



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
28.05.2014 Bulletin 2014/22

(51) Int Cl.:
F24H 4/04 (2006.01) F25B 1/00 (2006.01)

(21) Application number: **13382468.0**

(22) Date of filing: **22.11.2013**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(71) Applicant: **Energy Panel, S.L.**
14900 Lucena (ES)

(72) Inventor: **Marin Moscoso, Antonio**
14900 LUCENA (ES)

(74) Representative: **Hernández Hernández, Carlos**
Olten Consulting S.L.
C/ Entenca 332-334
08029 Barcelona (ES)

(30) Priority: **22.11.2012 ES 201231244 U**
20.05.2013 ES 201330609 U

(54) **Thermodynamic unit for hot water storage tanks (DHW) and composite capacitor**

(57) A thermodynamic unit comprising at least:
- a compressor (24), which draws out a refrigerant gas;
- a liquid container (16), which stores the coolant in a liquid state;
- a filter drier (17), which removes moisture from the circuit;
- and an expansion element which can be a thermostatic or electronic expansion valve (18).
- control and regulation means

which further comprises a capacitor, wherein the refrigerant gas which condenses with the flowing water due to heat exchange is inserted, which may be located inside or outside the thermodynamic unit, in which case it would be a composite capacitor, which, in addition to the medium of heat exchange between a fluid and the water, it comprises an electrical resistor and a sheath to house a temperature probe. The unit may have an evaporator housed on the inside, or may be connected to one or several direct expansion solar collectors.

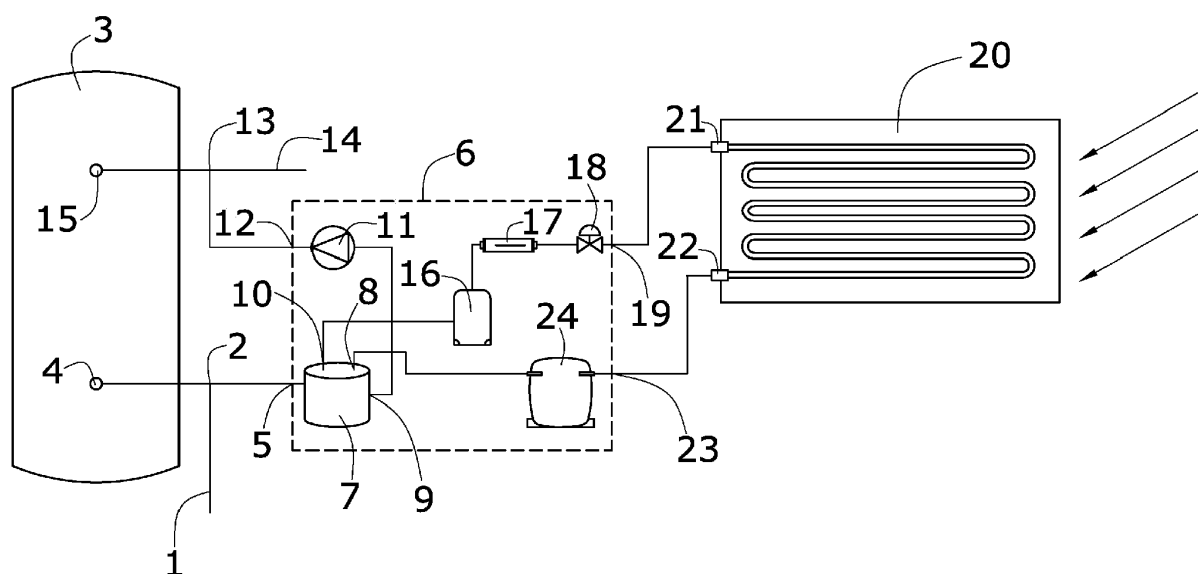


FIG.1

Description**OBJECT OF THE INVENTION**

[0001] The object of the invention herein is a thermodynamic unit for hot water storage (DHW), and a specially designed composite capacitor for one of the embodiments of the thermodynamic unit.

[0002] The special design features of each and every one of the elements that form part of the thermodynamic unit, as well as being arranged associated with the hot water storage tank, and with one or several direct expansion solar collectors or forced convection evaporators characterise the invention herein, thereby achieving an assembly, enabling a constructive improvement of existing heat pumps, and its adaptability, such that it can be connected to any type of evaporator.

[0003] Therefore, the invention herein relates to heat pump systems that use a refrigerant gas compression cycle.

BACKGROUND OF THE INVENTION

[0004] Heat pump systems that use a compression refrigeration circuit are very well known in the current state of the art.

[0005] The basic functional components of a heat pump and their function are: a compressor, which suctions and raises the pressure of the coolant; a capacitor, which condenses the gas from the compressor; an expansion element, where the coolant loses pressure and temperature; and an evaporator, where the fluid evaporates by extracting heat from a source. It also has auxiliary elements such as the liquid container, located at the capacitor outlet in order to collect the liquid from the condensing refrigerant, having the function of storing said liquid based on the requirements of the compressor, the filter drier, which filters the possible small droplets of moisture that may run through the circuit, and other elements such as a sight glass and pressure switches, etc.

[0006] These elements are integrated with a water tank to form the heat pump for obtaining hot water, which has several variations, depending on the type and position of the evaporator and capacitor used, yet it is not possible to be built into an existing tank.

