The present invention refers to a device intended for use with a system comprising a heat pump with an evaporator and a condenser, in which a heat transfer medium in a heat transfer circuit, heated up by means of the evaporator and a compressor, is arranged to give off heat to a first liquid flow via a first heat exchanger part, wherein said system further comprises a second heat exchanger part to give off heat to a second liquid flow, wherein said second liquid flow is arranged for circulation through a heat emission system, wherein the device includes means for heating water in a water reservoir, wherein said reservoir includes an inlet for entering water to be heated and an outlet for discharging heated water, wherein the water in the reservoir is heated by means of said first liquid flow. A closed circuit, separated from said heat emission system, is used to circulate said first liquid flow through said first heat exchanger part, wherein the circuit for heat emission passes through the water reservoir. The invention also relates to a method, a heat pump and a heating system.
Published:
— with international search report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.
Heat exchanger device

Technical field

The present invention refers to heating systems, and in particular to a heat exchanger device for heating water according to the preamble to claims 1 and 14, respectively.

The present invention also refers to a method for heating water according to the preamble to claims 24 and 25, respectively, a heat pump according to claim 26 and a heating system according to claim 27.

Background art

There are currently a large number of heating systems for heating dwellings. Heat pump systems are a type of heating system that is becoming increasingly popular as energy prices increase. Heat pumps for houses are designed to produce both hot water for taps and hot water for radiators. The heat for the house is normally distributed by means of underfloor heating loops, radiators, which can sometimes be provided with fans, and/or fan coil units.

The hot water for taps is usually stored in an accumulator tank in or beside the heat pump, and consists in principle of a water tank in which hot tap water is heated and stored in order to make possible an instantaneous supply of hot water that is larger than what the heating system can produce instantaneously.

In the case with an accumulator tank where heating up is carried out directly by electricity, the hot water can be heated up during the night to enable more hot water to be drawn off during the day. With this type of water heating, there is no limit, in principle, to the temperature to which the water in the accumulator tank can be heated, which enables
a large number of litres of blended hot water to be drawn off when the tank is fully heated up.

In the case of heat pumps, on the other hand, the heating of the hot water takes place at more frequent intervals. In addition, the heating up of the hot water takes place in the hot water reservoir, the so-called secondary water or the hot tap water, by the so-called primary water that is heated up via the heat pump loops. When the water-heating temperature that is possible is limited by the temperature to which the heat pump is able to heat the primary water, there is a limit to the temperature to which the secondary water can be heated.

There are thus limits to the temperature to which the heat pump can heat up the primary water, at least in an economical way, which leads to limits to how much the secondary water, the hot tap water, can be heated up by the primary water. These limits further has as result that a great number of components are required to achieve desired performance, which, in turn, leads to a heat pump that is expensive to manufacture.

There is thus a need for an improved heat pump that can provide desired performance.

**Summary of the invention**

An object of the present invention is to provide an improved heat pump.

This object is achieved, according to a first aspect of the invention, by a device according to claims 1 and 14, respectively, a method according to claims 24 and 25, respectively, and a heat pump according to claim 26 and a heating system according to claim 27.
The device according to the present invention is intended for use with a system including a heat pump with an evaporator and a condenser in which, in operation, a heat transfer medium in a heat transfer circuit that is heated up by means of the evaporator and a compressor is arranged to, at least in a heating mode, give off heat to a first liquid flow via a first heat exchanger part, wherein said system further includes a second heat exchanger part to, at least in a heating mode, give off heat to a second liquid flow, wherein said second liquid flow is arranged to circulate through a heat emission system, wherein the device includes means for, at least in a heating mode, heat water in a water reservoir, wherein said reservoir includes an inlet for entering water to be heated and an outlet for discharging heated water, wherein, at least in a heating mode, the water in the reservoir is heated by means of said first liquid flow. A closed circuit, separated from said heat emission system, is used to circulate said first liquid flow through said first heat exchanger part, wherein the circuit for heat emission passes through the water reservoir. The device can further be arranged such that said first liquid flow is arranged to self-circulate through said first heat exchanger part. This has the advantage that a heat pump with a reduced number of components can be obtained, which thereby results in a more cost efficient heat pump.

Further, the present invention also allows that the liquid flow can be heated to a high temperature in the first heat exchanger part, with the result that also the water in the water reservoir also can be heated to a high temperature. Said heating system can, e.g., consist of any from the group: radiator system, underfloor heating loop system and/or fan coil unit system.

The device can further comprise means for circulating said first liquid flow and said second liquid flow independently
from each other. This has the advantage that each flow, respectively, can be controlled such that a desired heating method simultaneously can be obtained in the closed circuit and heat emission system, respectively.

