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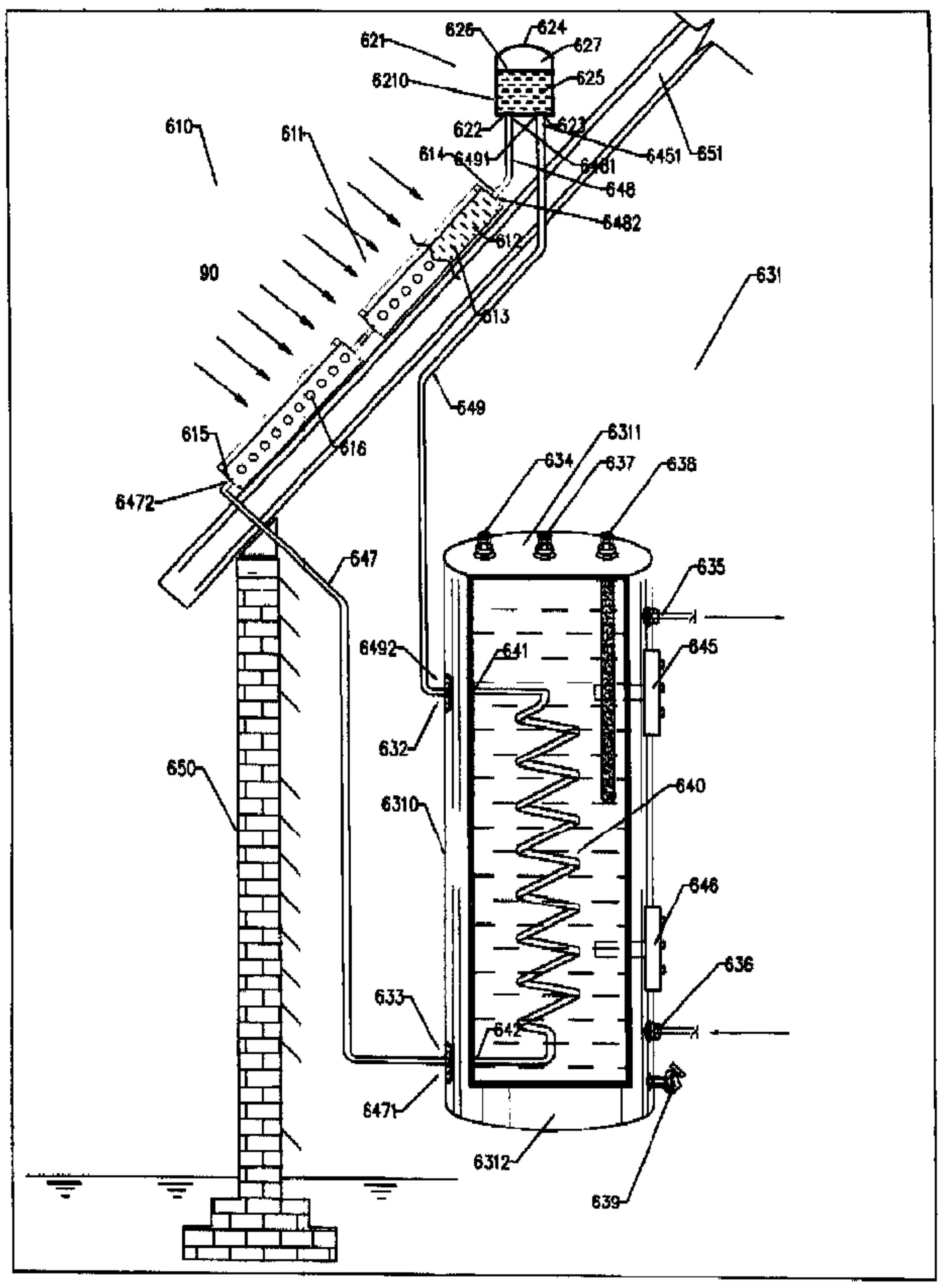
(54) Titre : POMPE AUTOMOTRICE POUR LIQUIDE CHAUFFE ET SYSTEME DE CIRCULATION AUTOMATIQUE EN BOUCLE FERMEE DE LIQUIDE ENTRAINE PAR LA CHALEUR Y FAISANT APPEL

(54) Title: SELF-POWERED PUMP FOR HEATED LIQUID AND HEAT DRIVEN LIQUID CLOSE-LOOP AUTOMATIC CIRCULATING SYSTEM EMPLOYING SAME



(57) Abrégé/Abstract:
A heat driven self-circulating device for a heated liquid for use with a liquid heat collector is disclosed. The devise comprises an airtight container for containing a heated liquid, said container having an upper air/vapor space located above a liquid level surface

(57) **Abrégé(suite)/Abstract(continued):**
therein and a lower liquid space located below said liquid level surface. The container has an inlet of said heated liquid and an outlet of said heated liquid wherein said outlet of said heated liquid is located below said liquid level surface in said container, and said inlet of said heated liquid inlet is located not lower than said heated liquid outlet. A breathing channel for continuously connecting atmosphere with said upper air/vapour space ; said breathing channel having a liquid vapour condensing and refluxing structure. A heat driven liquid self-circulating system has been also disclose that employs above mentioned heat driven self-circulating device This system circulates the liquid in a close-loop by the collected heat in the loop. The system may operate without external power for the pump. The system can transfer heated liquid to a place higher, lower or at same level of the heat collector. The heat driven liquid close-loop automatic circulating system may be a solar heated liquid close- loop automatic circulating system with a solar heat collector.

ABSTRACT

A heat driven self-circulating device for a heated liquid for use with a liquid heat collector is disclosed. The devise comprises an airtight container for containing a heated liquid, said container having an upper air/vapor space located above a liquid level surface therein and a lower liquid space located below said liquid level surface. The container has an inlet of said heated liquid and an outlet of said heated liquid wherein said outlet of said heated liquid is located below said liquid level surface in said container, and said inlet of said heated liquid inlet is located not lower than said heated liquid outlet. A breathing channel for continuously connecting atmosphere with said upper air/vapour space ; said breathing channel having a liquid vapour condensing and refluxing structure.

. A heat driven liquid self-circulating system has been also disclose that employs above mentioned heat driven self-circulating device This system circulates the liquid in a close-loop by the collected heat in the loop. The system may operate without external power for the pump. The system can transfer heated liquid to a place higher, lower or at same level of the heat collector. The heat driven liquid close-loop automatic circulating system may be a solar heated liquid close-loop automatic circulating system with a solar heat collector.

SELF-POWERED PUMP FOR HEATED LIQUID AND HEAT DRIVEN LIQUID CLOSE -LOOP AUTOMATIC CIRCULATING SYSTEM EMPLOYING SAME

FIELD OF TECHNOLOGY

[0001] The present disclosure relates to a modified self-powered pump for heated liquids. The present disclosure also relates to a heat driven liquid close-loop automatic circulating system employing modified self-powered pump.

BACKGROUND

[0002] A self-powered pump and a heat driven liquid automatic circulating system is disclosed in a Canadian patent application No.02628605 by the same applicants of the present application. However, the present system not only can transfer the heat from a higher place to a lower place, but also can transfer the heat to the place at the same level or a higher place. This patent application reflects our R&D progress in this topic. Solar thermal systems are also disclosed in GB.2383384 A published on June 25, 2009 and US4246890 (KRAUS et al) January 27, 1981.. However, the system of the present invention operates under the atmospheric pressure continuously and do not need external power pump to circulate the heated liquid. The disclosed system uses solar heat only as the circulating power.

[0003] The disclosed heat driven liquid automatic circulating system used in a solar heating system of the present invention may bring the following advantages to the system:

[0004] Comparing to the existing nature circulating unit solar water heater, the new system can put solar collector on the roof while the water tank is in building.

[0005] Comparing to the existing electric power pump forced circulation solar heating system, the heat driven solar heat automatic circulating system does not need electric power pump, expansion tank and controller.

SUMMARY

[0006] Following is the summary of the self-powered pump and the heat driven liquid close-loop automatic circulating system:

1. A self-powered pump for heated liquid, used with a liquid heat collector, comprising:
   an airtight container for containing heated liquid, having a wall to separate its outer and inner spaces; said inner space is filled with heated liquid partially and having a upper air/vapor space above liquid level surface and lower liquid space under liquid level surface;
   an inlet and a outlet arranged on said wall of the container that both are under the liquid level surface in said container, and said inlet not lower than said outlet;
   a breathing channel mounted on said wall of said container for connecting atmosphere with said inner upper air/vapor space above liquid level surface; said breathing channel having a liquid vapor condensing and reflux structure.
2. The pump of cliam1 wherein said container is a heat insulated container;
3. The pump of cliam1 wherein said container is a transparent container made of glass or polymeric material;
4. The pump of cliam1 wherein said container is a evacuated container;
5. The pump of cliam1 wherein said inlet and outlet of said container have a inlet pipe and outlet pipe that mounted at said inlet and said outlet; a portion of either inlet pipe or outlet pipe that extended outside said container is detachable;
6. The pump of claim 1 wherein said breathing channel comprising: a opening fitting on said wall of container above the said liquid level in said container; a tube having an lower end mounted on the top of the wall of said container and a upper opposite end with a removable cup; a hall on the side wall of said tube for connecting atmosphere with said inner space upper liquid level in said container; a set of vapor condensing pieces, e.g. copper or silver pieces, disposed in said breathing tube for liquid vapor condensing and condensate refluxing;
7. The mounted upward tube according to claim 6 is a transparent tube made of glass or polymeric.

8. The pump of claim 1 wherein said breathing channel comprising: a opening fitting on the wall under the liquid lever in said container; a breathing tube mounted on said opening fitting under the liquid lever in said container and extended upwardly into the inner air/vapor space upper the liquid level in said container; said breathing tube having a portion outside of said container wall and with a flexural shape, e.g. U or W shape, for liquid vapor condensing and for condensate temporary storage and refluxing;

9. The pump of claim 1 wherein said heated liquid is water;
10. The pump of claim 1 wherein said heated liquid is a anti-freezing liquid;
11. A heat driven liquid close-loop automotive circulation system, comprising:

a heat collector having a liquid vessel filled fully with heat transfer medium, which is a liquid; said liquid vessel having an inlet and an outlet; said outlet is not lower than said inlet;

a self-powered pump for heated liquid which used with a liquid heat collector, comprising:

an airtight container for containing heated liquid, having a wall to separate its outer and inner spaces; said inner space is filled with heated liquid partially and having a upper air/vapor space above liquid level surface and lower liquid space under liquid level surface;

an inlet and a outlet arranged on said wall of the container that both are under the liquid level surface in said container, and said inlet not lower than said outlet;

a breathing channel mounted on said wall of said container for connecting to atmosphere with said inner upper air/vapor space above liquid level surface; said breathing channel having a liquid vapor condensing and reflux structure.

first conduit connecting its one end at said outlet of said heat collector and the opposite end at said inlet of said self-powered pump, wherein said inlet of self-powered pump is not lower than said outlet of said heat collector;

econd conduit connecting its one end at said outlet of said self-powered pump and its opposite end at said inlet of said heat collector, wherein said outlet of self-powered pump is not lower than said inlet of said heat collector; said second conduit including three continued portions that are higher, lower and the at same level respectively comparing with the location of said heat collector.