[0007] However, the inventor has no knowledge, up to the present time, of a thermodynamic unit such as the one proposed, consisting of the compressor, capacitor, liquid container, the filter drier, the expansion element and a water impeller pump, offering the possibility of incorporating a forced air evaporator therein, such that there is a system that enables the coupling of a heat pump system in tanks that are already installed, which may have another source of energy, facilitating the installation of the unit, as it only has two hydraulic connections that connect to the power supply and tank outlet, and two gas outlets, which are connected to the evaporator, and which provide technical advantages, as even-

rything is built into one single unit.

DESCRIPTION OF THE INVENTION

[0008] Specifically, the object of the invention is a block integrating the thermodynamic elements required for operating the heat pump, with the option of including the evaporator or not, and the capacitor, as may be required, which may be coupled to the connections of any tank that has already been installed.

[0009] In a possible embodiment, the thermodynamic unit has a capacitor or enthalpy exchanger housed inside the same block, in which case it comprises:

- a compressor which draws out the refrigerant gas;
- a capacitor, where the refrigerant gas which condenses with the flowing water due to heat exchange is inserted, which may be formed by a water-gas enthalpy exchanger, comprising a container including a coil where the refrigerant gas which condenses with the flowing water inside the container due to heat exchange is inserted, or by a plate heat exchanger or a number of concentrically arranged tubes, or any other medium that allows heat exchange between the gas and circulating water;
- a liquid container that stores the coolant in a liquid state;
- a filter drier which removes moisture from the circuit;
- and an expansion element which can be a thermostatic or electronic expansion valve. In addition, in order to impel the water such that it circulates, there is an impeller pump, located between the capacitor outlet and the outlet of the aforementioned assembly;
- control and regulation means.

[0010] In another alternative embodiment, the thermodynamic unit shall comprise the same aforementioned elements, except the capacitor which shall be located outside the thermodynamic unit, a composite capacitor being formed by an electrical resistor and the capacitor or heat exchanger itself, and a sheath to house a temperature probe, a controller device being arranged in the thermodynamic unit, which, in addition to the elements in the thermodynamic unit, it would control the electrical resistor.

[0011] In the case of producing a compact thermodynamic unit, namely, that has all the necessary elements for the heat pump to operate integrated into an assembly, having the evaporator included or not, the aforementioned assembly is mounted on a compact casing which may be any material necessary for which it is intended, which has four fluid connections, two hydraulic connections (inlet and outlet) and two gas connections (gas inlet and outlet), and the electrical connection.

[0012] In addition to controlling the thermodynamic unit itself, the control and regulation means of the compact thermodynamic unit receive the temperature signal from

a sensor installed on the hot water storage tank.

[0013] In this manner, the device is connected to the water tank supply, which is introduced into the capacitor, where it captures the energy from the coolant in a gas state, and therefore, the water is heated and the fluid is condensed. The hot water is forced to the outlet pipe of the tank by the pump, and fed back into it, being continuously recirculated. For its part, the fluid leaves the capacitor in a liquid state, and travels to the liquid container, filter and expansion element, and exits the unit towards the evaporator. When it has evaporated, it re-enters therein, and enters the compressor, which impels it to the capacitor, thereby closing the cycle.

[0014] The evaporator of the heat pump circuit may be formed by one or several direct expansion solar collectors (also known as thermodynamic panels), or a forced convection evaporator. In this way, the installer only has to wire the connections between the tank and the block, and the block and the evaporator.

[0015] There is the possibility of greater integration of the assembly, incorporating a forced convection evaporator therein, which by means of forced air evaporates the aforementioned refrigerant gas. Therefore, in this case, there will only be hydraulic connections and the electrical connection.

[0016] The device will include all ancillary, electrical, control and regulation elements necessary in order to operate properly.

[0017] It is possible to produce the thermodynamic unit for hot water storage tanks (DHW) in an alternative manner, that does not have the capacitor built into a block, and may, as in the previous case, have the evaporator built into the same block or not. In this case the thermodynamic unit shall comprise:

- a compressor which draws out the refrigerant gas;
- a liquid container that stores the coolant in a liquid state;
- a filter drier which removes moisture from the circuit;
- and an expansion element which can be a thermostatic or electronic expansion valve;
- control and regulation means.

[0018] In this case, where the thermodynamic unit has no housed capacitor inside a same assembly, the unit has at least two fluid connections for the flow and return to the capacitor outside the unit; in the event the evaporator is not built into the unit, it will have two other outlets thereto.

[0019] The capacitor used for this embodiment of a thermodynamic unit without the capacitor, exhibits unique characteristics that make it a composite capacitor comprising a part which includes an electrical resistor, a sheath for a thermostat and a capacitor for the heat pump circuit built into a base that can be secured to a hot water storage tank, the gas and electrical connections for connecting to the thermodynamic unit emerging from said base.

[0020] In addition to controlling the systems of thermodynamic unit, the control and regulation means control the action of the electrical resistor and receive the signal from the temperature probe of the composite capacitor.

[0021] The condenser, which forms part of the composite capacitor, can be made of any material. It comprises a moulded tube to form a helical coil which externally surrounds the whole or most of the surface of the electrical resistor and the sheath, where appropriate. The last section of the aforementioned tube is curved in order for it to lower parallel to the axis of the aforementioned coil. The number of turns and the pitch thereof will be determined by the dimensions of the electrical resistor, and those available in the tank where it is going to be installed. In turn, the capacitor can be made in a double-walled or finned tube, depending on user needs.

