparatus 51 described above. The reference numbers in this drawing have been changed the first digital from 5 to 6. Otherwise the construction is similar to apparatus 51 described above.

A U-shaped tube 63 extends upwardly having one end 634 from the bottom 612 of the container 61 into the container and under the top wall 611. There is a gap between the end and the top wall. In Figure 6, the apparatus provides the breathing for the liquid due to expansion and contraction. A small amount of condensed liquid is retained at the bottom part of the apparatus 61, which prevents further vapor from escaping into the atmosphere through the U-shaped tube 63.

The feature of the above mentioned container is to condense the liquid vapor in the container and to let the condensed liquid to return to the heater. Usually any inside wall of a container at a temperature of less than 100 degrees Celsius can cause the vapor condensing to occur. Usually any metal, e.g. plastic, glass or polymeric material, can be used for making the container. When the system and environment temperature is high, in order to speed up the condensing processing, some condensing pieces may be installed in the container (not shown in Fig.3 and 4). The flexural pipe 63 also needs to make the vapor condense in the tube. Furthermore, at the U shaped lower part of the pipe the condensed liquid can be stored temporary to block the escaping of the escaped vapor. The flexural pipe can be made of many different materials e.g. glass, metal, plastic, polymeric material etc. The shapes of the pipe are flexible, e.g. U shaped, W shaped or the like in which the bottom part of the pipe can store some condensed liquid. Transparent pipes may be used to provide visible monitoring of the condensed liquid.

One of the main concerns for an operating heat driven self-circulating fluid heating and storage tank, e.g. solar heating system, is the fluid vaporizing and the vapor escaping through the breathing port. It may result in a failure of system operation. The application of the above introduced apparatus for fluid condensing and reclaiming resolves this problem completely. Usually the container of the apparatus is made of transparency materials, e.g. transparent glass, plastic or polymeric materials, thus the liquid level of the heat exchanger can be visually monitored, and the more liquid can be added through the breathing port if necessary.

There are two spare bolt caps for closing the unused inlet and outlet and one spare bolt cap for closing the unused breathing fitting. If necessary, all the breathing ports can be closed. In this case, the tank can be used as a regular tank with a heat exchanger or used with a self-power pump or electric pump. Fig.2 illustrates another kind of fluid heating and storage tank, which is a hot water tank 40, as in Fig.1. The fluid heating and storage tank 40 in Fig.1 is a water tank. It has a water container 401 comprising a cold water inlet 413 and a hot water outlet 412. At the top of the tank or alternatively at the side wall, there is a release valve 414, a drain valve 416 and one electric power heater 415. Two electric power heaters can be added if necessary. The tank further includes the heat insulation layer 417 and a crust 418. On the sidewall 401 of the tank two inlets 421 and 422, two outlets 423 and 424 and a breathing fitting 425 are arranged.

Fig 2 lists different components of the tank in details. They are not all necessary for the basic operation. For example, the crust may or may not be needed, if the heat insulation is ceramic. The number of the electric heater may be one, two or zero. The release valve can be installed on the top or sidewall of the tank.

A heat exchanger 430 is disposed within the fluid heating and storage tank 40 for providing the secondary fluid, which is a liquid through the storage tank in isolation from the water. The heat exchanger has a first inlet, a first outlet, a second inlet and a second outlet for secondary fluid and at least one breathing port. Each of the ports (inlet, outlet and breathing ports) is mounted on one of the relative connective fittings, i.e. the first inlet fitting, the first outlet fitting, the second inlet fitting and the second outlet fitting and at least one breathing fitting to connect to said storage tank. The two secondary fluid inlets are located higher than the two outlets; and the breathing fitting is located higher than the inlet fittings. Comparing to Fig.1, the heat exchanger in Fig.2 can be separated into liquidly isolating sub-system 4310 and 4320 by an isolation structure. This structure is a removable isolation plug 4309 located between tubes 4306 and 4307 and a second isolation plug 4308 located between tubes 4303 and 4304. The diameters at these two places are a little smaller than the diameters of the tubes. The two plugs are inserted through the ports 421 and 423. The plugs may also the pre-welded isolation caps. Here the sub-system 4310 is formed by across tubes 4303, 4306 and fin tube 4301. The sub-system 4302 is formed by across tubes 4304, 4307 fin tube 4302 and breathing pipe 4305.

A second fluid condensing and reclaiming apparatus 51 is connected at the fitting 126. Fig.3 is schematic diagram illustrating the apparatus 51.

The apparatus 51 is an airtight container. It has a top 511 and a bottom 512 and sidewall 513. An inlet pipe 52 has its one end extending upwardly from the bottom into the container and is mounted to the bottom of the container. In Fig. 3, the inlet pipe 52 is a hollow bolt. Its opposite end 522 can be revolved directly into the breathing fitting at the top of the tank.

A flexural U-shaped pipe 53 (it may be in many other shape pipes, e.g. W-shaped etc.) extends its one end 531 from the sidewall of the container 51 into the container and under the tope wall 511. There is a gap between the end and the top wall. The other parts including its lower part of the pipe stay outside of the tank. The pipe extends its opposite end downwardly first and then upwardly. So that the opposite end of pipe 53 is facing upwardly and its lower part 533 is near to the bottom of the container.

Referring to Fig. 4, an alternative fluid vapor condensing and reclaiming apparatus is illustrated. Except for the U-shaped tube 63, other parts in Fig 4 are identical to those in Fig.3. Each part's reference number differs by the first digital from 5 to 6; and all the names of the parts in Fig 4 are same as those in Fig.3.

An U-shaped tube 63 extends upwardly its one end 634 from the bottom 612 of the container 61 into the container and under the tope wall 611. There is a gap between the end and the top wall.
The feature of above mentioned container is to condense the liquid vapor in the container and let the condensed liquid return to the heater. Usually any inside wall of a container at the temperature less than 100 degrees Celsius can make the vapor condensing. Usually any metal, plastic, glass or polymeric material can be used for the container material. When the system and environment temperature is high, to speed up the condensing processing, some condensing pieces may be installed in the container (not shown in the Figures). The flexural pipe 63 also needs to make the vapor to condense in the pipe. Furthermore, at the lower part 633 of the pipe 63 condensed liquid can be stored temporarily to block the escape of the vapor from the container. The flexural pipe can be made of many different materials e.g. glass, metal, plastic, or polymeric material etc. The shape of the pipe may be U-shaped, W-shaped or similar shape such that condensed liquid can be stored at the curved bottom part of the pipe. Preferably, the pipes are transparent.

Fig.6 is a schematic diagram illustrating the heat driven and self-circulated fluid heating and storage system employing a fluid heating and storage tank 40 with an interior installed heat exchanger 430 and two solar heat collectors. Both solar heat collectors shown in Fig.6 are plate solar heat collectors. However, other similar type of solar heat collector may be used, for example, plate solar heat collector (with or without the heat tube), vacuumed tube solar heat collector (with or without the heat tube), and U-shaped solar heat collector etc.

The solar heat collector 760 in Fig.6 has a secondary fluid inlet 7611 and outlet 7612. The first conduit 762 is connected its one end to inlet 422 of the tank and an opposite end to the outlet 7611 of the solar heat collector 761. The one end of second conduit 763 is connected to the outlet of the tank and the opposite end 7632 to the inlet of solar heat collector 760. The solar heat collector 780 has similar connection arrangement.

Based on the application requirements, two couple inlet and outlet, 721/722 and 723/724 may be arranged at the sidewall in any angle from 90-180 degrees. When the heat driven self-circulated liquid heating system is used as building elements, for example as a unit element of the roof, fence, veranda etc, the units with two solar heat collectors arranged in 180 degrees would be the plane unit of the building walls, fences and verandas. The units with two solar heat collectors arranged at 90 degrees are the corner units.

As a building component unit, the heat driven self-circulated solar heating and storage system needs to be, and can be, a compacted component. In Fig. 6, when the solar heat collectors 780 and 760 are moved close to the fluid heating and storage tank while making the solar heat collector larger, so that a compact solar heating and storage system can be made.