12. The heat collector of claim 11 is a solar heat collector;
13. The heat collector of claim 11 wherein said heat collector is a heat insulated heat collector, e.g. a insulated water tank of boiler;
14. The heat collector of claim 11 wherein said heated liquid is water;
15. A heat driven liquid close-loop automotive circulation system, comprising:

a heat collector having a liquid vessel filled fully with heat transfer medium, which is a liquid; said liquid vessel having an inlet and an outlet; said outlet is not lower than said inlet;

a liquid heating and storage tank wherein filled with heated liquid partially; comprising:

a heated liquid level surface separating the inner space into upper air/vapor space and lower heated liquid space;

a heated liquid inlet and a heated liquid outlet, wherein both of said inlet and outlet are under the heated liquid level surface; said heated liquid inlet is not lower than said heated liquid outlet;

a breathing channel mounted on said wall of said storage tank for connecting atmosphere with said inner upper air/vapor space above liquid level; said breathing channel having a liquid vapor condensing and reflux structure;

first conduit connecting its one end at said outlet of said heat collector and the opposite end at said inlet of said liquid heating and storage tank, wherein said

inlet of said liquid heating and storage tank is not lower than said outlet of said heat collector;

Second conduit connecting its one end at said outlet of said liquid heating and storage tank and the opposite end at said inlet of said heat collector, wherein said

outlet of said liquid heating and storage tank is not higher than said inlet of said heat collector.

16. The liquid heating and storage tank of claim 15 wherein said a breathing channel mounted on said wall of said storage tank is a connecting fitting with a mounted pressure release valve; such that the said liquid heating and storage tank is a pressure tank;
17. The heat collector of claim 15 wherein said heated liquid is water;
18. The said liquid storage tank of claim 15 wherein said breathing channel comprising: a opening fitting on said wall of said liquid heating and storage tank above the said liquid level in said liquid heating and storage tank; a tube having an lower end mounted on the top of the wall of said liquid heating and storage tank and a upper opposite end with a removable cup; a hall on the side wall of said tube for connecting atmosphere with said inner space upper liquid level in said liquid heating and storage tank; a set of vapor condensing pieces, e.g. copper or silver pieces, disposed in said breathing tube for liquid vapor condensing and condensate refluxing;
19. The mounted upward tube according to claim 15 is a transparent tube made of glass or polymeric

20. The heat collector of claim 15 is a solar heat collector;

21. The heated liquid of claim 15 is water;

22. The liquid heating and storage tank of claim 15 having a liquid inlet for cooled liquid supply, a liquid outlet for supplying heated liquid to user, a pressure release valve and a drain;

23. A heat driven liquid close-loop automotive circulation system, comprising:

a heat collector having a liquid vessel filled fully with heat transfer medium, which is a liquid; said liquid vessel having an inlet and an outlet; said outlet is not lower than said inlet;

a fluid heating and storage tank, comprising:

a storage tank for primary fluid, said storage tank having a primary fluid inlet, a primary fluid outlet, a secondary fluid inlet and a secondary fluid outlet; and

an apparatus disposed within said storage tank for flow a secondary fluid, which is a liquid, through said storage tank in isolation from said primary fluid , said apparatus fluidly interconnecting said secondary fluid inlet with said secondary fluid outlet and comprising a heat exchanger; said apparatus having a breathing channel extended upward and mounted at the top wall of said storage tank; said breathing channel is fluidly communicated with said secondary fluid within apparatus and opened to atmosphere;

first conduit connecting its one end at said outlet of said heat collector and the opposite end at said secondary fluid inlet of fluid heating and storage tank, wherein said secondary fluid inlet of said liquid heating and storage tank is not lower than said outlet of said heat collector;

Second conduit connecting its one end at said secondary fluid outlet of said fluid heating and storage tank and the opposite end at said inlet of said heat collector, wherein said secondary fluid outlet of said fluid heating and storage tank is not higher than said inlet of said heat collector.

24. the fluid storage tank of claim 23 wherein said breathing channel further comprising: a tube having an lower end mounted on the top of the wall of said liquid heating and storage tank and a upper opposite end with a removable cap; a holl on the side wall of said tube for connecting atmosphere with inner air/vapor space upper secondary liquid level in said apparatus; a set of vapor condensing pieces, e.g. copper or silver pieces, disposed in said breathing tube for liquid vapor condensing and condensate refluxing;

25. the fluid storage tank of claim 23 wherein said primary liquid is water and secondary fluid is a anti-freezing liquid;
26. The heat collector of claim 23 is a solar heat collector;
27. The fluid heating and storage tank of claim 23 having a fluid inlet for cooled fluid supply, a fluid outlet for supplying heated fluid to user, a pressure release valve and a drain;
28. A heat driven liquid close-loop automotive circulation system, comprising:

    a heat collector having a liquid vessel filled fully with heat transfer medium, which is a liquid; said liquid vessel having an inlet and an outlet; said outlet is not lower than said inlet;

    a self-powered pump for heated liquid, comprising:

    an airtight container for containing heated secondary fluid, which is a liquid, having a wall to separate its outer and inner spaces; said inner space is filled with heated secondary liquid partially and having a upper air/vapor space above liquid level surface and lower liquid space under liquid level surface;

    an inlet and a outlet arranged on said wall of the container that both are under the secondary liquid level surface in said container, and said inlet not lower than said outlet;

    a breathing channel mounted on said wall of said container for connecting to atmosphere with said inner upper air/vapor space above liquid level surface; said breathing channel having a liquid vapor condensing and reflux structure.

    a fluid heating and storage tank, comprising:

    a storage tank for primary fluid, said storage tank having a primary fluid inlet, a primary fluid outlet, a secondary fluid inlet and a secondary fluid outlet; and

    an apparatus disposed within said storage tank for flow a secondary fluid, which is a liquid, through said storage tank in isolation from said primary fluid , said apparatus fluidly interconnecting said secondary fluid inlet with said secondary fluid outlet and comprising a heat exchanger; wherein said secondary fluid inlet of said fluid heating and storage tank is not lower than said secondary fluid outlet of

    said fluid heating and storage tank,;

    first conduit connecting its one end at said outlet of said heat collector and the opposite end at said secondary liquid inlet of said self-powered pump, wherein said outlet of said heat collector is not higher than said secondary fluid inlet of self-powered pump;

second conduit connecting its one end at said secondary fluid outlet of said self-powered pump and the opposite end at said secondary fluid inlet of said fluid heating and storage tank, wherein said secondary fluid outlet of said self-powered pump is not lower than said secondary fluid inlet of said fluid heating and storage tank;

third conduit connecting its one end at said secondary fluid outlet of said fluid heating and storage tank, and the opposite end at said inlet of said heat collector, wherein said secondary fluid outlet of said fluid heating and storage tank is not higher than said inlet of said heat collector;

29. The heat collector of claim 28 is a solar heat collector;

30. the heat storage tank of claim 28 wherein said primary fluid is water and said secondary liquid is a anti-freezing liquid;

31. The fluid heating and storage tank of claim 28 having a fluid inlet for cooled fluid supply, a fluid outlet for supplying heated fluid to user, a pressure release valve and a drain;

32. A heat driven liquid close-loop automotive circulation system, comprising:

a heat collector having a liquid vessel filled fully with heat transfer medium, which is a liquid; said liquid vessel having an inlet and an outlet; said outlet is not lower than said inlet;

a self-powered pump for heated liquid, comprising:

an airtight container for containing heated secondary fluid, which is a liquid, having a wall to separate its outer and inner spaces; said inner space is filled with heated secondary liquid partially and having a upper air/vapor space above liquid level surface and lower liquid space under liquid level surface;

an inlet and a outlet arranged on said wall of the container that both are under the secondary liquid level surface in said container, and said inlet not lower than said outlet;

a breathing channel mounted on said wall of said container for connecting to atmosphere with said inner upper air/vapor space above liquid level surface; said breathing channel having a liquid vapor condensing and reflux structure.

a heat exchanger, comprising:

a fluid reservoir for primary fluid, said reservoir having a primary fluid inlet, a primary fluid outlet, a secondary fluid inlet and a secondary fluid outlet; and

an apparatus disposed within said reservoir for flow a secondary fluid, which is a liquid, through said reservoir in isolation from said primary fluid , said apparatus fluidly interconnecting said secondary fluid inlet with said secondary fluid outlet; wherein said secondary fluid inlet of said heat exchanger is not lower than said secondary fluid outlet of said heat exchanger,;

first conduit connecting its one end at said outlet of said heat collector and the opposite end at said secondary liquid inlet of said self-powered pump, wherein said outlet of said heat collector is not higher than said secondary fluid inlet of self-powered pump;

second conduit connecting its one end at said secondary fluid outlet of said self-powered pump and the opposite end at said secondary fluid inlet of said heat exchanger, wherein said secondary fluid outlet of said self-powered pump is not lower than said secondary fluid inlet of said heat exchanger;

third conduit connecting its one end at said secondary fluid outlet of said heat exchanger, and the opposite end at said inlet of said heat collector, wherein said secondary fluid outlet of said heat exchanger is not higher than said inlet of said heat collector;

33. the heat collector of claim 32 is a solar heat collector;
34. the heat exchanger of claim 32 wherein said primary fluid is water and said secondary liquid is a anti-freezing liquid;

BRIEF DESCRIPTION OF THE DRAWINGS

In the figures which illustrate exemplary embodiments of this invention:

[0007] FIG. 1 is schematic diagram illustrating a simple heat driven liquid close-loop automotive circulation system;

[0008] FIG. 2 is schematic diagram illustrating the self-powered pump of FIG. 1 with a breathing channel at the top of pump;

[0009] FIG. 3 is schematic diagram illustrating the self-powered pump of FIG. 1 with another breathing channel structure;

[0010] FIG. 4 is schematic diagram illustrating a heat driven liquid close-loop automotive circulation system without heat exchanger;

[0011] FIG. 5 is schematic diagram illustrating a heat driven liquid close-loop automotive circulation system with a heat exchanger opened to atmosphere;

[0012] FIG. 6 and Fig.7 are schematic diagram illustrating two heat driven liquid close-loop automotive circulation systems when the relevant locations between solar heater collector and heat storage tank;

[0013] FIG. 8 is a is schematic diagram illustrating a heat driven liquid close-loop automotive circulation system with a heat exchanger.