[0022] The aforementioned coil leaves a free cylindrical volume which encompasses the entire inner diameter of the propeller, and with the height determined by the height of the coil. This free volume is used for fitting the necessary electrical resistor and the sheath for the thermostat, where applicable.

[0023] Different types or geometric shapes of the aforementioned electrical resistor may be used. For example, a U-shaped tube with built-in connections, or a cylindrical tube where the resistor is incorporated inside, and which can be changed if necessary.

[0024] Likewise, the invention provides the possibility of including the thermostat sheath in this hollow cylindrical free volume left by the coil, and next to the electrical resistor. Or alternatively, there is the possibility of fitting said sheath on the outside of the capacitor coil built into the connector. The position of the thermostat sheath depends on the shape of the electrical resistor and dimensions available at the base of the connector. The sheath may have various configurations such as a cylindrical tube or rod.

[0025] Both the aforementioned capacitor, and the resistor and the sheath are attached to the connector by soldering or another bonding method, either physical or chemical. The connector is made from a compatible material and has a base with the holes necessary for inserting the flow and return capacitor tube, the electrical resistor and the sheath. The lateral portion of the part has a threaded surface for insertion into a hole or an accessory that has the equivalent diameter.

[0026] The invention offers the possibility of incorporating an anode of any type, in the aforementioned available hollow formed by the helical coil or on the outside of the coil, as appropriate. In this case, the thread will have the relevant hole.

[0027] All or some of the elements may have a specific coating depending on the application.

[0028] We therefore believe that the composite capacitor device can be installed in any tank, both open and pressurised, which may already have a heating source installed or not, making this a tank with two heat sources that can be used simultaneously; a heat pump when it is

connected thereto (with the ensuing savings provided by the COP thereof), and electrical resistance.

[0029] We understand therefore that the device presented herein is a constructive improvement of existing heat pumps, as it can be built into tanks that are already installed, and, in addition, its adaptability means it can be connected to any type of evaporator. Furthermore, and advantageously, its ease of assembly and compact presentation should be noted.

[0030] Therefore, it is object of the invention, both the thermodynamic units developed for generating hot water in hot water storage tanks, and in systems in which said thermodynamic units are built into, and the composite capacitor used in combination, with one of the embodiments of the thermodynamic units, all being linked by the fact that they use a heat pump or thermodynamic unit to generate hot water in combination with a tank, and with either a forced convection evaporator or one or several direct expansion solar collectors.

DESCRIPTION OF THE DRAWINGS

[0031] As a complement of the description being made and for a better understanding of the characteristics of both the thermodynamic unit for DHW tanks in their various embodiments, and the composite capacitor created, attached to the present descriptive memory and as an integral part thereof, the following figures are shown:

Figure 1 shows a diagram of the elements comprising the compact thermodynamic unit for DHW tanks and their connection to a tank and an evaporator.

Figure 2 shows a diagram of the preferred embodiment of the composite capacitor being used to obtain hot water.

Figure 3 shows a detailed view of a composite capacitor including its components

Figure 4 shows a detailed view of the composite capacitor without the copper coil for easier viewing.

Figure 5 shows a perspective view of the base of the connector from the rear.

PREFERRED EMBODIMENT OF THE INVENTION

[0032] In view of the figures, a preferred embodiment of the proposed invention is described below.

[0033] Figure 1 shows the elements constituting the thermodynamic unit for DHW tanks (6) in a compact embodiment, namely, which include the capacitor and its installation in a DHW tank (3) and its respective evaporator, which in this preferred embodiment is a direct expansion solar collector (20).

[0034] The mains water is fed via the feed pipe (1), where a T-shaped connection (2) is made, from where

the cold water is branched into the tank (4), and the power is fed to the compact thermodynamic unit (5). The water feed enters the condenser, which in this preferred embodiment is a gas-water enthalpy exchanger (7), where the gas enters the gas inlet (8) to the exchanger, connected to a coil in the container, wherein said gas transfers heat to water, and thus the condensation of the gas and the heating of the water is achieved. The hot water exiting the exchanger water drain (9) enters the impeller pump (11) and exits the compact unit through the unit's water outlet (12). In the hot water outlet pipe (14) of the tank (3), there is a division (13) through which the hot water obtained from the thermodynamic unit to the tank (3) is fed, entering the tank (3) via the tank supply outlet (15).

[0035] The condensed gas, obtained via the gas outlet (10) of the exchanger enters the liquid container (16), and then travels towards the filter drier (17), and is passed through the expansion element, which in this preferred embodiment is a thermostatic expansion valve (18), wherein the fluid begins to expand, and is evacuated through the gas outlet of the unit (19), towards the evaporator, which in this preferred embodiment is a direct expansion solar collector (20). The fluid enters through the gas inlet of the collector (21), in which the capture of energy from the environment and solar radiation is produced by evaporating the coolant exiting the collector outlet (22), and travels to the gas inlet of the unit (23) connected to the compressor (24), which raises the pressure of the refrigerant gas, and impels it into the gas-water enthalpy exchanger (7), thereby closing the cycle.