Similar to those shown in Fig. 5, each of the two couple of inlet/outlet ports is in a plumb line. However, the angle of the solar heat collector may be oriented to an oblique (i.e. not 90 degrees) angle to the surface of the earth. Even if the inlet and outlet ports are in a plumb line, the arrangement of the connecting conduits 762, 763,782 and 783 can be adjusted to let the solar heat collector to be at an oblique angle (not 90 degrees) to the surface of the earth for receiving a point-black amount of sun light. It is also possible to arrange the entire unit of the solar heat collector and the tank to stay at an oblique angle to the earth. In this case the tank is catty-cornered.

After installation, the heat driven self-circulating solar heating and storage system 100 becomes two fluidly separated but heat connected liquid spaces. The first space is the interior space within the tank 40 which may be filled with the liquid to be heated e.g. water, air or other fluids. The second space is the space formed by the heat exchanger 430, two conflux tubes 761 and 781 of the two solar heat collectors 760, 780, connecting conduits 762 763, 782, 783 and the inner space of the apparatus for fluid condensing and reclaiming 61. (the stoppers 4307 and 4308 are removed). This close-loop system is exposed to the atmosphere indirectly through the U-shaped tube 63. After the system is installed, the system will be filled with the heat conductive liquid, e.g. water or glycol etc. The liquid level in the tank will be lower than the breathing fitting.

When the sunlight irradiation heats the liquid in the solar heat collectors 760 and 780, the liquid in the conflux tubes 761 and 781 (within the heat insulation which is not shown) is heated and it tends to flow upwardly. The heated liquid flows through the connecting conduit 762 and 782 into the heat exchanger 430, and the heated liquid transfers its heat to the liquid in the tank. Then the liquid temperature drops as well as the volume of the liquid also reduces. Through the outlet 424 and the conduit pipe 763, the cooled liquid flows back into solar heat collector 760 again to be heated. This process continues such repeating cycles to heat the water in the tank by the solar heater. In this process, the solar heat is the only energy source to drive the circulating liquid and to complete the energy exchange. Therefore, no other energy source, e.g. electric power, is required except the solar heat. In this process, when the sunlight is stronger, the heat circulation will be faster, whereas the heat circulating is slower, when the sunlight is weaker. When there is no sunlight, the heat circulating will terminate completely. It is not necessary to provide additional controller for controlling the liquid circulation. This head driven system has the functions of self-driven, self-control and self-circulating.

When the system is in operation, the breathing port 425 serves several important functions. First it releases the pressure in the system, which is caused by the heated liquid expansion, for keeping the system pressure close to the atmospheric pressure. It also provides a space for the liquid's breathing (namely, expansion and contraction) so as to facilitate the self-circulating operation. When the heater is in operation, the heated liquid causes some liquid and vapor to flow into the container 51. The part of the vapor is cooled and condensed in the container 51, and then it is returned to the heat exchanger. Some vapor may escape into the U-shaped tube to change into liquid by condensation. The condensed liquid will stay in the curved lower part of the tube. The gathered liquid in the tube blocks further escape of vapor and would also enhance further vapor to condense in the tube. When the heater stops working, the liquid in the container 51 and the heat exchanger cools down and contracts, so that the system generates a negative pressure to reclaim all the liquid gathered in the U-shaped tube to be drawn back into the heat exchanger. Even though the space storing the heat liquid is connected to the atmosphere directly or indirectly, the system working temperature is high, but the loss of the secondary liquid through vaporizing is not significant. Accordingly the system operates continuously and safely.

For the space limitation or other reasons, sometimes the solar heating system may be equipped with a single solar heat collector only. In this case, the solar heat collector 780 may be removed and the spare inlet and outlet ports 421 and 423 in Gig. 6 may be closed as 321 and 323 shown in Fig.5. In another alternative, we can also replace the single solar heat collector by another type of heater operated with another energy source.

Fig. 7 illustrates a heat driven self-circulated liquid heating and storage system 120 using a tank 40 with an interior installed heat exchanger 430. Comparing to Fig. 6, Fig. 7 shows a solar heat collector 760 and another energy source heater that is a fossil fuel (coal) heater 1200.

In Fig. 7, the tank 40, solar heat collector 760 and the connections between them are similar to those mentioned in Fig.6. Here the coal heater 1200 comprises a central vacant cylinder (or other shaped e.g. taper, square etc) metal (or ceramic etc) tank 1201.

The tank 1201 further comprises an inner wall 1202 and an outer wall 1204. One metal coil tube 1203 located in the heat insulation material. One end of the tube 1203 is at the bottom of the tank 1201. The opposite end of the tube 1203 is at the upper part1205 of the tank. The bottom of the heater is a hearth for coal burning in side. When the system is in operation, the coal burns in the hearth 1210 to heat the water tube 1203. The water in the tube is heated and expanded to move upwardly to the heat exchanger 430 through tube1207. In the heat exchanger the water releases the heat and returns to the tube 1203 through outlet 424 and tube 1208 to be heated again. The above-mentioned process functions in a continuous cycle to heat the water in the tank. The process in this heating system is similar the process of the solar heat collector system. A valve 1209 is connected in series to the tube 1207 for turning off the connection with heater when the heater 1200 is not in service. The same valve may be connected to the bottom conduit 1208 for the same reason.

For a heat driven self-circulating fluid heating and storage system with a solar heat collector and another energy source, its other parts have similar working processing that has been mentioned in the prior system with two solar heat collectors.

Even though the second heater shown in Fig. 7 is a coal heater, it can also be any alternative kind of non-solar heaters, e.g. fossil fuel (e.g. coal) heater, natural gas heater, biomass energy heater, (including biomass gasification heater), earth energy and air energy heater etc. The advantage of this kind of the liquid heater is that the heating liquid storage space of this kind of heater is much smaller than any other kind of liquid heater. Because the solar heated water tank replaces the heat storage space that other energy water heater usually required. For example, one metal tube can be used as the storage container of the liquid to be heated in the heater. For the reason such as heat insulation and corrosion protection e.g. a firebrick or a ceramic protective layer may be provided. Furthermore, this heater can be a heater of earth or air heat energy. Since these kinds of heaters usually require forced circulation, so the heaters need a separator (e.g. separators 4308 and 4309 in Fig.2) to separate the liquid into two sub-systems. In this case, only the sub-system connected to the solar heat collector has a breathing port. Another sub-system either has no breathing port or the port is closed with a spare cap.

Fig. 8 illustrates the heat driven self-circulating fluid heating and storage system 140 with a heat appliance (radiator 970). The system includes a solar heater 760, a radiator 970 and a liquid heating and storage tank 30 with an interior installed heat exchanger 330. In Fig. 8, the tank 10 and radiator and their connections are same as the embodiment shown in Fig.7. The radiator includes a fin pipe 771, which may alternatively be a coil tube, a helix tube, a straight tube or a flat heat exchanger etc. Two pipes connect the inlet 773 and outlet 774 of the radiator to the inlet 123 and the outlet 124 of the tank respectively. Two valves 777 and 778 are provided for separating the radiator with the tank when necessary.

Solar heat collector 760 receives solar energy and transfers it to the tank 30, so the temperature in the tank is higher than the temperature of the surrounding air. When heated air is required, the valve 777 and 778 of the tank are opened, so that the hot water circulates into valve 777 and passes through the fin tube 771 to emit warm air therefrom. After the emission of warm air, the cold water then goes through valve 778 to return to the bottom of the tank 30. In order to increase the amount of heated air generating and to send the air to a planned direction, a cover 721 with an active window 770 may be provided. (as shown in Figure 8, the window is opened upwardly). In fact the direction of the window can be varied. One or more fans (not shown in the drawings) may be provided in the cover to speed up the heat pervasion from the fin tube. (If a channel is added to the window of cover 721, the heated air can be transferred to a desired location (not shown in the figure).

It can be noted that the fitting 322 of the tank is an inlet when it is connected to a heater; but when it is connected to a radiator, it becomes an outlet, while the fitting 324 is an outlet when it is connected to a heater, it becomes an inlet when it is connected to a radiator.