DETAILED DESCRIPTION

[0014] Referring to FIG. 1, an exemplary heat driven liquid close-loop automotive circulating system is illustrated during use. The system 110 includes a heat collector 111 having a vessel 112 filled fully with heat transfer medium, which is a liquid 113; said vessel having an inlet 115 and an outlet 114; said outlet 114 is not lower than said inlet 115.

[0015] A self-powered pump 121 for heated liquid which used with a liquid heat collector 111. The self-powered pump 121 has an airtight container 1210 for containing heated liquid, having a wall to separate its outer and inner spaces. The inner space is filled with heated liquid partially, so that there is a upper air/vapor space 127 above liquid level surface 126 and lower liquid space 125 under liquid level surface 126. An inlet 122 and a outlet 123 arranged on said wall of the container that both are under the liquid level surface 126 in said container, and the inlet 122 is not lower than said outlet 123.

[0016] A breathing channel 124 mounted on said wall of said container 121 for connecting to atmosphere with said inner upper air/vapor space127 above liquid level surface 126; said breathing channel 124 has a liquid vapor condensing and reflux structure that will be explained in Fig.2 and Fig.3.

[0017] First conduit 131 connects its one end 1311 at the outlet 114 of the heat collector 111. The opposite end of conduit 131 connects at the inlet 122 of the self-powered pump 121.

The inlet 122 of self-powered pump 121 is not lower than the outlet 114 of said heat collector 111. This is for the heat driven liquid move upwardly to the self-powered pump 121.

[0018] Second conduit 132 connects its one end 1321 at said outlet 123 of said self-powered pump 121 and its opposite end 1322 at said inlet 115 of said heat collector121, The outlet 123 of self-powered pump 121 is not lower than the inlet 115 of said heat collector 111. Fig. I shows that the second conduit 132 has its top potion higher than the heat collector 111_and the lower portion lower than the heat collector 111 and its middle portion is as high as the level of the heat collector 111 located.

[0019] In Fig. 1, the heat collector111, conduit 131, self-powered pump 121 and conduit 132 are formed a heated liquid close-loop circuit. When the heat collector 111 received the heat, the heated liquid tends to move upwardly and the cooler liquid in the opposite direction. The heated liquid moves to the self-power pump 121 and the cooler liquid in the bottom of heat collector 111 and conduit 132 comes and replenishes the space. So that a circulating power is generated in the system 110 and make the system operation continuously when the heat is available.

[0020] This example circuit shows that by employing a self-powered pump at the upper place of the heat collector. It is possible to form a close loop circuit. In this circuit a heater can transfer its heat to the places whatever is higher, lower or the same level of the heater without external power pump.

[0021] Referring to FIG. 2, an exemplary a self-powered pump 221 for heated liquid is illustrated during use. This pump includes an airtight container 2210 for containing heated liquid, having a wall 2211 to separate its outer and inner spaces; The inner space is filled with heated liquid partially and having a upper air/vapor space 227 above liquid level surface 226 and a lower liquid space 225 under liquid level surface 226.

[0022] An inlet 222 and a outlet 223 and 229 or 224 and 260 are arranged on said wall 2211 and 2012 of the container 2210 that both are under the liquid level surface 226 in said container 2210, and said inlet 222 not lower than said outlet 223. A part 224 of breathing channel is a connecting fitting mounted on said wall 2211 of said container 221 for connecting atmosphere with the inner upper air/vapor space 227 above liquid level surface 226. The breathing channel having a liquid vapor condensing and reflux structure 229 or 260. A end 2291 of 229 is mounted on the fitting of 224. The part 229 is a "N" shape tube. When the liquid vapor from container 2210 may be condensed in the tube 229 and the condensate may be temporary stored at the inner lower poison 2290. When the liquid in self-powered pump is cooled, the negative pressure may draw the condensate back to the container 2210, So that the liquid in the close-loop may be kept. This is also a channel to add the liquid to the close-loop circuit when the end 2292 of the tube 229 is higher.

[0023] The liquid vapor condensing and reflux structure 260 is another kind of structure that mounted on the fitting of 224. This is a transparent tube 241 with a cup 243 and a bottom 242. A hole 244 on the wall of the tube 241 is for connecting space 227 with atmosphere. A set of vapor condensing pieces 245, e.g. copper pieces, are disposed in the breathing tube 241 for liquid vapor condensing and condensate refluxing to the container.

[0024] Referring to FIG. 3, an exemplary another kind of breathing channel 321 is illustrated during use. An airtight container 3210 for containing heated liquid, having walls 3211 and 3212 to separate its outer and inner spaces. The inner space is filled with heated liquid partially and having a upper air/vapor space 327 above liquid level surface 326 and lower liquid space 325 under liquid level surface 326. An inlet 322 and a outlet 323 are arranged on said wall 3212 of the container 3210. They both are under the liquid level surface 326. The inlet 322 is not lower than outlet 323.

[0025] A breathing channel 324 includes two portions 328 and 329. An end 3281 of 328 and an end 3291 of 329 mounted on a fitting 3241 of said wall of said container for connecting atmosphere with said inner upper air/vapor space 327 above liquid level surface 326. The breathing channel has a liquid vapor condensing and reflux structure. It includes an opening fitting 3241 on the wall under the liquid lever 326 in said container. The breathing tube 329 having one end 3291mounted on said opening fitting 3241 under the liquid lever 326 in said container. The opposite end 3292 is out of the container. A end 3243 of 328 extended upwardly into the inner air/vapor space 327 that is upper the liquid level 326 in said container. An end 3243 of 328 is upper the water lever 3242. The breathing tube 329 has a portion 3290 outside of said container wall and with a flexural shape, e.g. U shape. It is for liquid vapor condensing and for condensate 3290 temporary storage and refluxing as explained in Fig 2. The second end 3292 of 329 is connected to atmosphere.

[0026] Referring to FIG. 4, an exemplary a heat driven liquid close-loop automatic circulating system 410 is illustrated during use. This system includes a heat collector 411, a liquid heating and storage tank 431 and the connecting conduits 451 and 452. The heat collector 411 combines two solar heat collectors 412 and 416. The heat collector has a liquid vessel 412 filled fully with heat transfer medium, which is a liquid 413. The vessel has an inlet 415 and an outlet 414. The outlet 414 is not lower than said inlet 415.

[0027] A liquid heating and storage tank 431 has a storage tank 4312 that is filled with heated liquid partially. It has a side wall 4310, top wall 4311 and the tank has a heated liquid inlet 432 and a heated liquid outlet 433. Both of them are under the heated liquid level surface. The heated liquid inlet 432 is not lower than the heated liquid outlet 433. a breathing channel 437 mounted on the wall of said storage tank for connecting atmosphere with said inner upper air/vapor space above liquid level. The breathing channel has a liquid vapor condensing and reflux structure as explained in Fig. 2 and 3. First conduit 451 connects its one end 4511 at the outlet 414 of the heat collector 411 and the opposite end 4512 at the inlet 432 of the liquid heating and storage tank 431. The inlet 432 is not lower than the out let 414 of the heat collector. Second conduit 452 connects its one end 4521 at the outlet 433 of said liquid heating and storage tank and the opposite end 4522 at the inlet 415 of the heat collector. The outlet 433 of said liquid heating and storage tank 431 is not higher than the inlet 415 of said heat collector 411.

[0028] In Fig. 4, the heat collector 411, conduit 451, storage tank 431 and conduit 452 are formed a heated liquid close-loop circuit. They located in two sides of a building wall 450 respectively. When the solar heat collector 411 received the solar heat from sunlight 90, the heated liquid tends to move upwardly and the cooler liquid in the opposite direction. The heated liquid, it is water, moves to the storage tank 431 and the cooler liquid in the bottom of heat collector 411 and conduit 452 comes and replenishes the space. So that a circulating power is generated in the system 410 and make the system operate continuously when the heat is available.

[0029] In some case, a release valve that mounted at the fitting on the storage tank 431 can replace the breathing channel 437. In this case the storage tank 431 becomes a pressured storage tank. The release valve may become a breathing channel. The heat transfer speed of this kind of pressured tank is not as good as an opened tank. Further more, there is a concern of the safety for frequent on/off release valve. One of the solutions is to add a release valve at the fitting 434 at different start pressure setting value.

[0030] The storage tank has cool liquid inlet 436, hot liquid outlet 435, drain 439 and protective anode 438 as normal tank.

[0031] Referring to FIG. 5, an exemplary a heat driven liquid close-loop automatic circulating system 510 is illustrated during use. In this case, a solar heat collector 511 is arranged in a place out of the building wall 550 and the heat storage tank 531 in seats in the room for freezing protection. A heat collector 511 has its liquid vessel 513 filled fully with heat transfer medium 512, which is a liquid. This liquid vessel 513 has an inlet 515 and an outlet 514. The outlet 514 is not lower than the inlet 515. 516 is one of two solar heat units.

[0032] A fluid heating and storage tank 531 has a storage tank 5312 for primary fluid. The storage tank has a primary fluid, it is water, a pressure release valve 537, top wall 5311, side wall 5310, an inlet 536, a primary fluid outlet 535, a secondary fluid inlet 541 and a secondary fluid outlet 542. The storage tank also has an apparatus 540 disposed within the storage tank 531 for flow a secondary fluid, which is a liquid, through the storage tank in isolation from the primary fluid, The apparatus fluidly interconnects the secondary fluid inlet 532 with the secondary fluid outlet 533 and comprising a heat exchanger 540. The apparatus 540 has a breathing channel extended upward and mounted at a fitting 534 on -the top wall 5311 of the storage tank 531. The breathing channel is fluidly communicated with the secondary fluid within apparatus and opened to atmosphere.