[0036] The compact thermodynamic unit for DHW tanks (6) is shown as a dotted line where the elements that comprise it are located inside. In addition, it has an electrical connection that is not shown.

[0037] Figure 2 shows an alternative embodiment of the thermodynamic unit, which as such, unlike the previous case, no longer houses the capacitor inside.

[0038] In respect of the evaporator, as already explained above, both in the embodiment of the thermodynamic unit with or without a built-in capacitor, it may or may not form part of the unit. In the embodiment shown, it does not form an integral part thereof, being a direct expansion solar collector (20).

[0039] The thermodynamic unit (26) comprises:

- a compressor (24), which draws out the refrigerant gas;
- a liquid container (16), which stores the coolant in a liquid state;
- a filter drier (17), which removes moisture from the circuit;
- and an expansion element which may be a thermostatic or electronic expansion valve (18);
- a controller device (25) for controlling a capacitor.

[0040] The thermodynamic unit (26) is connected to the tank (3) to obtain hot water by means of a composite

capacitor (27).

[0041] The composite capacitor (27), as seen in Figure 2 comprises:

- a base (27.1) that has means for connecting to the tank (3) and on which the following are arranged and fixed:
- an electrical resistor (27.2);
- a sheath (27.3) or cylindrical tube inside of which a temperature probe is inserted;
- a coil (27.4), which in a possible embodiment can be helical and which surrounds the electrical resistor (27.2) and the sheath (27.3);
- connection means between the aforementioned elements and the outside.

[0042] Figure 2 shows that the coil (27.4) that acts as a capacitor is formed by a tube of any compatible material that can be used to form it. The coil tube (27.4) is straight in a first section, the flow section (27.5) and after it has been wound into a spiral with a diameter larger than that occupied by the electrical resistor (27.2) and the sheath (27.3) but smaller than that of the base (27.1) in order to be inserted easily into the tank (3). The last section of the tube which forms the coil (27.4), return section (27.6) is a straight section from the upper end of the coil to the end thereof, passing through the base (27.1).

[0043] The base (27.1) of the composite capacitor comprises two bores (27.7) and (27.8) to which the flow section (27.5) and the return section (27.6) respectively are soldered.

[0044] The electrical resistor (27.2), in a possible embodiment, takes on a "U" shape inside of which there is an electric line necessary for supplying the Joule heat to the fluid to be heated. Said electrical resistor (27.2) passes through the base (27.1) through a number of bores (27.9) made on the base (27), while the sheath (27.3) which houses the temperature probe passes through the base (27.1) through a bore (27.10).

[0045] The base (27.1) of the composite capacitor, in a possible embodiment, and preferably, has a means for fastening to the hot water tank (3) by means of a perimeter threading (27.11).

[0046] Finally, Figure 5 shows the connection means towards the outside from the elements installed on the composite capacitor, while Figure 2 shows the connections made between the connection means of the composite capacitor (27) and the thermodynamic unit. Hence, the composite capacitor (27) comprises:

- a number of electrical terminal (27.12) connections, and which are connected via a connection cable (30) to the controller device (25) of the thermodynamic unit (26);
- a number of temperature probe terminals (27.13), which are connected via the cable (31) to the controller device (25) of the thermodynamic unit (26);
- a straight connector terminal or flow section (27.5)

of the coil (27.4) connected via the connection pipe (28) to the compressor (24) of the thermodynamic unit (26);

- a straight connector terminal or return section (27.6) of the coil (27.4) connected via the connection pipe (29) to the liquid container (16) of the thermodynamic unit (26).

[0047] The thermodynamic unit (26), in one possible embodiment, and as shown in Figure 2, is connected to a direct expansion solar collector (20), which acts as an evaporator for the circuit

[0048] In this manner, the thermodynamic unit, shown in Figure 2, with the aid of the composite capacitor shown in Figures 3 to 4 enable a system for generating hot water to be obtained, wherein the refrigerant gas leaves the compressor (24) at high pressure and temperature and is directed to the composite capacitor (27), where it is inserted via the flow section (27.5) of the capacitor, wherein one possible embodiment has the shape of a coil (27.4). The composite capacitor (27) is immersed in the water inside the tank (3), and due to the temperature gradient between the gas inside the coil (27.4) and of the capacitor and the water, the gas condenses throughout the whole surface of the coil (27.4) discharging its energy to the water, which, in turn, is heated. When it returns, the refrigerant leaves the coil (27.4) via the return section (27.6) thereof and is reintroduced into the thermodynamic unit (26), by connecting to the liquid container (16), and the coolant is then carried to the filter drier (17), and after this to the expansion element, which in this preferred embodiment is a thermostatic expansion valve (18), wherein the fluid begins to expand. The thermodynamic unit (26) in this preferred embodiment comprises an evaporator consisting of a direct expansion solar collector (20) connected thereto. In this manner, the fluid exiting the thermostatic expansion valve (18) enters through the gas inlet of the collector (32), in which the capture of energy from the environment and solar radiation is produced by evaporating the coolant exiting the collector outlet (33), and returns to the thermodynamic unit (26) via its connection with the compressor (24), which raises the pressure of the refrigerant gas, and impels it again to the composite capacitor (27), thereby closing the cycle.

[0049] The controller (25) of the thermodynamic unit (26) interprets the signals obtained by means of the probe wire (31) of the temperature probe (27.13) which is inside the sheath (27.3) of the composite condenser (27) and actuates on the elements in the thermodynamic unit (26) and/or the electrical resistor (27.2) built into the composite capacitor (27) via the appropriate cable (31).