It is also possible to install the radiator or other heat appliances in a heat driven self-circulated system with two solar heat collectors or with one solar heat and one other heat source. In this case, the fluid heating and storage tank is required to be provided with three pairs of the inlets and outlets .

Other aspects and features of present disclosure will become apparent to those ordinarily skilled in the art upon review of following description of specific embodiments of the invention in conjunction with the accompanying figures.

WHAT IS CLAIMED IS:

1. A fluid heating and storage tank with a heat exchanger, comprising:

a storage container forming a portion of said fluid heating and storage tank for a primary fluid, said storage container having an inlet and an outlet for the primary fluid, a first inlet fitting and a first outlet fitting, a second inlet fitting and a second outlet fitting for a secondary fluid, and at least one breathing port and port fitting; and

a heat exchanger disposed within said fluid heating and storage tank for directing the secondary fluid through said fluid heating and storage tank in isolation from said primary fluid comprising a first inlet and a first outlet, a second inlet and a second outlet for said secondary fluid and at least one breathing port; wherein each of said inlets, outlets and breathing ports are connected to a respective corresponding fitting of said fluid heating and storage tank; wherein said two secondary fluid inlet fittings being located not lower than two said secondary fluid outlet fittings, and said breathing fitting being located not lower than said inlet fitting; and

at least one apparatus for condensing and reclaiming secondary fluid vapor having a breathing and condensing pipe and said breathing and condensing pipe connected to said at least one breathing port and port-fitting of said fluid heating and storage tank.

2. The fluid heating and storage tank of claim 1, wherein said heat exchanger has a separable space, and an inner liquid separating tool separating said separable space into a first sub-space and a second sub-space, wherein said first inlet and said first outlet of said heat exchanger are connected to said first sub-space and said second inlet and second outlet of said heat exchanger are connected to the second sub-space.

3. The fluid heating and storage tank according to claim 1, wherein said apparatus for condensing and reclaiming said vapor of said secondary fluid further comprises:

an airtight container for containing escaped heated secondary liquid and vapor from a fluid vapor source; and said airtight container comprising a base, a top and an inner tool for condensing the liquid vapor;

a breathing pipe having one end extending upwardly into said airtight container and being mounted at the base of said airtight container and having an opposite end connected to said fluid vapor source;

a flexural breathing and condensing pipe extending upwardly into said airtight container and having an end therein located within said airtight container, and being located lower than an interior top side of said airtight container and also having an opposite end located outside of said airtight container for condensing said escaped vapor and temporally storing a condensed liquid of said vapor for reclaiming.

4. The fluid heating and storage tank according to claim 1or 2 further including at least one release valve, a drain valve, a protective anode and at least one electric heater.

5. The fluid heating and storage tank according to claim 1 or 2 wherein said heat exchanger is made of a material selected from the group consisting of ceramic, metal, copper, stainless steel, steel plated by

porcelain enamel and glass.

6. The fluid heating and storage tank according to claim 1or 2 wherein said first outlet fitting and said second outlet fitting are provided on a wall of said storage container and located at opposite directions; and said first inlet fitting and said second inlet fitting are also provided on said wall of the storage container at opposite directions.

7. The fluid heating and storage tank according to claim 1or 2 wherein said first outlet and said second outlet are provided on a wall of said storage container and located at 90 degrees relative to the ground, and said first inlet and said second inlet are also provided at said wall of storage container at 90 degrees relative to the ground.

8. The fluid heating and storage tank according to claim 1or 2 further comprising back up bolt caps for capping said first inlet, said second inlet, said first outlet, said second outlet, and said breathing port selectively.

9. The fluid heating and storage tank of claim 1or 2 wherein said heat exchanger is selected from the group consisting of a tube heat exchanger, a plate heat exchanger, a coil heat exchanger, a fin tube heat exchanger, a helix tube heat exchanger and a hybrid combination thereof.

10. The fluid heating and storage tank of claim 2 wherein said heat exchanger is a plate heat exchanger and said liquid separating tool in said heat exchanger is a separator installed in a chamber of the heat exchanger separating secondary fluid space into two sub-spaces, and said first inlet and said first outlet, said second inlet and said second outlet of said heat exchanger are provided on the walls of said first and second sub-spaces respectively; wherein at least one said sub-space has a breathing port fitting located on top of said sub-spaces.

11. The fluid heating and storage tank of claim 2, wherein said heat exchanger is selected from the group consisting of a tube heat exchanger, a plate heat exchanger, a coil heat exchanger, a fin tube heat exchanger, a helix tube heat exchanger and a hybrid combination thereof; and wherein said heat exchanger has two separable sub-spaces separated by two removable stoppers at two joint points of connecting tubes.

12. A heat driven self-circulated fluid heating and storage system, comprising:

a fluid heating and storage tank with a heat exchanger, including

a storage container for a primary fluid having an inlet and an outlet for said primary fluid, a first inlet fitting and a first outlet fitting, a second inlet fitting and a second outlet fitting for a secondary fluid, and at least one breathing fitting;

a heat exchanger disposed within said fluid heating and storage tank for directing said secondary fluid through said storage tank in isolation from said primary fluid, said heat exchanger having a first inlet and a first outlet, a second inlet and a second outlet for said secondary fluid and at least one breathing port; wherein each of said first inlet and said second inlet, and said first outlet and said second outlet and said at least one breathing port are connected to one of the corresponding fitting of said storage tank respectively, and said first inlet fitting and said second inlet fitting for said secondary fluid being located not lower than said first outlet fitting and said second outlet fitting for said secondary fluid respectively; and said at least one breathing fitting being located higher than said inlet fitting for said secondary fluid;

at least one apparatus for condensing and reclaiming vapor generated from said secondary fluid, and said apparatus having a breathing and condensing pipe, and said breathing and condensing pipe connected to said breathing fitting of said fluid heating and storage tank;

a heater for heating secondary fluid having a heater inlet and a heater outlet, wherein said heater inlet is located not higher than said heater outlet;

a first conduit having one end connected to said heater outlet and an opposite end connected to said first inlet of said fluid heating and storage tank;

a second conduit having one end connected to said heater inlet and an opposite end connected to said first outlet of said fluid heating and storage tank; and

two caps for closing said second inlet and second outlet of said fluid heating and storage tank.

13. A heat driven self-circulated fluid heating and storage system, comprising:

a fluid heating and storage tank with a heat exchanger including:

a storage container for a primary fluid, said storage container having an inlet and an outlet for the primary fluid, a first inlet fitting and a first outlet fitting, a second inlet fitting and a second outlet fitting for a secondary fluid, and at least one breathing port and port fitting; and

a heat exchanger disposed within said fluid heating and storage tank for directing the secondary fluid through said fluid heating and storage tank in isolation from said primary fluid comprising a first inlet and a first outlet, a second inlet and a second outlet for said secondary fluid and at least one breathing port; wherein each of said inlets, outlets and breathing ports are connected to a respective corresponding fitting of said fluid heating and storage tank; wherein said two secondary fluid inlet fittings being located not lower than two said secondary fluid outlet fittings, and said breathing fitting being located not lower than said inlet fitting; and

at least one apparatus for condensing and reclaiming secondary fluid vapor having a breathing and condensing pipe and said breathing and condensing pipe connected to said breathing port fitting of said fluid heating and storage tank;

a first heater having a first heater inlet and a first heater outlet;

a second heater having a second heater inlet and an second heater outlet;

wherein said first heater inlet is located lower than said first heater outlet, and said second heater inlet is located lower than said second heater outlet;

a first conduit having one end connected to said first heater outlet and an opposite end connected to said first inlet fitting of the fluid heating and storage tank, said first inlet being located not lower than said first heater outlet;

a second conduit having one end connected to said first heater inlet and an opposite end connected to said first outlet of said fluid heating and storage tank;

a third conduit having one end connected to said second heater outlet and an opposite end connected to said second inlet of said fluid heating and storage tank, said second inlet being located higher than said second heater outlet;

a fourth conduit having one end connected to said second heater inlet and an opposite end connected to said second outlet of the fluid heating and storage tank.