[0033] First conduit 545 connects its one end at the outlet 5452 of a heat collector 511 and the opposite end 5451 at the secondary fluid inlet 532 of fluid heating and storage tank 531. The secondary fluid inlet 532 of said liquid heating and storage tank 531 is not lower than the outlet of the heat collector 511. Second conduit 546 connects its one end 5461 at said secondary fluid outlet 533 of the fluid heating and storage tank 531 and the opposite end 5462 at the inlet of the heat collector 511. The secondary fluid outlet 533 of the fluid heating and storage tank 511 is not higher than the inlet 515 of the solar heat collector.

[0034] In Fig. 5, the heat collector 511, conduit 545, the apparatus 540 in the storage tank 531 and conduit 446 are formed a heated liquid close-loop circuit. When the solar heat collector 511 receives the solar heat, the heated liquid tends to move upwardly and the cooler liquid in the opposite direction. The heated liquid moves to the apparatus 540 in the storage tank 531 and the cooler liquid in the bottom of heat collector 511 and conduit 546 comes and replenishes the space. So that a circulating power is generated in the system 510 and make the system operate continuously when the heat is available. The apparatus (it is a fin tube in this example) transfer the heat in heated secondary liquid to primary fluid in the tank and the cooled secondary liquid returns to the solar hat collector. A heat transfer processing is completed. In this case, even the close-loop circuit is opened, but the primary fluid circuit is closed and pressured.

[0035] The storage tank 531 has cool liquid inlet 536, hot liquid outlet 535, drain 539 and protective anode 538 as normal tank.

[0036] Referring to FIG. 6, an exemplary heat driven liquid close-loop automatic circulating system 610 is illustrated during use. In this case a self-powered pump 621 is used and the solar heat collector is installed in a roof 651 upper a wall 650 of a building.

[0037] This system includes a solar heat collector 611 to absorb sunlight 90, a self-powered pump 621 and a storage tank 631 with a heat exchanger 640 and connecting conduits.

[0038] The solar heat collector 611 has a liquid vessel 613 filled fully with heat transfer medium, which is a liquid 612. The liquid vessel 613 has an inlet 615 and an outlet 614. The outlet 614 is not lower than said inlet 615. 616 is one of two solar heat units.

[0039] The self-powered pump 621for heated liquid, has an airtight container 6210 for containing heated secondary fluid, which is a anti-freezing liquid. The pump 621 has a wall to separate its outer and inner spaces. The inner space is filled with heated secondary liquid partially and has a upper air/vapor space 627 above liquid level surface 626 and a lower liquid space 625 under liquid level surface 626.

[0040] An inlet 622 and a outlet 623 are arranged on said wall of the container. Both inlet 622 and outlet 623 are under the secondary liquid level surface 626 in said container 6210. The inlet 622 is not lower than the outlet 623. A breathing channel 624 mounted on said wall of said container for connecting atmosphere with the inner upper air/vapor space 627 above liquid level surface 626. The breathing channel 624 has a liquid vapor condensing and reflux structure that is not shown in this Fig. The detailed structure of the breathing channel has discussed in details in Fig. 2 and 3.

[0041] The fluid heating and storage tank 631 has a top wall 6311, a side-wall 6310, a pressure release valve 637, a spare fitting 634, drain valve 639, electric heaters 645, 646, heat exchange fluid inlet 641 and outlet 642 and a storage tank 6312 for primary fluid. The storage tank 631 has a primary fluid inlet 636, a primary fluid outlet 635, a secondary fluid inlet 632 and a secondary fluid outlet 633 and an apparatus 640 disposed within the storage tank 631 for flow a secondary fluid, which is a anti-free liquid, through the storage tank 631in isolation from said primary fluid. The apparatus 640 fluidly interconnect the secondary fluid inlet 632 with the secondary fluid outlet and comprising a heat exchanger; wherein said secondary fluid inlet 632 of the fluid heating and storage tank is not lower than said secondary fluid outlet 633 of said fluid heating and storage tank 631.

[0042] First conduit 648 connects its one end 6482 at the outlet 614 of the heat collector 611 and the opposite end 6481 at the secondary liquid inlet 622 of said self-powered pump 621. The outlet 615 of the heat collector 611 is not higher than the secondary fluid inlet 622 of the self-powered pump 621. Second conduit 649 connects its one end 6451 at the secondary fluid outlet 623 of the self-powered pump 521 and the opposite end 6492 at said secondary fluid inlet 632 of said fluid heating and storage tank 631. The secondary fluid outlet 623 of the self-powered pump 621 is not lower than the secondary fluid inlet 632 of the fluid heating and storage tank 631. Third conduit 647 connects its one end 6471 at the secondary fluid outlet 633 of the fluid heating and storage tank 631 and its opposite end 6472 at the inlet 615 of the solar heat collector 611. The secondary fluid outlet 622 of the fluid heating and storage tank 631 is not higher than the inlet 615 of the heat collector 611.

[0043] In Fig. 6, the heat collector 611, conduit 648, self-power pump 621, conduit 649, storage tank 631 and conduit 647 are formed a heated liquid close-loop circuit. When the solar heat collector 611 received the solar heat, the heated liquid tends to move upwardly and the cooler liquid in the opposite direction. The heated liquid, it is water, moves to the storage tank 631 and the cooler liquid in the bottom of heat collector 611 and conduit 647 comes and replenishes the space. So that a circulating power is generated in the system 610 and make the system operate continuously when the heat is available.

[0044] Referring to FIG. 7, an exemplary heat driven liquid close-loop automatic circulating system 710 is illustrated during use. Comparing Fig.7 with Fig.6, The difference is a building wall 7501 replaces the building wall 650. In Fig.6 the heat receiver 610 is higher than the storage tank 631, but in Fig.7, the heat receiver 711 has the same heighth with the storage tank 731. The tank 731 has electric heaters 745 and 746 that are the optional components did not show in every system. The other components are same as in Fig.6.

[0045] It is easy to understand the system and how it works, if compare Fig.7 with Fig. 6 . So that there is no more explanation is required.

[0046] Referring to FIG. 8, an exemplary heat driven liquid close-loop automatic circulating system 810 is illustrated during use. This system includes a heat exchanger and without heat storage tank. It is for the engineering case wherein the heat storage tank has no internal installed heat exchanger.

[0047] This system includes a heat collector 811 to absorb heat from sunlight 90, a self-powered pump 821, a heat exchanger 831 and connecting conduit 861, 862 and 863.

[0048] A heat collector 811 has a liquid vessel in the insulation and did not show in Fig.8. The liquid vessel is filled fully with heat transfer medium, which is a anti-freezing liquid. The said liquid vessel has an inlet 815 and an outlet 814. The outlet 814 is not lower than the inlet 815.

[0049] A self-powered pump 821 for heated liquid has an airtight container 8210 for containing heated secondary fluid, e.g. an anti-freezing liquid. The pump 821 has walls 8211 and 8212 to separate its outer and inner spaces. The inner space is filled with heated secondary liquid partially and has a upper air/vapor space 827 above liquid level surface 826 and a lower liquid space 825 under liquid level surface 826.

An inlet 822 and an outlet 823 are arranged on said wall of the container. Both inlet 822 and outlet 823 are under the secondary liquid level surface 826 in said container 8210. The inlet 822 is not lower than the outlet 823. A breathing channel 824 mounted on said wall of said container for connecting atmosphere with the inner upper air/vapor space 827 above liquid level surface 826.

The breathing channel 824 has a liquid vapor condensing and reflux structure 829. Its one end 8241 is above the liquid level surface 826. The breathing tube 829 having one end 8291mounted on said opening fitting 8241 under the liquid lever 826 in said container. The opposite end 8292 is out of the container. In the lower portion 8290, some condensed liquid is stored. The detailed structure of the breathing channel has discussed in details in Fig. 2 and 3. is as discussed before in Fig. 2 and Fig.3. It has a breathing channel 829 as discussed in Fig.3.

[0050] A heat exchanger 831 includes following components: A fluid reservoir 8310 is for primary fluid. The reservoir 8310 has a primary fluid inlet 836, a primary fluid outlet 835, a secondary fluid inlet 832 and a secondary fluid outlet 833. An apparatus 840 is disposed within reservoir 8310 for flow a secondary fluid, which is a liquid, through the reservoir 8310 in isolation from the primary fluid. This apparatus fluidly interconnects secondary fluid inlet 832 with said secondary fluid outlet 833. The secondary fluid inlet 841of said heat exchanger 831 is not lower than the secondary fluid outlet 842 of the heat exchanger.

[0051] First conduit 862 has ends 8621 and 8622. Second conduit 863 has ends 8631 and 8632. third conduit 861 has ends 8611 and 8611. The conduits connect the solar heat collector 811, self-powered pump 821 and the heat exchanger 831 to form a heat driven close-loop liquid flow circuit. For the reasons mentioned in Fig. 6., there is a heat driven power to circulate the secondary liquid and transfer the heat from solar heat collector 811 to the primary fluid within heat exchanger 831. Based on the discussion in Fig.1 –Fig 7, it is not difficult to understand how the system 810 works.

[0052] From above discussions, we can find that there is a possibility to circulate the heated liquid in a close-loop circuit without external power and pump. The heat received in heat collector can be transferred to a place where is higher, lower or the sane heighth comparing with the location of the heat collector. In the thermal industry, especially in solar hot water industry above results are desired.

[0053] Other modifications will be apparent to those skilled in the art and, therefore, the invention is defined in the claims.

WHAT IS CLAIMED IS:

1. A heat driven self-circulating device for a heated liquid for use with a liquid heat collector, comprising:

an airtight container for containing a heated liquid, said container having an upper air/vapor space located above a liquid level surface therein and a lower liquid space located below said liquid level surface;

said container having a heated liquid inlet and a heated liquid outlet wherein said heated liquid outlet is located below said liquid level surface in said container, and said heated liquid inlet is located not lower than said heated liquid outlet; and

a breathing channel for continuously connecting atmosphere with said upper air/vapour space ; said breathing channel having a liquid vapour condensing and refluxing structure.

2. The heat driven liquid self-circulating device according to Claim 1 wherein said device forms a part of a heat driven liquid self-circulating system, and said system further comprising:

a heat collector having a heat collector inlet and a heat collector outlet; said heat collector outlet being located not lower than said heat collector inlet;

a first connecting conduit having one end connecting to said heat collector outlet and an opposite end connecting to said heated liquid inlet wherein said heated liquid inlet is located not lower than the heat collector outlet.

3. The heat driven self-circulating device according to Claim 1 further comprising:

a primary fluid inlet for admitting a primary fluid in said container;
a primary fluid outlet for removing said primary fluid from said container;

a heat exchanger disposed within said device for flowing a secondary fluid, which is said heated liquid, through said container in isolation from said primary fluid, and said heat exchanger being fluidly interconnecting said secondary fluid inlet with said secondary fluid outlet; and said breathing channel being fluidly communicated with said secondary fluid within said heat exchanger.