[0050] The final appearance of thermodynamic unit for DHW tanks, whether it is compact or not, can be as varied as the designs to be made thereof, while always maintaining the essential technical requirements in order to operate.

[0051] It is deemed unnecessary to provide more comprehensive content to this description for a person skilled

in the art to understand its scope and advantages derived from the invention, and to develop and carry out the practical implementation thereof.

[0052] Having sufficiently described the nature of this invention and how to implement it, it is noted that, within its essential nature, it may be applied in other embodiments that differ in detail from that shown, by way of example, and which will also be protected, provided its fundamental principle is not altered, changed or modified.

Claims

1. Thermodynamic unit for hot water storage tanks **characterised in that** it comprises at least the following inside a single block:

- a compressor (24), which draws out a refrigerant gas;
- a capacitor (7), where the refrigerant gas which condenses with the flowing water due to heat exchange is inserted;
- a liquid container (16), which stores the coolant in a liquid state;
- a filter drier (17), which removes moisture from the circuit;
- and an expansion element which can be a thermostatic or electronic expansion valve (18);
- an impeller pump (11) to boost the flow of water, located between the capacitor outlet and the outlet of said assembly;
- two hydraulic connections (water inlet (5) and outlet (12));
- control and regulation means.

2. Thermodynamic unit, according to claim 1, **characterised in that** there is at least one forced convection evaporator built into the block, which by means of forced air evaporates the aforementioned refrigerant gas.

3. Thermodynamic unit, according to claim 1, **characterised in that** the block has two gas connections (one inlet (23) and one outlet (19) for connection to at least one direct expansion solar collector (20).

4. Thermodynamic unit according to any of the claims 1 to 3 **characterised in that** the capacitor is either:

- a water-gas enthalpy exchanger, comprising a container including a coil inside of which the cooling fluid circulates, and wherein the water circulates in the space between the coil and the container;
- or a plate heat-exchanger;
- or by a number of concentrically arranged tubes.

5. System for generating hot water in a tank **characterised in that** it comprises:

- a thermodynamic unit housing at least the following inside a same block:

- a compressor (24), which draws out a refrigerant gas;
- a capacitor (7), where the refrigerant gas which condenses with the flowing water due to heat exchange is inserted;
- a liquid container (16), which stores the coolant in a liquid state;
- a filter drier (17), which removes moisture from the circuit;
- and an expansion element which can be a thermostatic or electronic expansion valve (18);
- an impeller pump (11) to boost the flow of water, located between the capacitor outlet and the outlet of said assembly;
- two hydraulic connections (water inlet (5) and outlet (12));
- an evaporator, either housed inside the previous block, or external thereto, in which case it is one or several direct expansion solar collectors (20);
- a hot water storage tank (3) to which the hydraulic connections (5) and (12) are connected.

6. Thermodynamic unit for hot water storage tanks **characterised in that** it comprises at least the following inside a single block:

- a compressor (24), which draws out the refrigerant gas;
- a liquid container (16), which stores the coolant in a liquid state;
- a filter drier (17), which removes moisture from the circuit;
- and an expansion element which may be a thermostatic or electronic expansion valve (18);
- a controller device (25) for controlling the thermodynamic unit;
- at least two fluid connections for the flow and return of the thermodynamic unit;
- a number of electrical connections between the controller device (25) and an outer capacitor (27).

7. Thermodynamic unit for hot water storage tanks according to claim 6, **characterised in that** there is at least one forced convection evaporator inside the block, which by means of forced air evaporates the aforementioned refrigerant gas.

8. Thermodynamic unit, according to claim 6, **characterised in that**

terised in that the block has two gas connections (one inlet (23) and one outlet (19) for connection to at least one direct expansion solar collector (20).

9. Thermodynamic unit, according to any of the claims 6 to 8, **characterised in that** the composite capacitor (27) comprises:

- a base (27.1) that has means for connecting to the tank (3) and on which the following are arranged and fixed
- an electrical resistor (27.2);
- a sheath (27.3) or cylindrical tube inside of which a temperature probe is inserted;
- a capacitor element which is preferably a helical coil that surrounds the electrical resistor (27.2) and the sheath (27.3);
- connection means between the aforementioned elements and the outside.

10. System for generating hot water in a tank **characterised in that** it comprises:

- a thermodynamic unit housing at least the following inside the same block:
- a compressor (24), which draws out the refrigerant gas;
- a liquid container (16), which stores the coolant in a liquid state;
- a filter drier (17), which removes moisture from the circuit;
- and an expansion element which may be a thermostatic or electronic expansion valve (18);
- a controller device (25) for controlling a composite capacitor (27) arranged outside the block;
- at least two fluid connections for the flow and return of the thermodynamic unit;
- a number of electrical connections between the controller device (25) and the capacitor (27).

- An evaporator, either housed inside the previous block, or external thereto, in which case it is a direct expansion solar collector (20).
- A tank (3) for hot water on which a composite capacitor (27) is fixed and housed on the inside, to which the water inlet and outlet hydraulic connections of the thermodynamic unit, and the electrical connections between the controller device (25) and the condenser (27) are connected.