14. A heat driven self-circulated fluid heating and storage system, comprising:

a fluid heating and storage tank with a heat exchanger, comprising:

a storage container for a primary fluid, said storage container having an inlet and an outlet for the primary fluid, a first inlet fitting and a first outlet fitting, a second inlet fitting and a second outlet fitting for a secondary fluid, and at least one breathing port and port fitting; and

a heat exchanger disposed within said fluid heating and storage tank for directing the secondary fluid through said fluid heating and storage tank in isolation from said primary fluid comprising a first inlet and a first outlet, a second inlet and a second outlet for said secondary fluid and at least one breathing port; wherein each of said inlets, outlets and breathing ports are connected to a respective corresponding fitting of said fluid heating and storage tank; wherein said two secondary fluid inlet fittings being located not lower than two said secondary fluid outlet fittings, and said breathing fitting being located not lower than said inlet fitting; and

at least one apparatus for condensing and reclaiming secondary fluid vapor having a breathing and condensing pipe and said breathing and condensing pipe connected to said breathing port fitting of said fluid heating and storage tank;

a heater for heating secondary fluid having a heater inlet and a heater outlet, wherein said heater inlet being located not higher than the heater outlet;

a heat appliance having a heat appliance inlet and a heat appliance outlet connected to the first or second outlet and inlet of said container respectively;

a first conduit having one end connected to said heater outlet and an opposite end connected to said first inlet of said fluid heating and storage tank, said first inlet being located not lower than said heater outlet;

a second conduit having one end connected to said heater inlet and an opposite end connected to said first outlet of said fluid heating and storage tank;

a third conduit having one end connected to said heat appliance inlet and an opposite end connected to said second outlet of said fluid heating and storage tank,

a fourth conduit having one end connected to said heat appliance outlet and an opposite end connected to said second inlet of the fluid heating and storage tank.

15. The heat driven self-circulated fluid heating and storage system according to any one of claim 12 or 14, wherein said heater for heating said secondary fluid is a solar heat collector, said solar heat collector is selected from the group of devices consisting of: a plate solar heat collector, a plate solar heat collector with heat tubes, an evacuated tube solar heat collector, an evacuated tube solar heat collector with a heat tube, and a U-shaped pipe solar heat collector.

16. The heat driven self-circulated fluid heating and storage system according to any one of the claim 12 or 14, wherein said heater is a heater using an energy selected from the group consisting of: fossil fuel, biomes, natural gas, earth, air and electricity; and said heater comprising an airtight container for a secondary fluid and having an inlet, an outlet located in a heat insulator, and said energy heating source located at an inner part of the heat insulator for heating said secondary liquid in said airtight container; and sais airtight container being made of a heat conductive material chosen from the group consisting of: ceramic, glass, and metal.

17. The heat driven self-circulated fluid heating and storage system according to claim 14, wherein said heater for heating said secondary fluid further comprising a power ump for pumping said secondary liquid; said container for secondary liquid having at least one sub-space being connected to said heater, and said breathing port fitting is closed by a cap.

18. The heat driven self-circulated fluid heating and storage system according to any one of the claim 12, 13, or 14 wherein a solar heat collector is used to form solar heating module units for various building elements including building walls, fences and verandas; and said module units being formed with two said solar heat collectors arranged at 180 degrees in the plane of the building elements, and said module units with two said solar heat collectors being arranged in less than 180 degrees relative to one another are corner units of the building elements.

19. The heat driven self-circulated fluid heating and storage system according to claim 14 wherein said heat appliance is a heat radiator, comprising: a heated air generator having a fluid radiator comprising a set of tubes, a fluid radiator inlet and a fluid radiator outlet for said secondary fluid with at least one control valve; and said heat radiator further having a crust with a window for directing heated air to a certain direction and at least one fan with controller for transmitting of heated air directionally; and said fluid radiator outlet and fluid radiator inlet being connected to the inlet and the outlet of said fluid heating and storage tank.

20. The heat driven self-circulated fluid heating and storage tank according to claim 1, wherein said apparatus for condensing and reclaiming said secondary fluid vapor further comprising: flexural said breathing and condensing pipe selected from the group consisting of: a U-shaped pipe, and W-shaped pipe, and said breathing pipe having an inner tool for condensing the liquid vapor including an inner heat conductive wall and a set of condensing pieces installed therein.

21. The heat driven self-circulated fluid heating and storage system according to claim 13, wherein said first or second heater for heating said secondary fluid is a solar heat collector, said solar heat collector is selected from the group of devices consisting of: a plate solar heat collector, a plate solar heat collector with heat tubes, an evacuated tube solar heat collector, an evacuated tube solar heat collector with a heat tube, and a U-shaped pipe solar heat collector.

22. The heat driven self-circulated fluid heating and storage system according to claim 13, wherein said first or second heater selectively is a heater using an energy selected from the group consisting of fossil fuel, biomes, natural gas, earth, air and electricity; and said heater comprising an airtight container for a secondary fluid and having an inlet, an outlet located in a heat insulator, and said energy heating source located at an inner part of the heat insulator for heating said secondary liquid in said airtight container; and said airtight container being made of a heat conductive material chosen from the group consisting of ceramic, glass and metal.

23. The heat driven self-circulated fluid heating and storage system according to claim 13, wherein said first or second heater selectively for heating said secondary fluid further comprising a power pump for pumping said secondary liquid; said container for secondary liquid having at least one sub-space being connected to said heater, and said breathing port fitting is closed by a cap.