4. The heat driven self-circulating device according to Claim 1 or 2 wherein said airtight container is Selected from a group consisting of:

a container of a heated liquid self-powered pump;

a fluid storage tank containing said heated liquid, said breathing channel being mounted on a wall of said tank, and said heated liquid inlet being located higher than said heated liquid outlet; and

a fluid storage tank with a heat exchanger, wherein said heated liquid is a secondary fluid and said heated liquid inlet is higher than said heated liquid outlet.

5. The heat driven liquid self-circulating system according to Claim 2 further comprising:

a second conduit connecting at one end therein to said heated liquid outlet of said self-circulating device, which is a heated liquid self-powered pump, and an opposite end connected to said heat collector inlet, said second conduit including three continued portions that are located higher, lower and at the same level respectively comparing with the location of said heat collector.

6. The heat driven liquid self-circulating system according to Claim 2 further comprising:

a second conduit having one end connecting to said heated liquid outlet and an opposite end connecting to said heat collector inlet; and

a fluid inlet and a fluid outlet arranged on the wall of said container.

7. The heat driven liquid self-circulating system according to Claim 2 further comprising:

a second conduit having one end connected to said heated liquid outlet and an opposite end connected to said heat collector inlet; wherein said airtight container is a fluid storage tank, and still further comprising:

a primary fluid inlet on said airtight container;

a primary fluid outlet on said airtight container;

a heat exchanger disposed within said storage tank for flowing a secondary fluid, which is said heated liquid, through said storage tank in isolation from said primary fluid, and said heat exchanger being fluidly interconnecting said secondary fluid inlet with said secondary fluid outlet, and

said breathing channel fluidly being communicated with said secondary fluid within said heat exchanger.

8. The heat driven liquid self-circulating device according to Claim 1 or 2 further comprising:

a fluid storage tank having a storage tank for a primary fluid, said storage tank having a primary fluid inlet, a primary fluid outlet, a heated liquid inlet and a heated liquid outlet; and

a heat exchanger disposed within said storage tank for flowing said heated liquid, which is a secondary fluid, through said storage tank in isolation from said primary fluid, said heat exchanger being fluidly interconnecting said heated liquid inlet with said heated liquid outlet and said heated liquid inlet of said fluid storage tank being located not lower than said heated liquid outlet of said fluid storage tank;

a second conduit having one end therein connecting to said heated liquid outlet of said heat driven self-circulating device, which is a self-powered pump, and an opposite end therein connecting to said heated liquid inlet of said fluid storage tank, wherein said heated liquid outlet of said self-powered pump is located not lower than said heated liquid inlet of said fluid storage tank; and

a third conduit having one end therein connecting to said heated liquid outlet of said fluid storage tank, and an opposite end therein connecting to said inlet of said heat collector.

9. The heat driven liquid self-circulating system according to Claim 2 further comprising:
a heat exchanger, comprising:

a fluid reservoir for a primary fluid, said reservoir having a primary fluid inlet, a primary fluid outlet, a heated liquid inlet and a heated liquid outlet; and a heat exchanger disposed within said reservoir for flowing said heated liquid which is a secondary liquid, through said reservoir in isolation from said primary fluid, said heat exchanger being fluidly interconnecting said heated liquid inlet with said heated liquid outlet; wherein said heated liquid inlet of said heat exchanger is located not lower than said heated liquid outlet of said heat exchanger;

a second conduit having one end therein connecting to said heated liquid outlet of said heat driven self-circulating device, which is a heated liquid self-powered pump, and an opposite end connected to said heated liquid inlet of said heat exchanger, wherein said heated liquid outlet of said self-powered pump is located not lower than said heated liquid inlet of said heat exchanger;

a third conduit having one end therein connecting to said heated liquid outlet of said heat exchanger, and an opposite end connecting to said inlet of said heat collector.

10. The heat driven self-circulating device according to Claim 1 or 2 wherein said container is selected from a group consisting of:

a heat insulated container;
a transparent container; and
an evacuated container.

11. The heat driven self-circulating device according to Claim 1 or 2 wherein said breathing channel comprising a fitting selected from a group consisting of:

a breathing fitting mounted on said wall of said container, which is located higher than said liquid level; and

a breathing fitting mounted on the wall of said container at a location below said liquid lever, a breathing tube having one end therein mounted ~~on~~ to said opening fitting, and a opposite end therein extending upwardly into the inner air/vapor space above said liquid level in said container.

12. The heat driven self-circulating device according to Claim 1 or 2 wherein said liquid vapour condensing and reclaiming structure is selected from a group consisting of:

a breathing fitting;

a tube connected to said breathing channel;

a tube having a lower end therein mounted on the breathing fitting of said container and a upper opposite end therein closed with a removable cup, a hall on the side wall of said tube for connecting said inner space above said liquid level in said container to atmosphere; a set of metal vapor condensing pieces disposed in said breathing tube operative for liquid vapor condensing and condensate refluxing;

a flexural pipe having a first end therein mounted at the breathing fitting of the airtight container and having a second end located higher than the first end and the liquid surface level;

a condensing airtight container for containing escaped heated liquid and vapor from said airtight container, said condensing airtight container having a inner tool for condensing the liquid vapour and a upper port open to atmosphere; a breathing pipe having a upper end extending upwardly into said airtight container and being mounted at the wall of said condensing airtight container, and an opposite end connected to said breathing fitting at said airtight container; and

an condensing airtight container for containing heated liquid vapor from said airtight container; a breathing pipe having one end extending upwardly into said condensing airtight container and being mounted at the bottom of said airtight container, and an opposite end of breathing pipe connected to said breathing fitting of said airtight container; a flexural breathing and condensing pipe having one end extending upwardly into said condensing airtight container and located within the condensing airtight container being located lower than the interior top side of said condensing airtight container, and an opposite end located outside of said condensing airtight container for condensing the escaped vapor and temporally storing the condensed liquid for reclaiming.

13. The heat driven liquid self-circulating system according to Claim 2 wherein said heat collector is selected from a group consisting of:

a solar heat collector; and
a heat insulated heat collector.

14. The heat driven self-circulating device according to Claim 1 or 2 further comprising one or more components selected from the group consisting of:

a fluid inlet, a fluid outlet, a pressure release valve, a electric heater and a drain.

15. The heat driven self-circulating device according to Claim 1 wherein said breathing channel comprising a pressure release valve whereby said device is operative as a pressure device.

16. A heat driven liquid self-circulating system having a heat driven self-circulating device for a heated liquid for use with a liquid heat collector, comprising:

an airtight container for containing a heated liquid, said container having an upper air/vapour space located above a liquid level surface therein and a lower liquid space located below said liquid level surface;

said container having an inlet of said heated liquid and an outlet of heated liquid wherein said heated liquid outlet is located below said liquid level surface in said container and said heated liquid inlet is located not lower than said heated liquid outlet; and

a breathing channel for continuously connecting atmosphere to said upper air/vapour space; said breathing channel having a liquid vapour condensing and refluxing structure.