11. Composite capacitor **characterised in that** it comprises:

- a base (27.1) that has means for connecting to a tank (3) and on which the following are arranged and fixed:
- an electrical resistor (27.2);
- a sheath (27.3) or cylindrical tube inside of which a temperature probe is inserted;
- a capacitor element which is preferably a helical coil that surrounds the electrical resistor (27.2) and the sheath (27.3);
- connection means between the aforementioned elements and the outside.

12. Composite capacitor, according to claim 11 **characterised in that** the coil tube (27.4) is straight in a first section, flow section (27.5) and after it has been wound into a spiral with a diameter larger than that occupied by the electrical resistor (27.2) and the sheath (27.3) but smaller than that of the base (27.1) in order to be inserted easily into a tank (3); on the other hand, the last section of the tube which forms the coil (27.4), return section (27.6) is a straight section from the upper end of the coil to the end thereof, passing through the base (27.1), two bores (27.7) and (27.8) being arranged on the base (27.1) of the composite capacitor to which the flow section (27.5) and the return section (27.6) respectively are soldered.

13. Composite capacitor according to claim 11 **characterised in that** the electrical resistor (27.2) passes through the base (27.1) through a number of bores (27.9) made on the base (27), while the sheath (27.3) which houses the temperature probe passes through the base (27.1) through a bore (27.10).

14. Composite capacitor according to claim 13 **characterised in that** the electrical resistor (27.2) takes on a "U" shape inside of which there is an electric line for supplying the Joule heat to the fluid to be heated, or there is a cylindrical tube where the resistor is incorporated inside and can be changed if necessary.

15. Composite capacitor according to claim 11 **characterised in that** the base (27.1) of the composite capacitor has a means for fastening to the tank (3) of hot water by means of a perimeter threading (27.11).

16. Composite capacitor, according to claim 11 **characterised in that** the connection means towards the outside of the elements installed on the composite capacitor is:

- a number of electrical terminal (27.12) connections;
- a number of temperature probe terminals (27.13);
- a straight connector terminal or flow section

(27.5) of the coil (27.4);
- a straight connector terminal or return section
(27.6) of the coil (27.4).

17. Composite capacitor according to claim 11 **characterised in that** the capacitor is a double-walled or finned tube. 5
18. Composite capacitor, according to any one of the claims 11 to 17 **characterised in that** it has an anode inserted into the base (27.1). 10