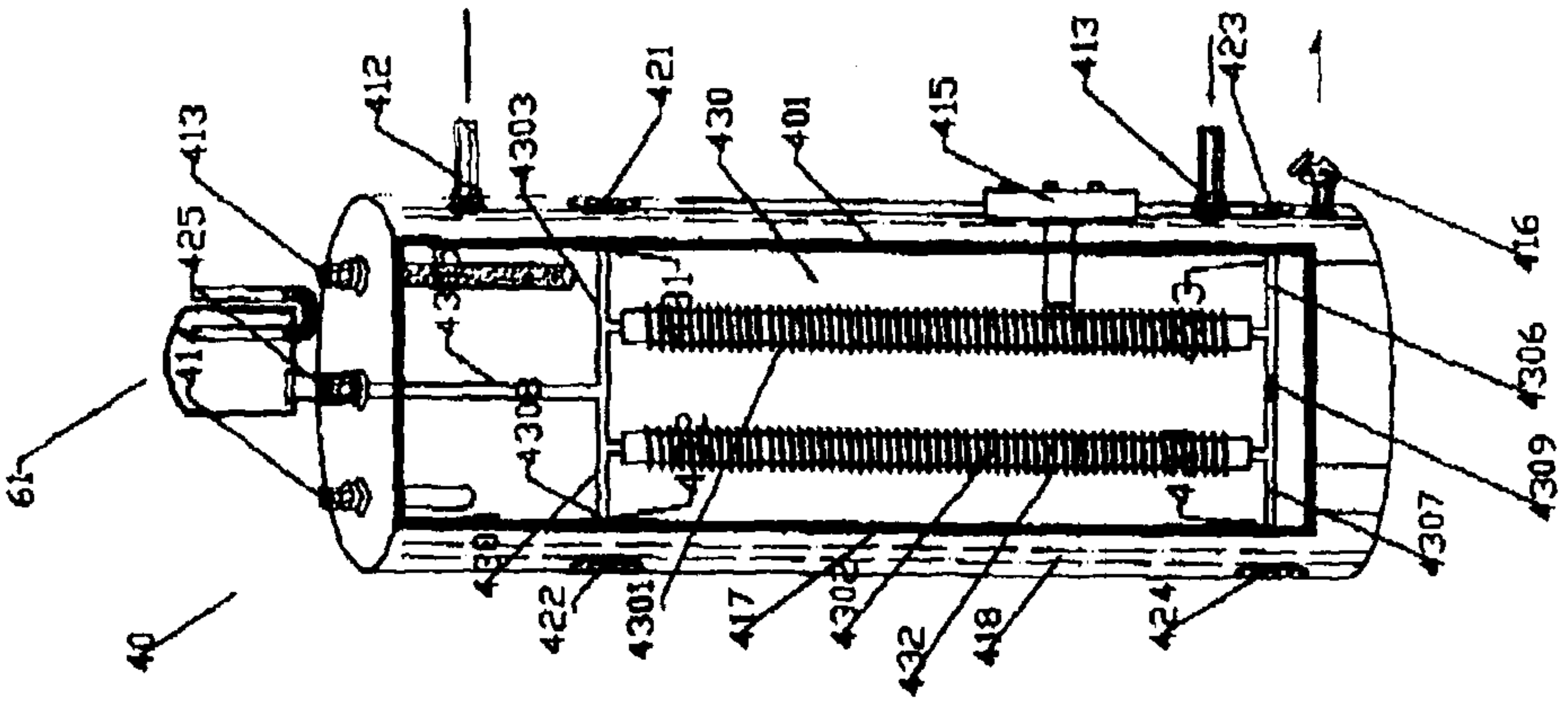


FIG. 2

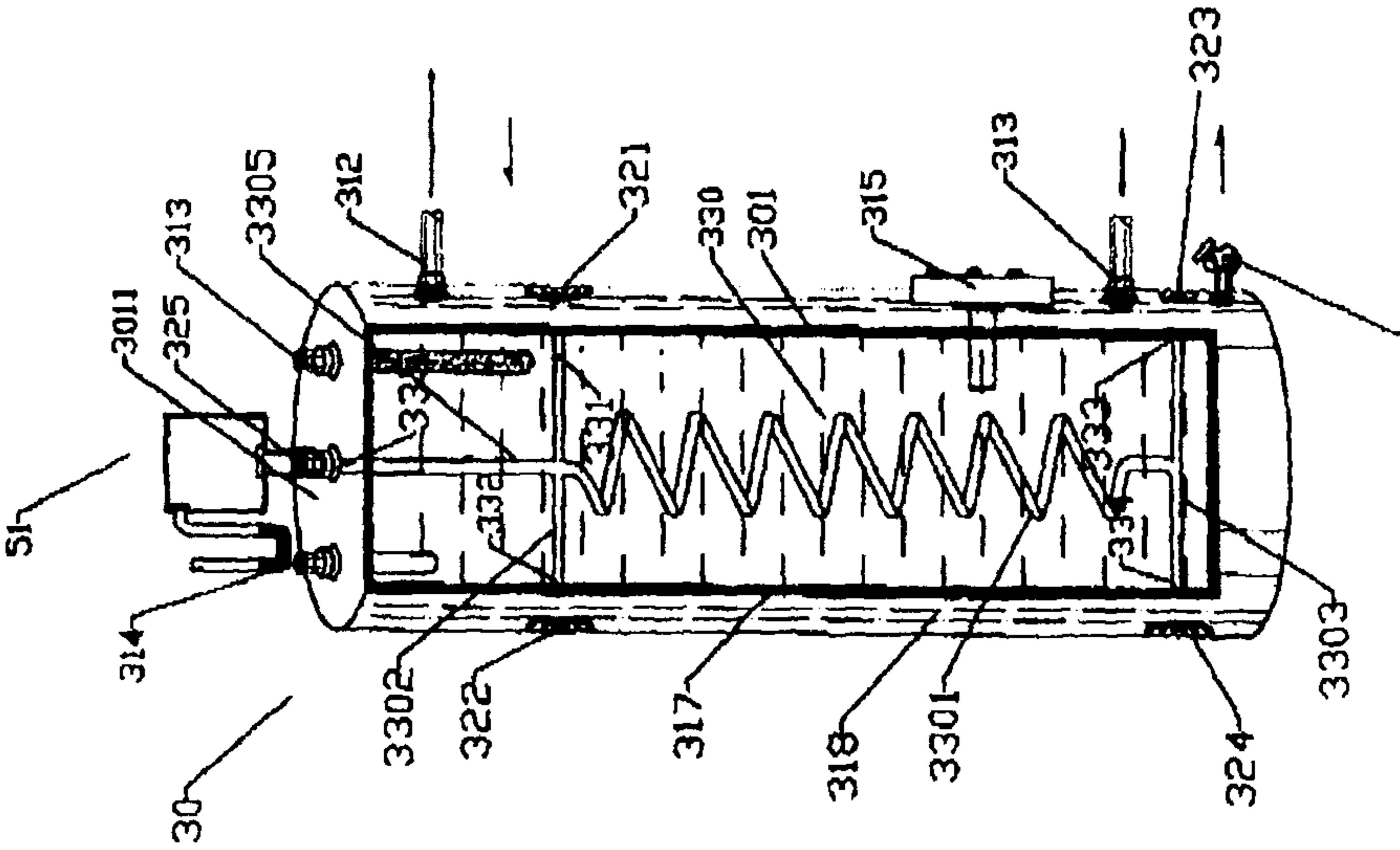


FIG. 1

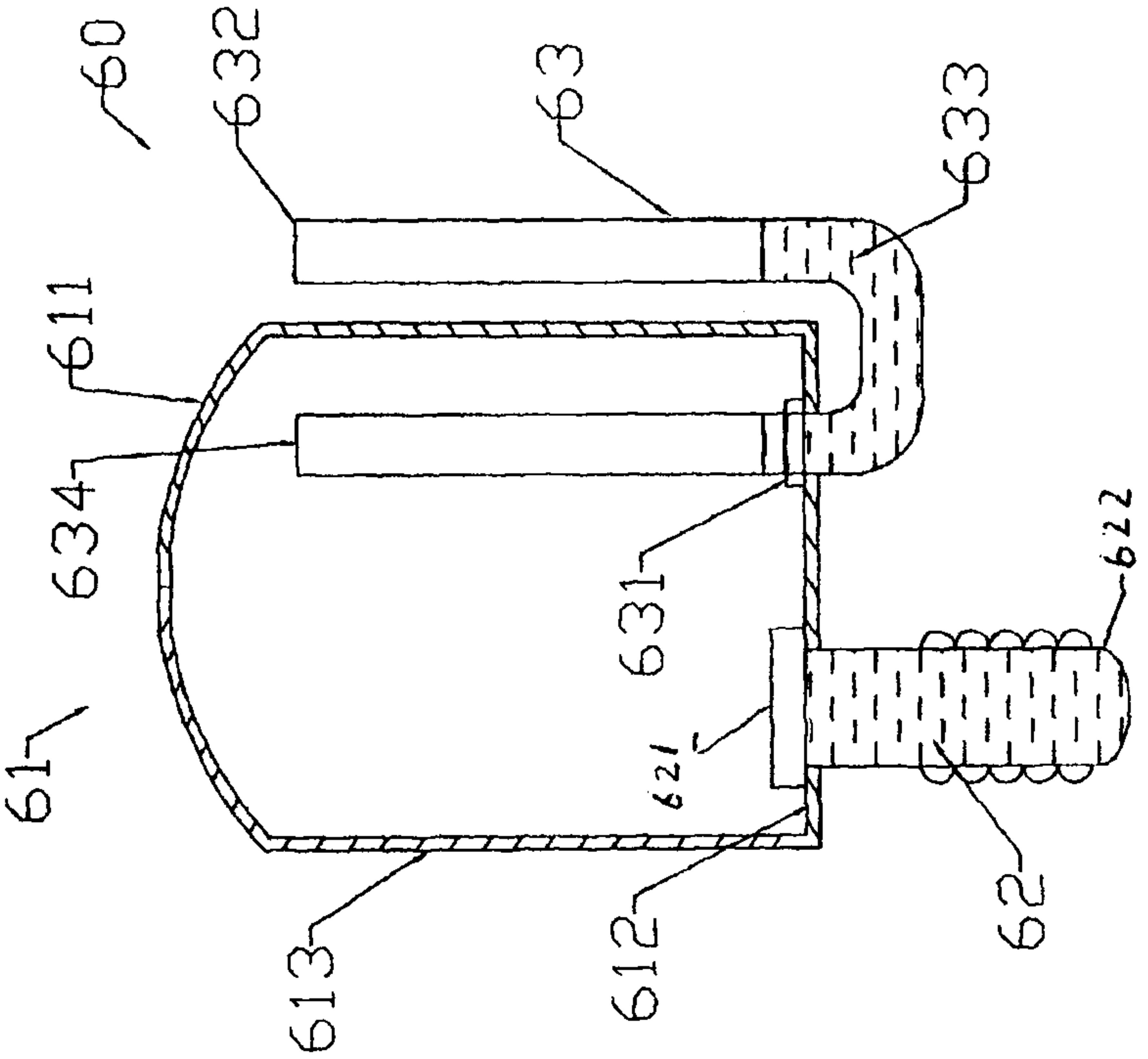

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FIG. 4