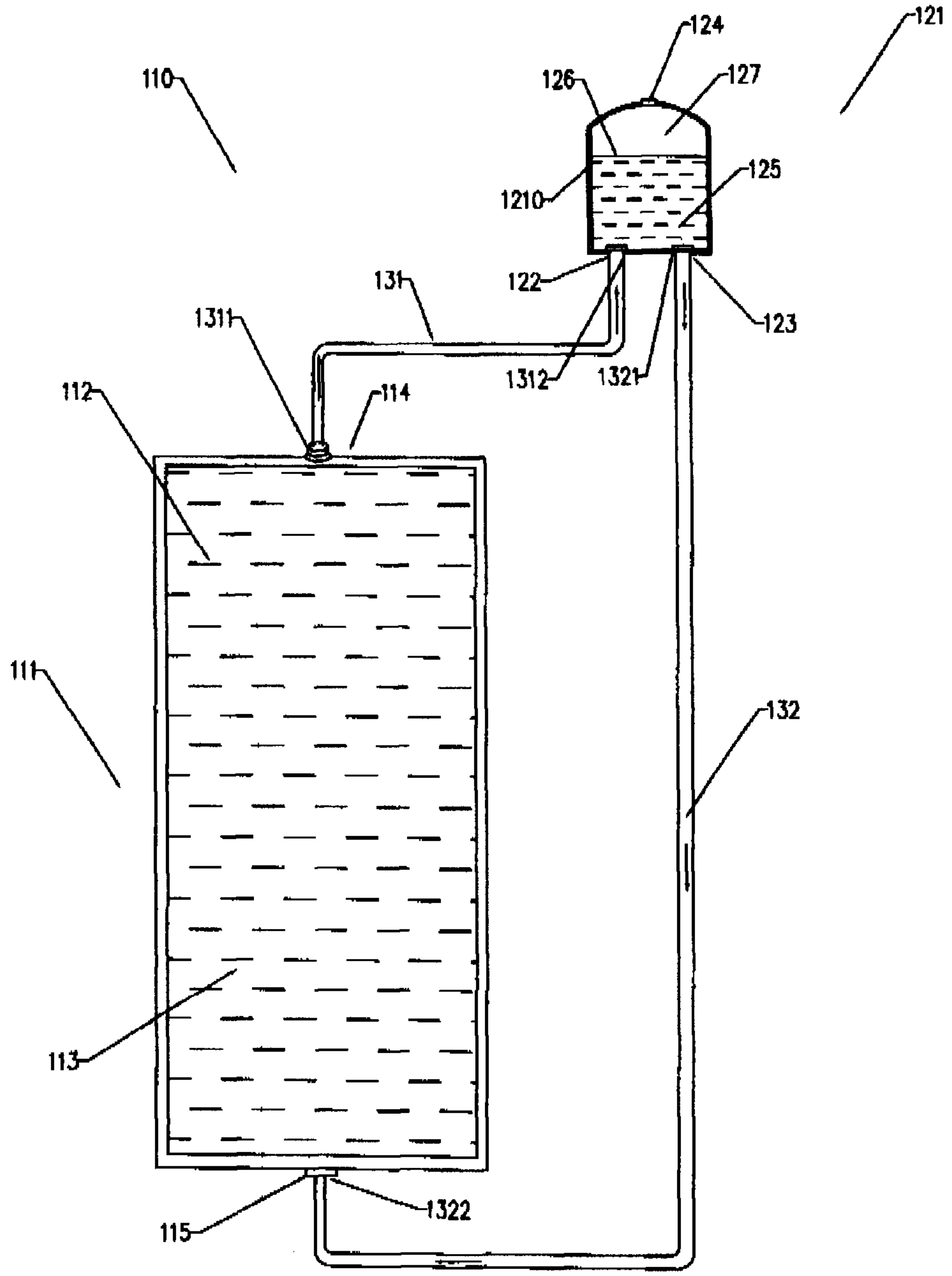

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FIG. 1

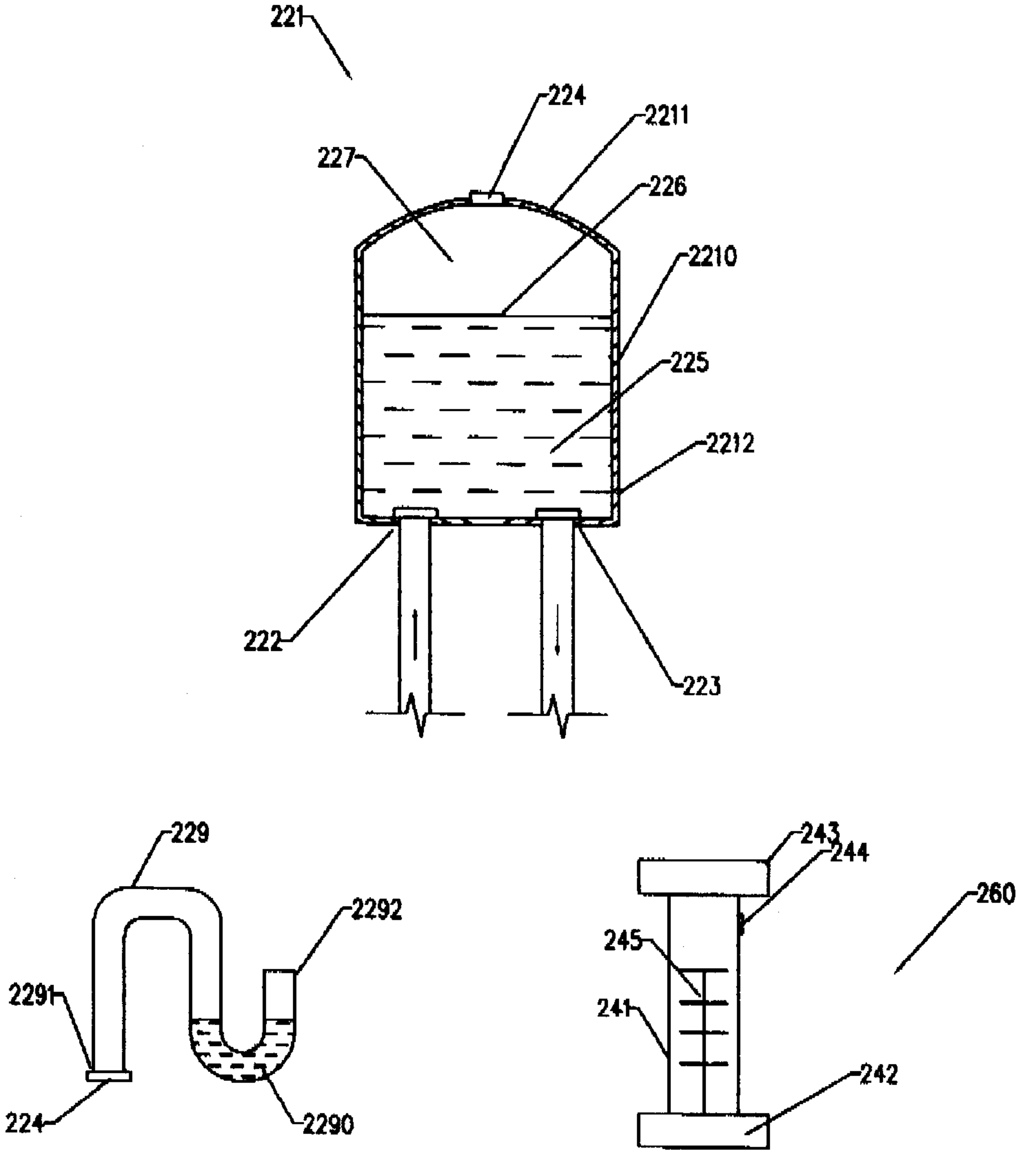
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FIG. 2

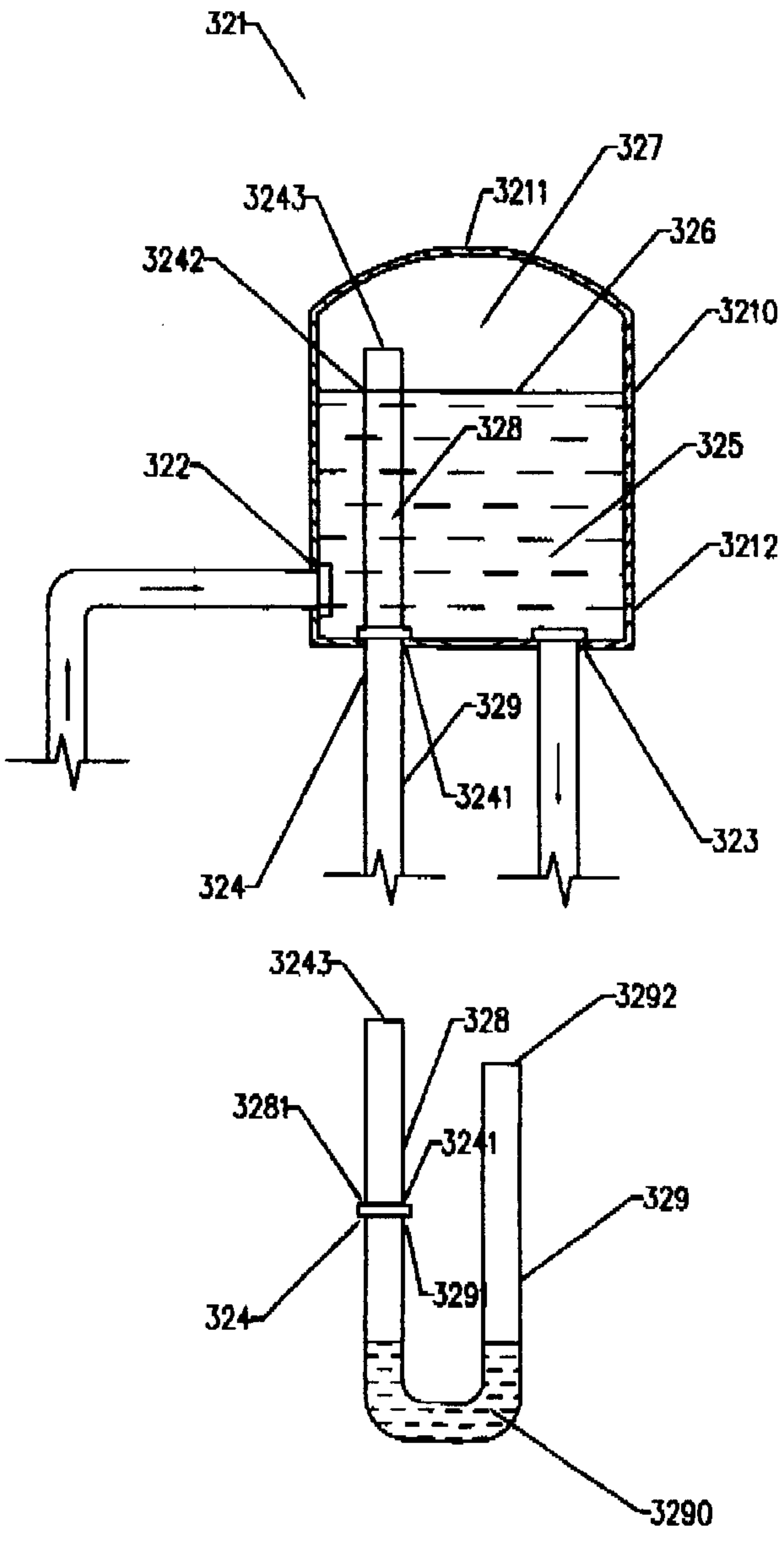
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FIG. 3