15

20

25

30

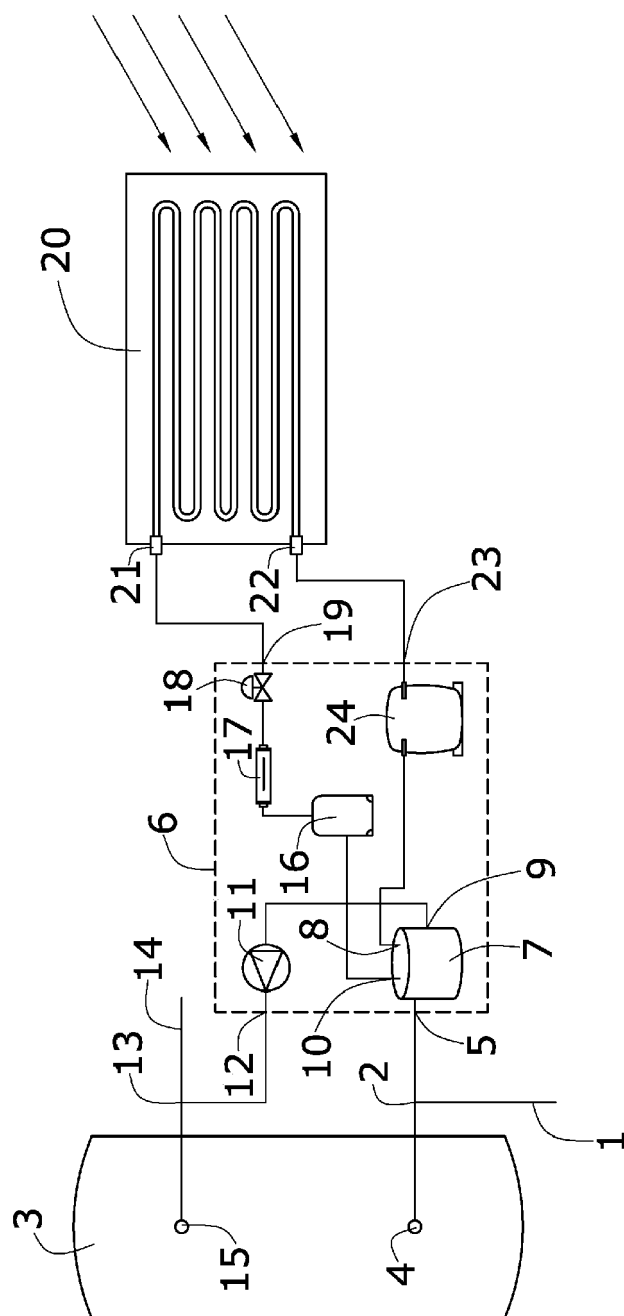
35

40

45

50

55



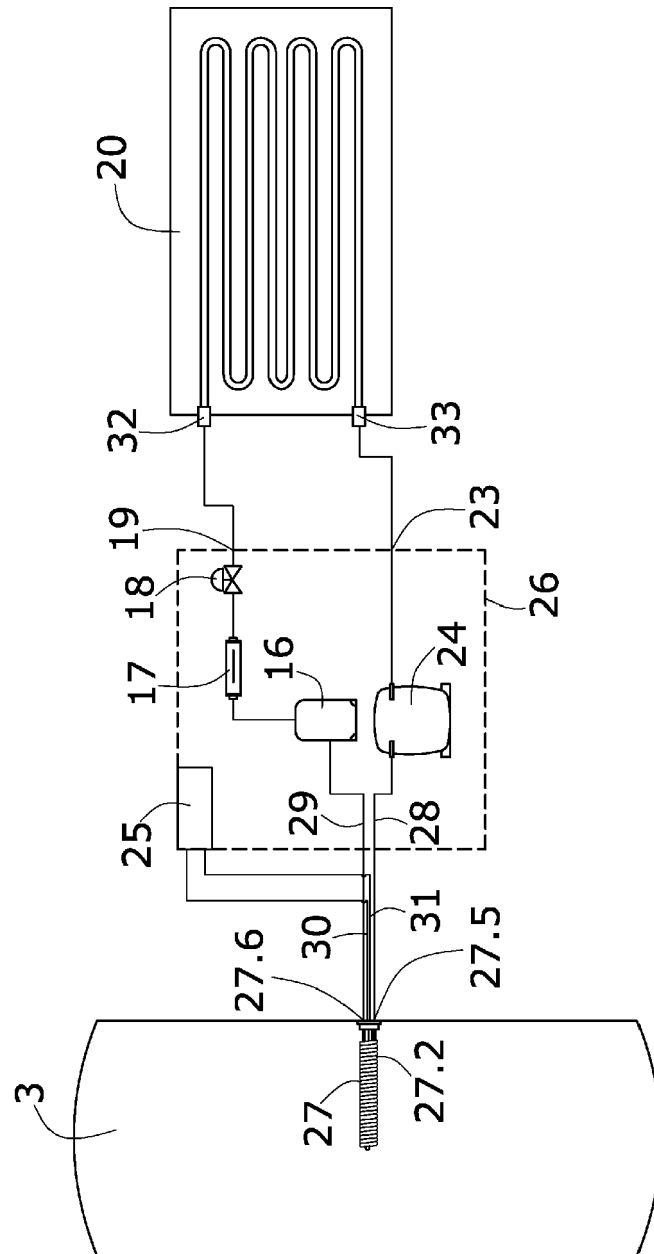


FIG.2

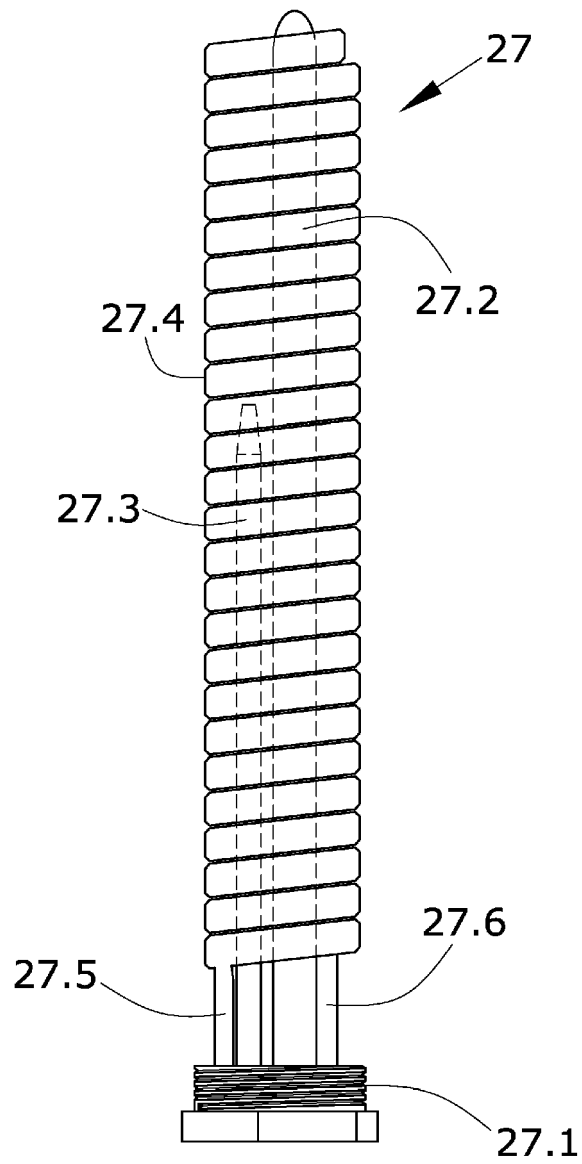
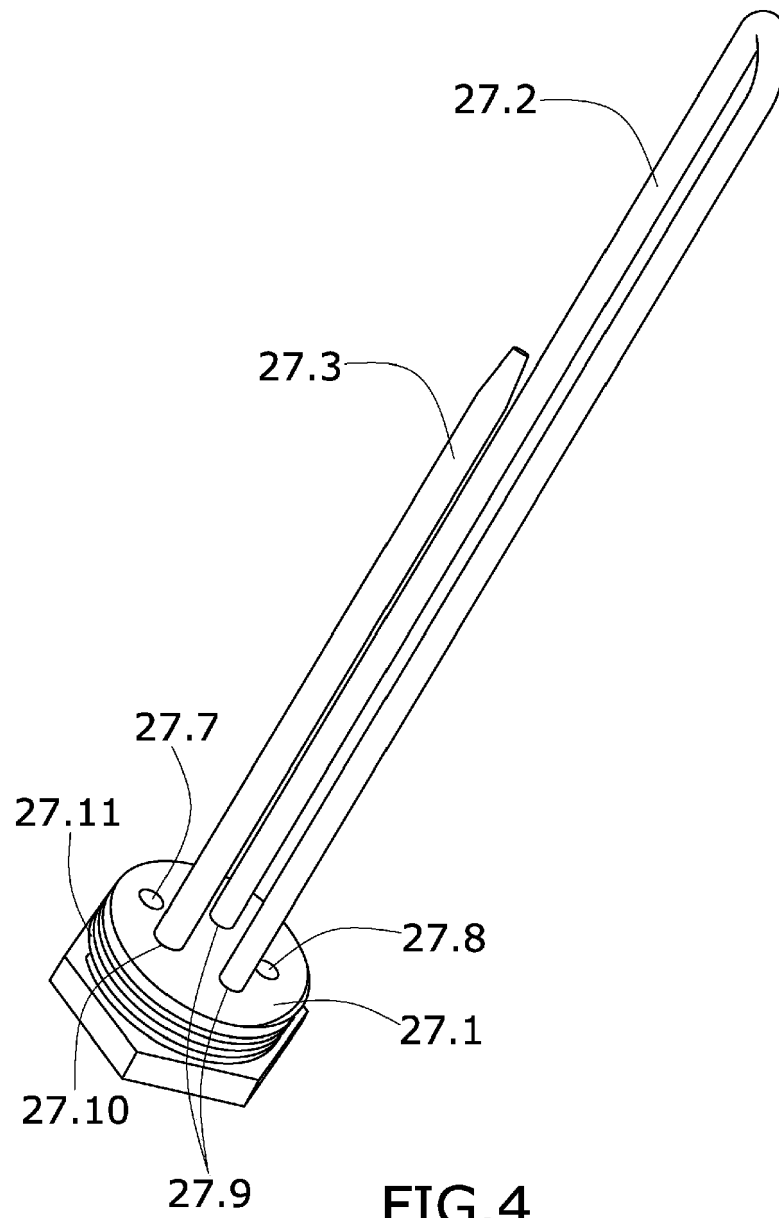