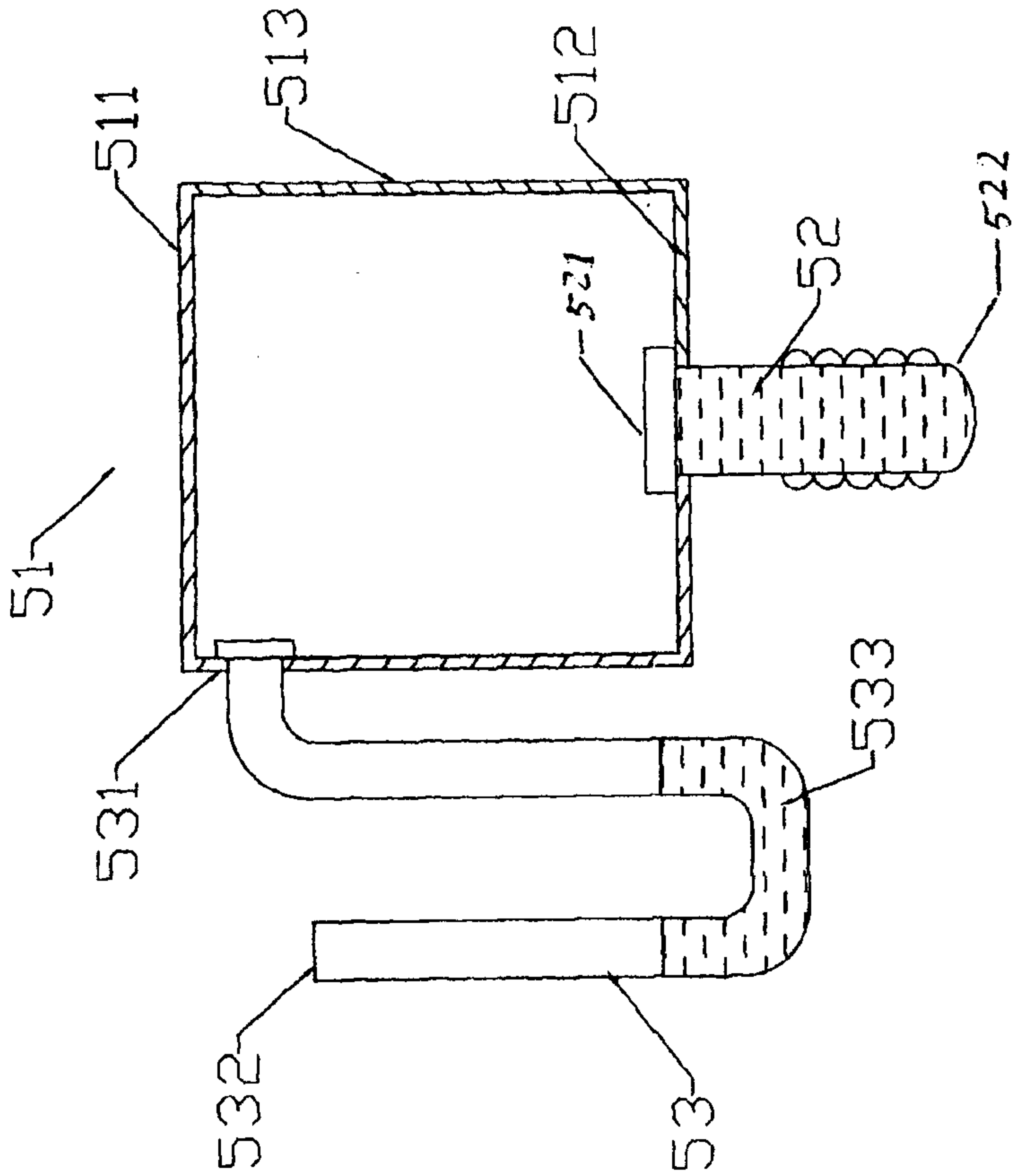
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FIG. 3

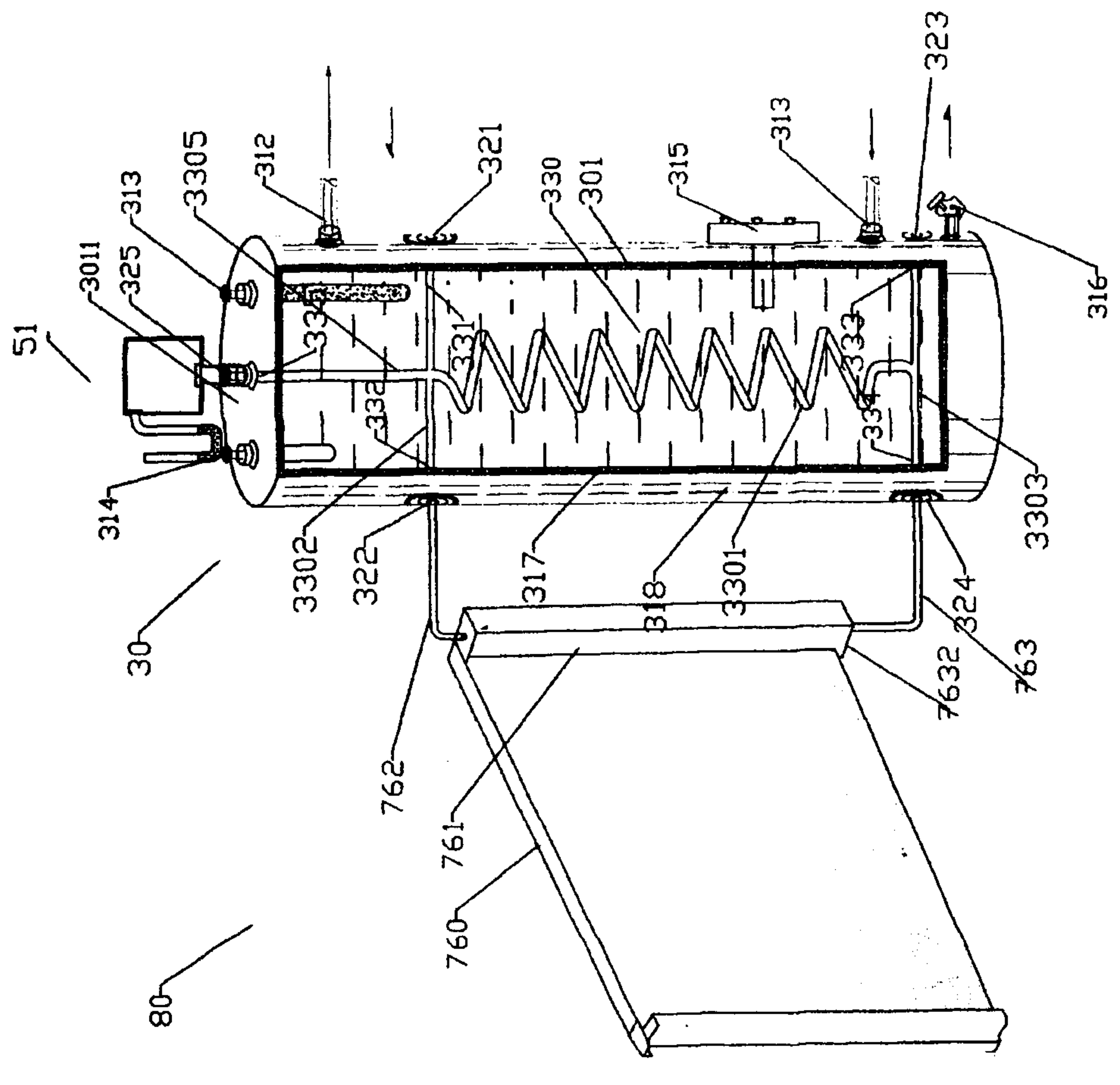
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FIG. 5