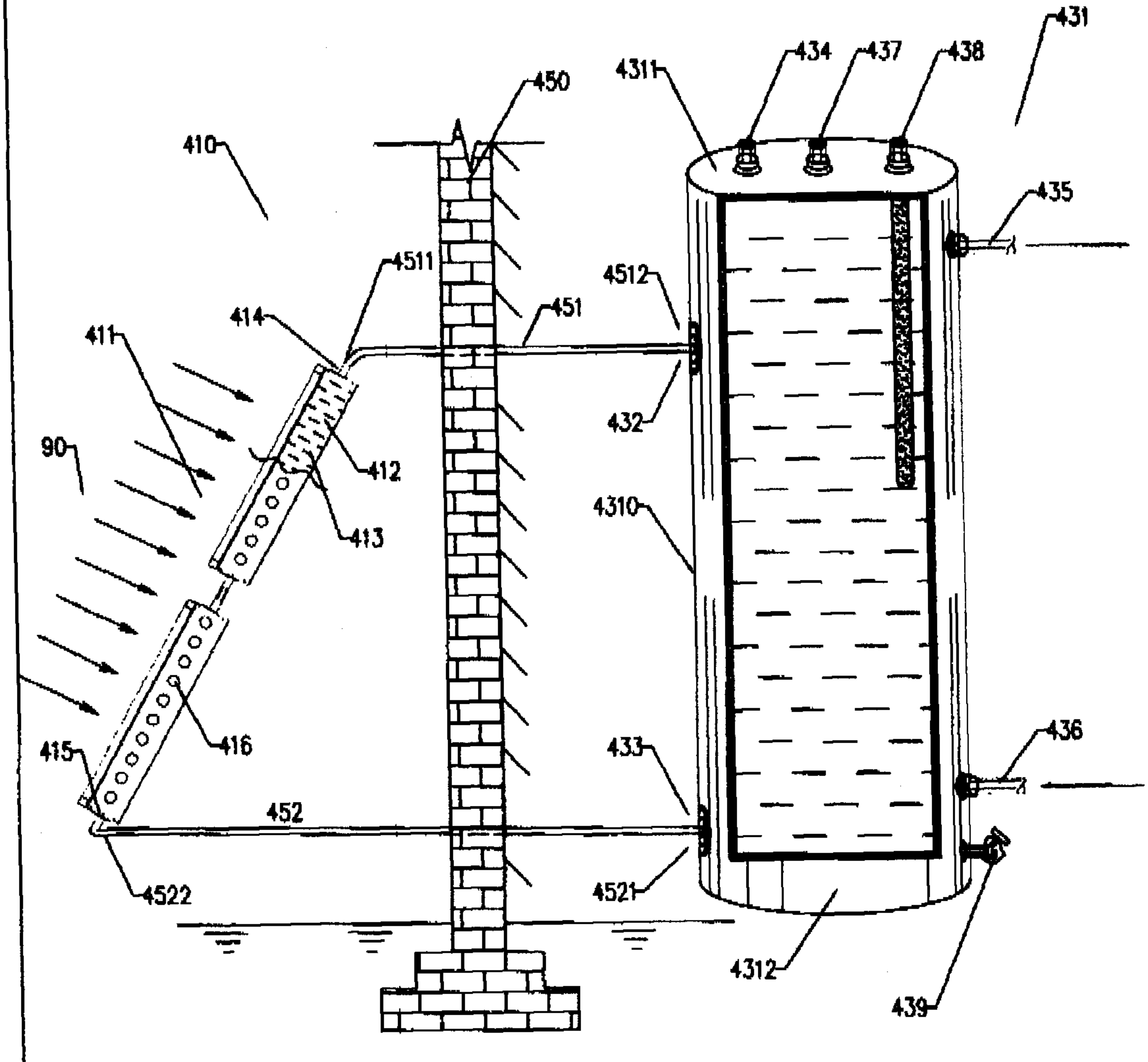

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FIG. 4

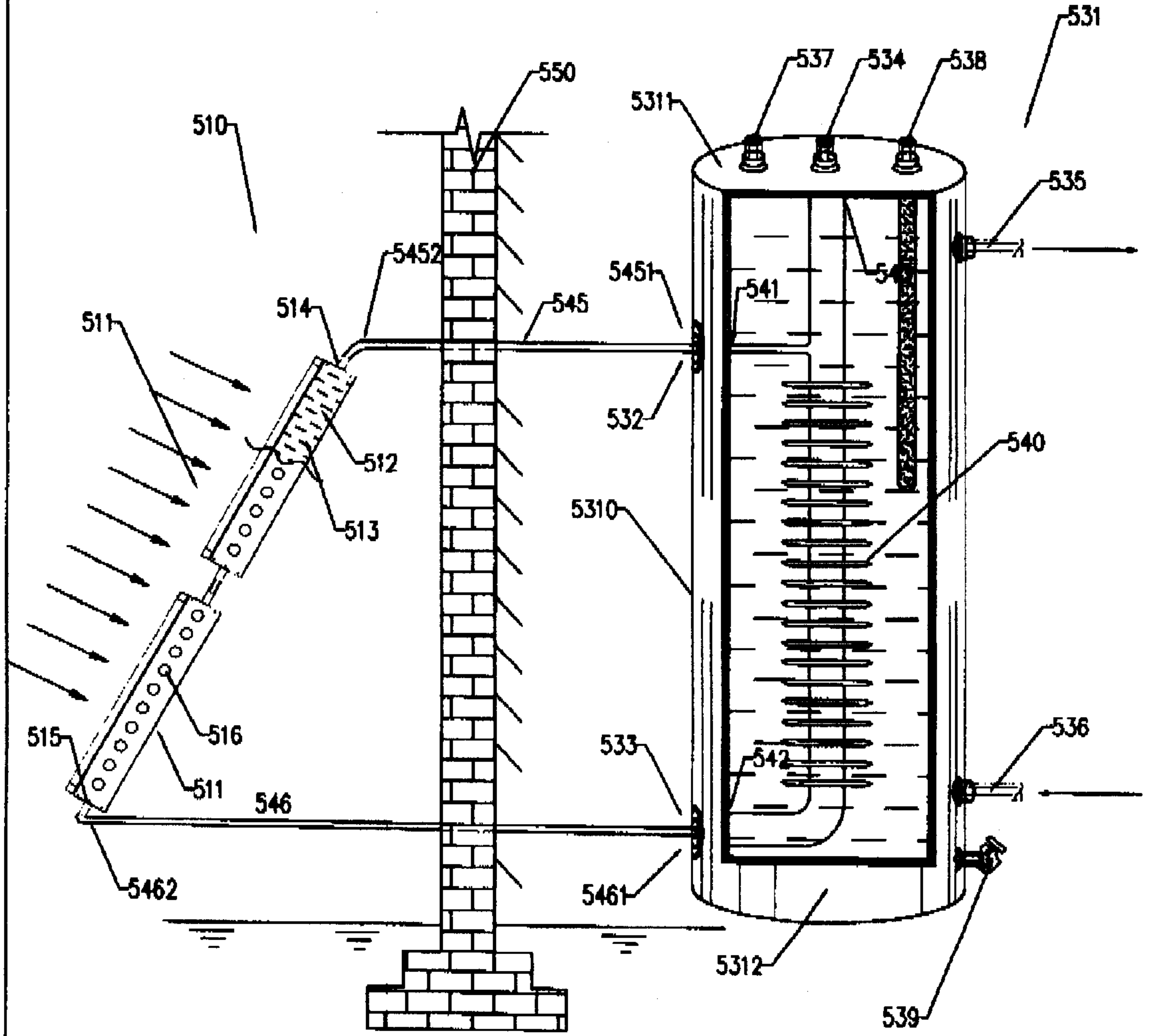
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FIG. 5

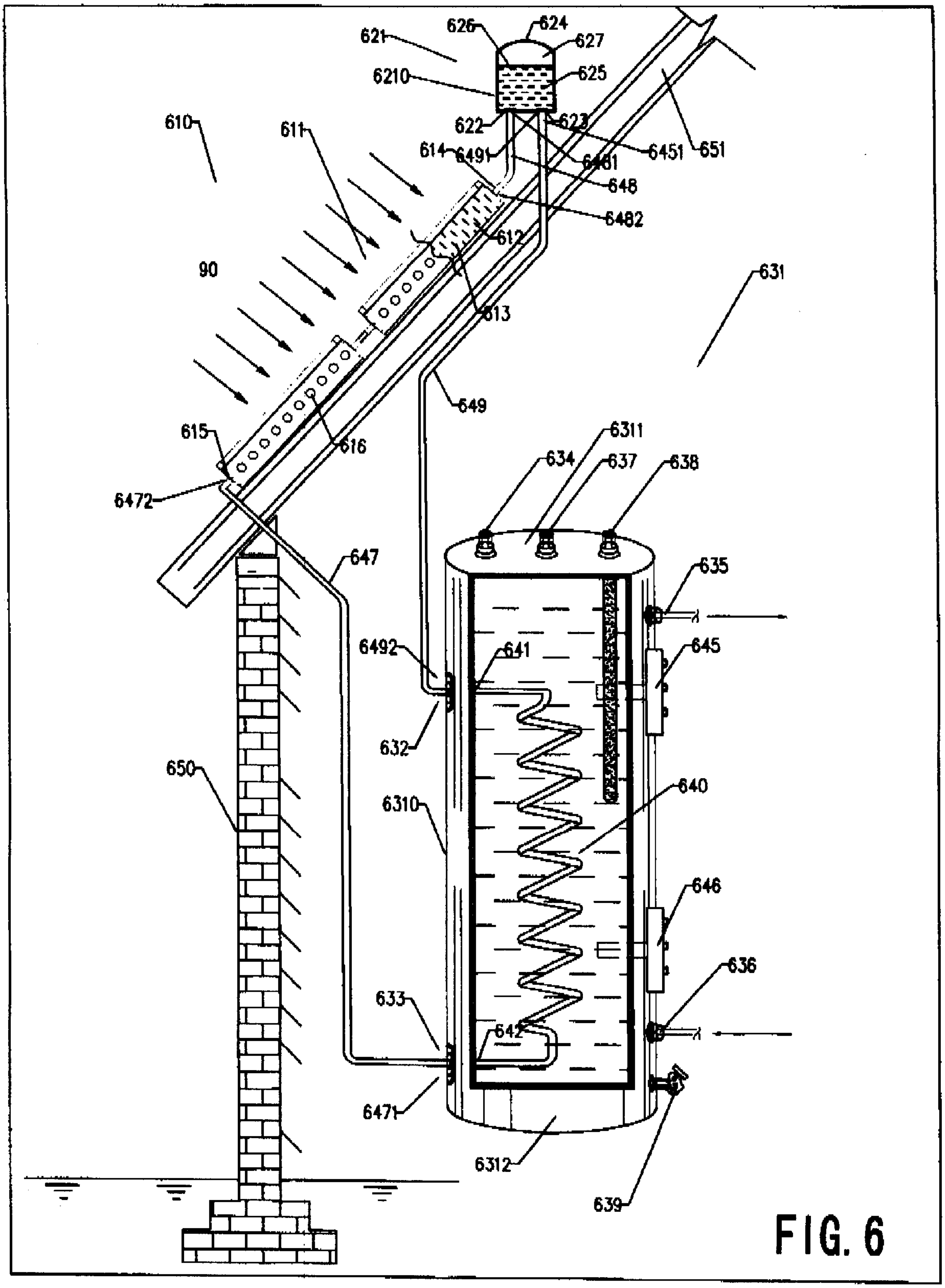
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FIG. 6