FIG.3



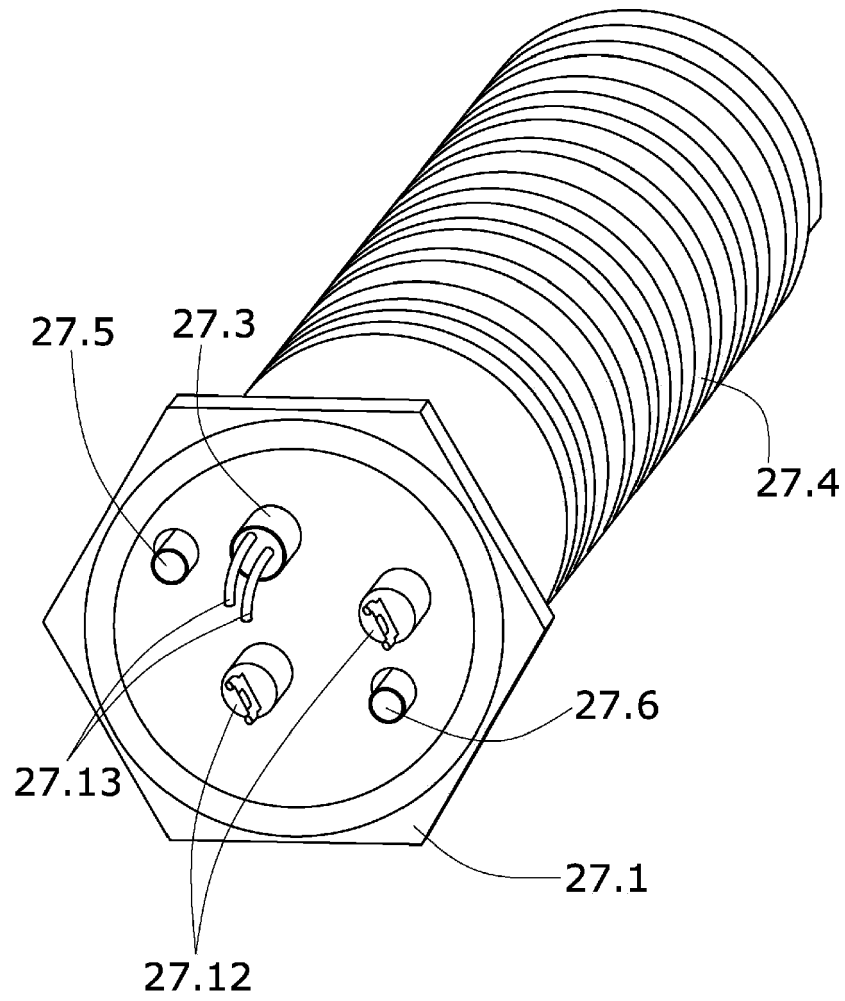


FIG. 5