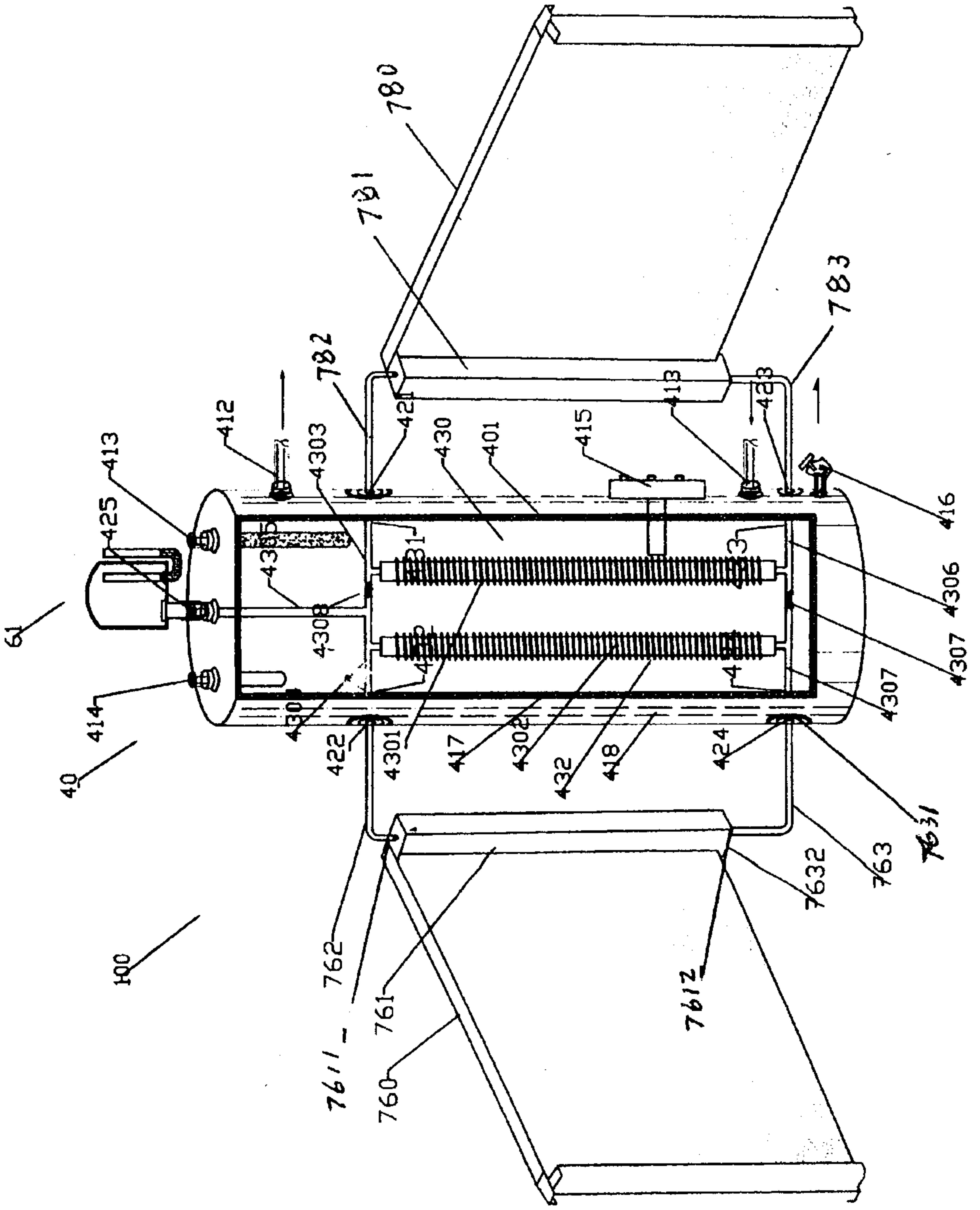

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FIG.6

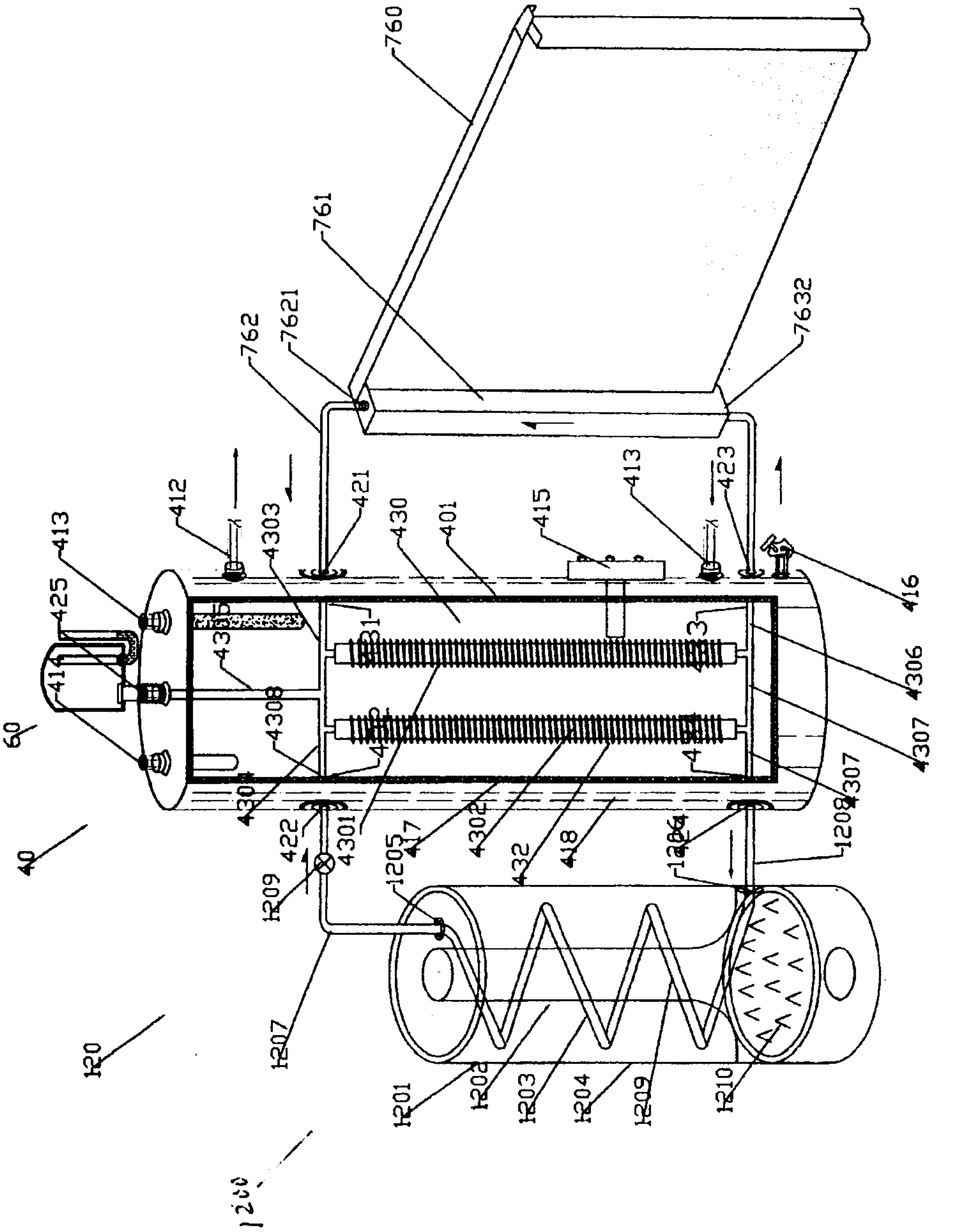
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FIG. 7