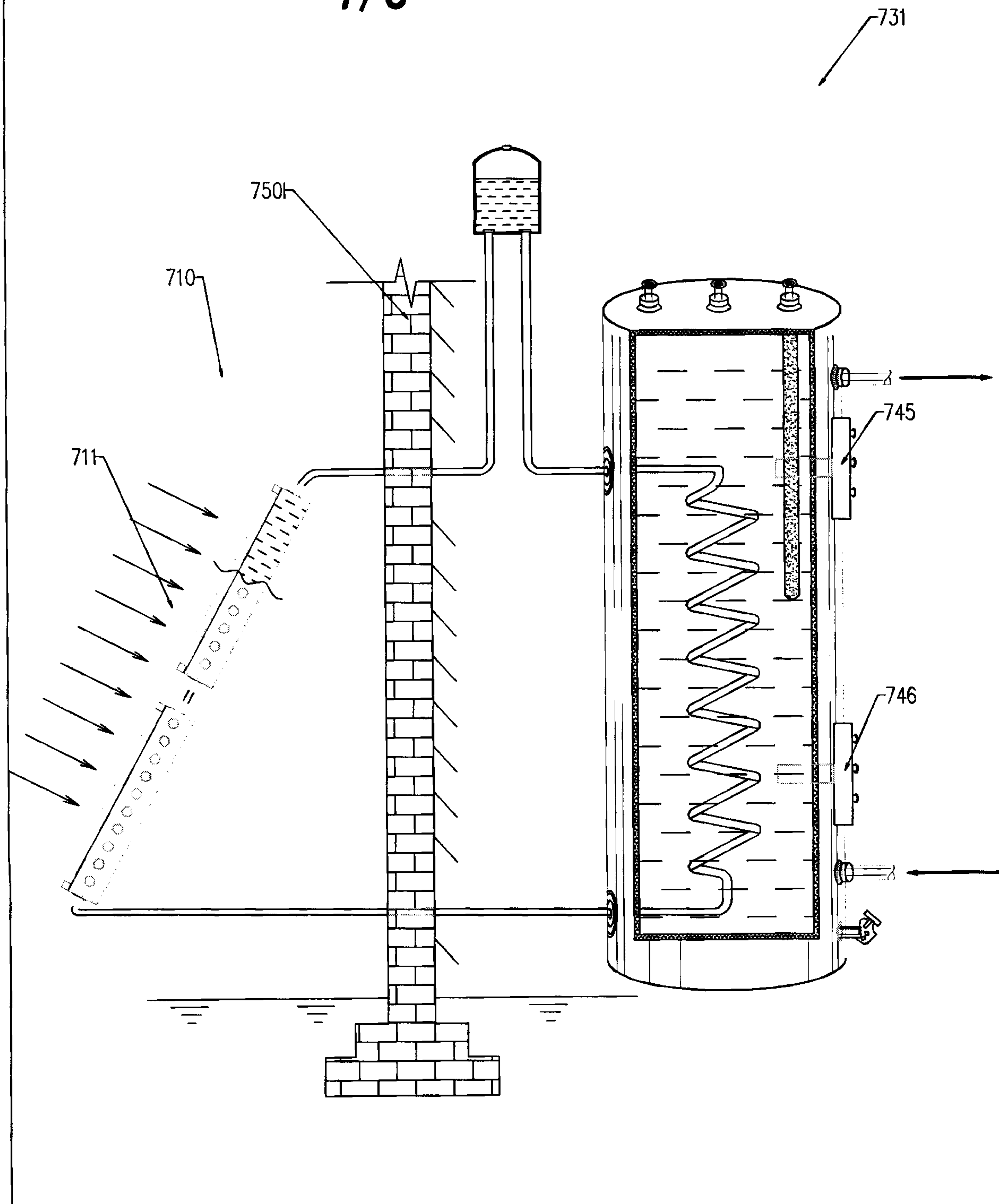

FIG. 7

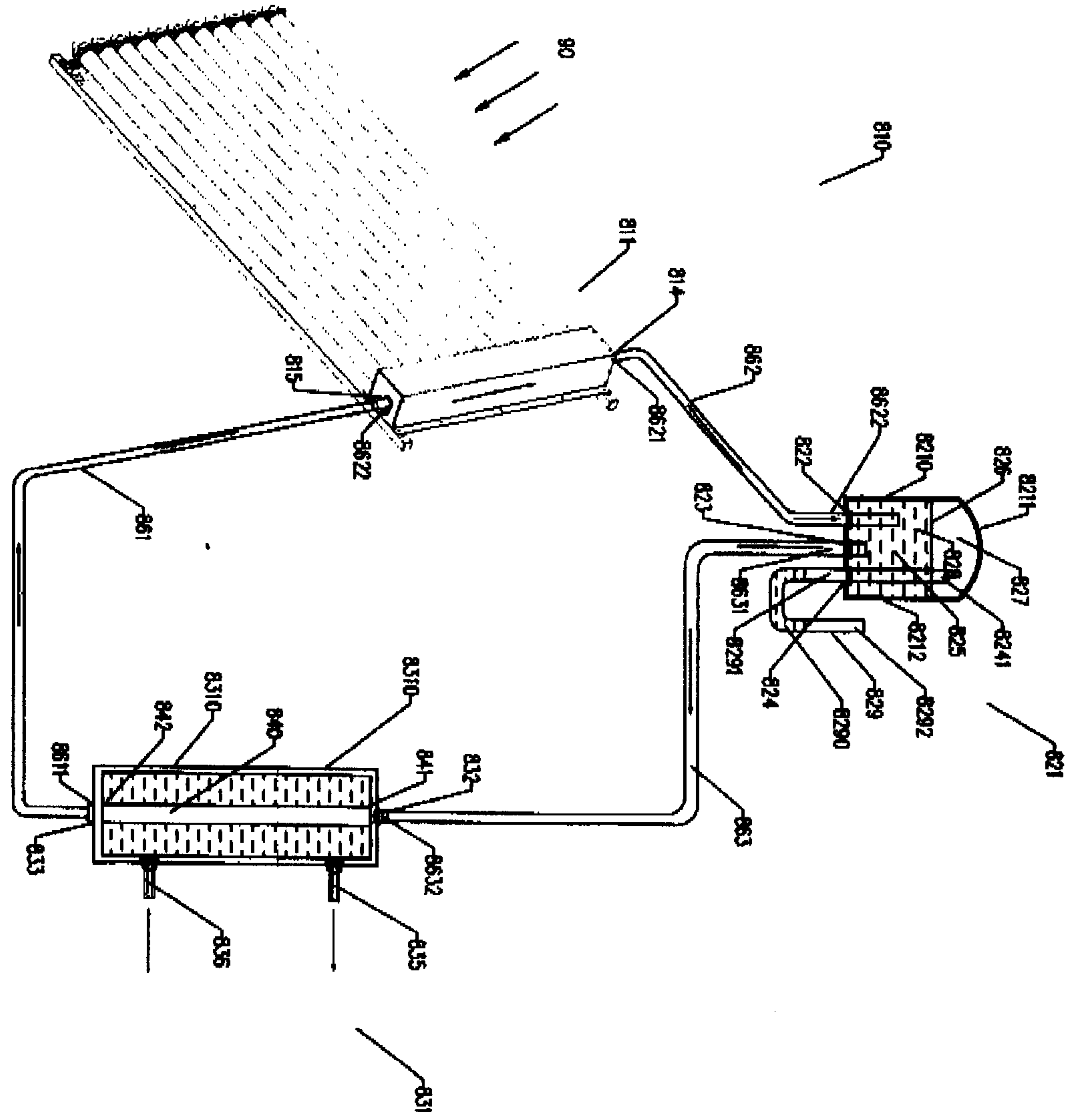
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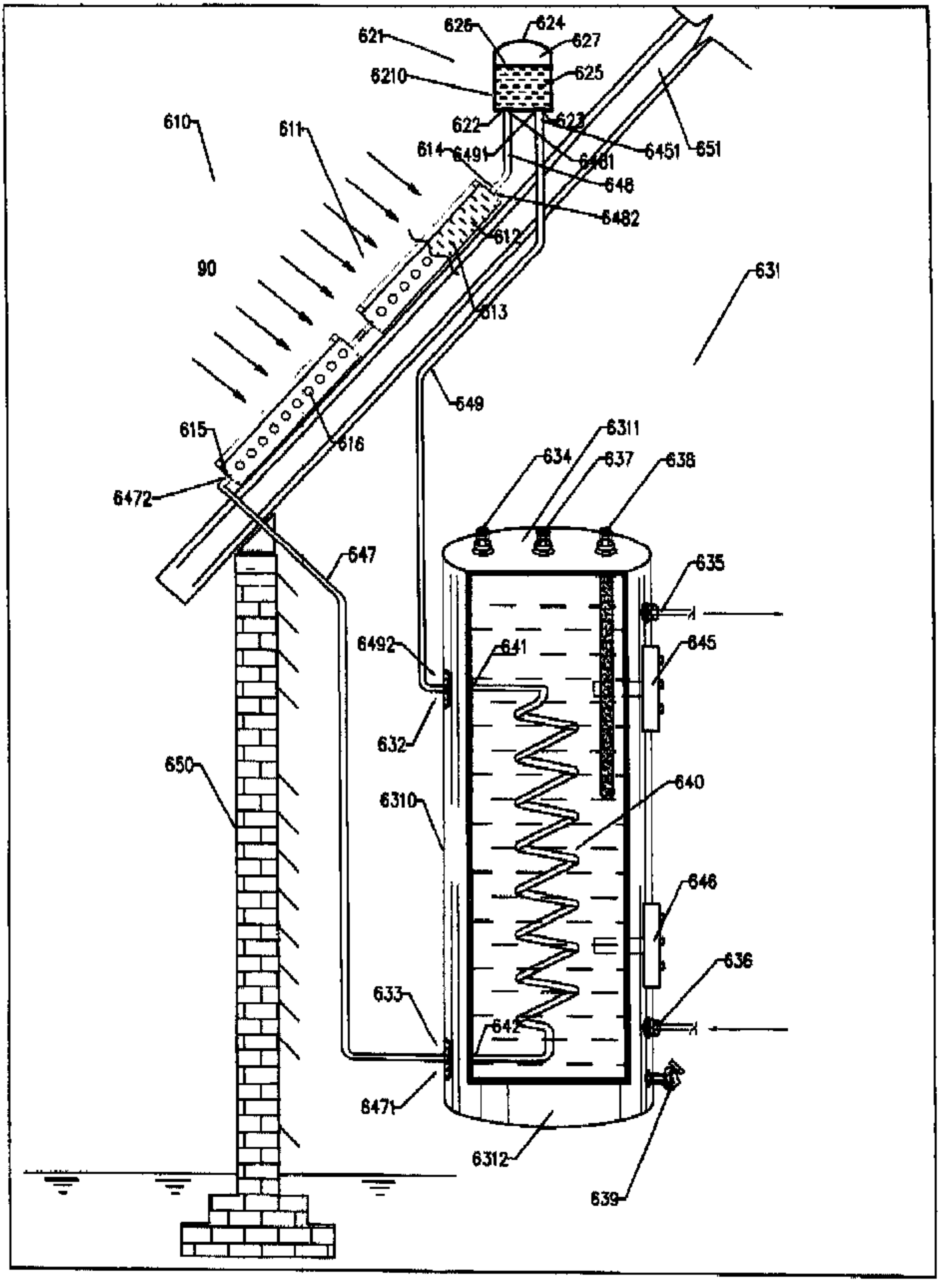
FIG. 8



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