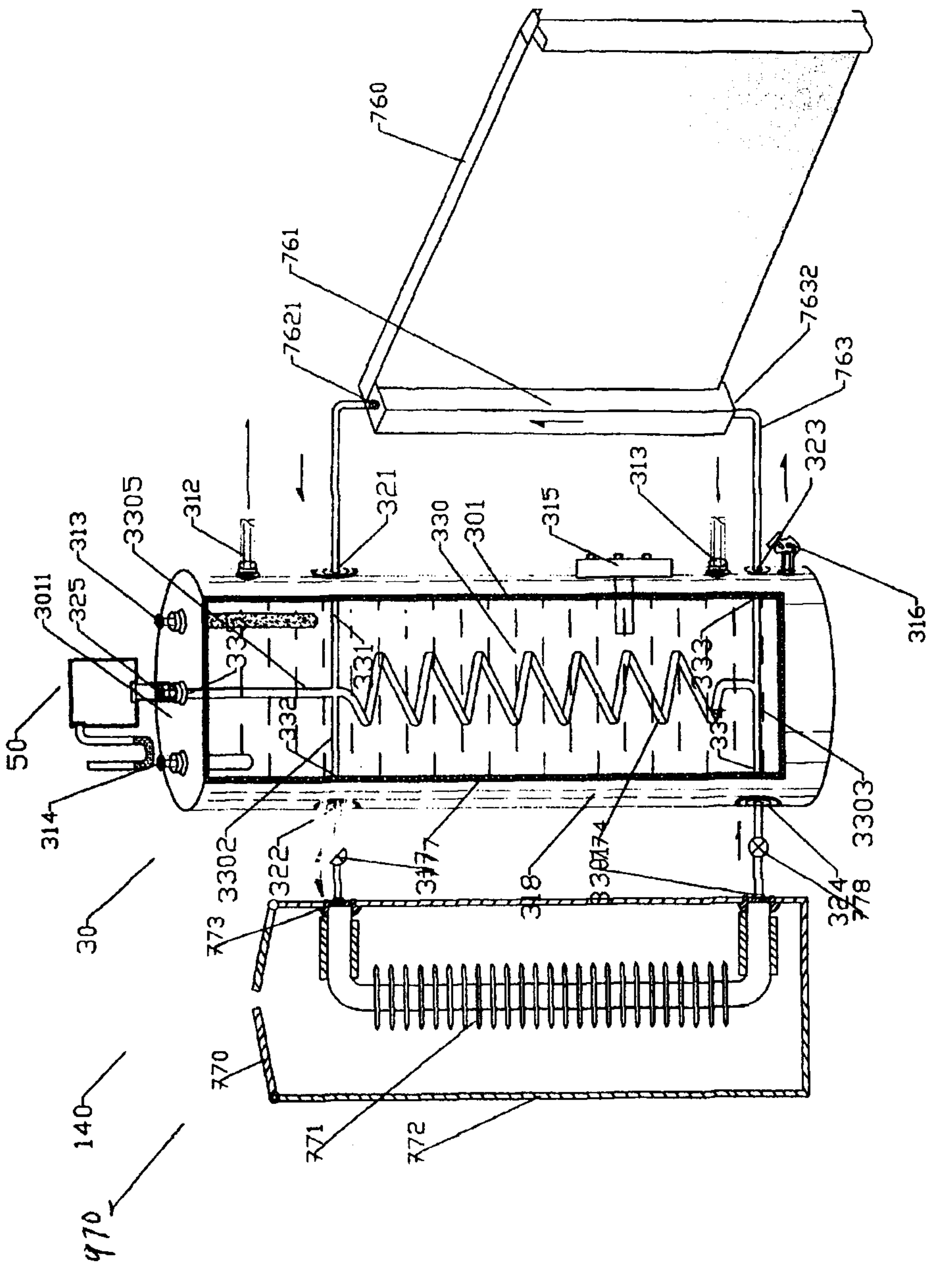
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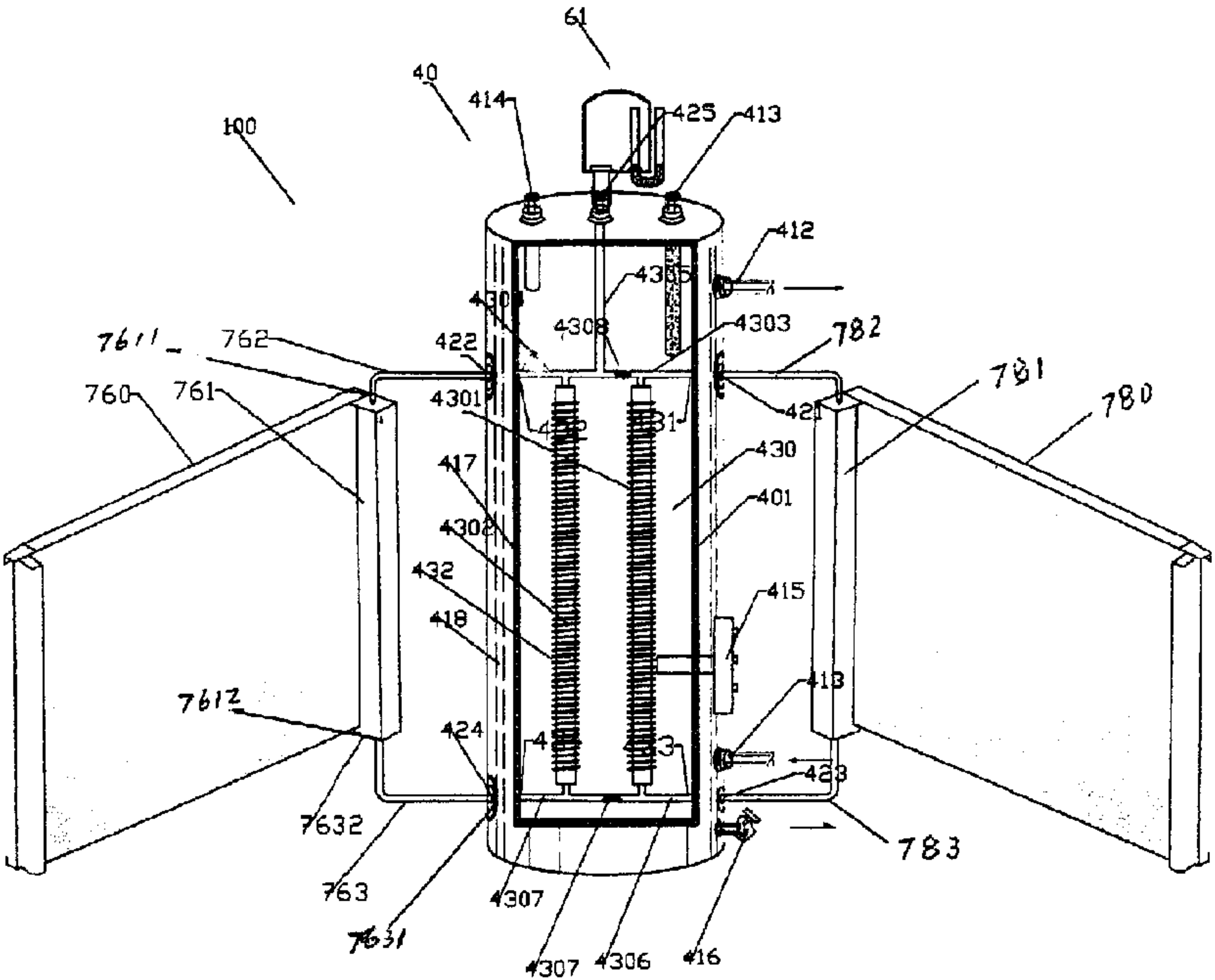
FIG. 8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