The closed circuit can be hermetically sealed. The circuit can further consist of a pipe coil, wherein said pipe coil extends substantially through the water carrying height of the water reservoir. This has the advantage that heat transfer can be carried out in a manner similar to the prior art.

The circuit can be arranged to only partially be filled with liquid, wherein said liquid can consist of a mixture of various liquids. This has the advantage that the liquid in the circuit can be arranged to at least partially evaporate when passing the first heat exchanger part, wherein the liquid vapour can give off heat to water in the reservoir through condensation and/or cooling when passing through the water reservoir. This has the advantage that a more efficient heat transfer can be obtained since the transition factor is substantially increased at heat transfer through condensation as compared to liquid-liquid heat transfer.

Means, such as a piston, can be used to control the ratio between the quantity of liquid and quantity of gas. This has the advantage that the amount of liquid being evaporated in the circuit can be adjusted when necessary.

The device can comprise means for diverting water in the water reservoir, preferably through an outlet in the lower portion of said reservoir, for passage through said first heat exchanger part instead of using a closed circuit as above, where the device further comprises means for returning said water to said water reservoir through an inlet, preferably arranged in the upper portion of the water reservoir, after
passage through the heat exchanger part. This has the advantage that a very simple structure can be obtained. The device can also in this instance, e.g., be arranged such that said first liquid flow is arranged to self-circulate through the first heat exchanger part, which has as result that an even more cost efficient heat pump can be obtained. In an alternative embodiment, the liquid flow is circulated through the first heat exchanger part by means of a circulation pump. This has the advantage that a very accurate control of the heating process can be obtained.

The device can further comprise means for turning off the first liquid flow. This has the advantage that the hot water heating can be turned off, e.g., if a water leakage occurs in the property.

**Brief description of the drawings**

Figure 1 shows in general a heat pump according to known technology.

Figure 2 shows a heat pump according to an exemplary embodiment of the present invention.

Figure 3 shows a heat pump according to another exemplary embodiment of the present invention.

**Detailed description of preferred embodiments**

Figure 1 shows a heat pump 10 according to known technology that is installed in a property such as a house, and shows schematically a radiator system 15 (apart from radiator systems, e.g., underfloor heating loop systems and/or fan coil unit systems can be utilised, or a combination of one or more systems of such kinds). The heat pump 10 is provided with a control computer 12, that controls and monitors various functions in the heat pump. Examples of such functions can be setting and/or monitoring of working temperatures for the heat
pump's compressor, indoor and outdoor temperatures, adjustment of heat curves, control of room temperatures depending upon the time of day or in the event of absence from home for holidays, etc. Additional examples will be given below. A user can communicate with the control computer 12 via a display and keyboard (not shown) arranged on the heat pump 10. The heat pump 10 comprises, in addition, a heat pump circuit and a water reservoir in form of a water tank 11 with an inlet 13 at the bottom portion of the tank at which water enters that is to be heated up and an outlet 14 at the top of the tank for discharging heated water.

The heat pump circuit comprises a circulating heat transfer medium in which the mostly liquid heat transfer medium 21 takes up heat from a heat source such as a rock heat loop 22, in which a cold medium such as glycol/water at a temperature of approximately -5° to +5° is circulated by a circulation pump in a water-filled borehole. When the liquid heat transfer medium 21 takes up heat, it is vaporised in an evaporator 23. The evaporating temperature can, for example, be -7°. The gaseous heat transfer medium is then compressed by a compressor 24 to a higher pressure which, on account of the smaller volume of gas, means that the temperature of the gas is increased. The compressed, heated gas (the hot gas) then gives off its heat via a condenser 25 and an undercooler 26 to the so-called primary water, radiator water 27, while the gas is condensed to liquid. The undercooling means that additional heat can be extracted and thus provides a more economical heat pump, while at the same time it is ensured that no bubbles of gas remain in the heat transfer medium when this reaches the expansion valve 28, via which the pressure of the liquid heat transfer medium is reduced considerably, whereupon the temperature of the heat transfer medium is reduced rapidly, after which the heat transfer medium again takes up heat from
the rock heat loop 22. Instead of the heating loop taking up heat from rock, it can take up heat from the soil, air and/or water. The figure also shows an electric heater cartridge 29, which is only used when an extra provision of heat is required, for example, on very cold days, and a change-over valve 16 for changing between hot water production and heat production. In addition, a circulating pump 17 is shown for circulation of the primary water.

The primary water heated up by the heat pump circuit is then used alternately to heat hot tap water and the property's radiator system, underfloor heating system and/or fan coil unit system. The efficiency of the heat pump is governed by the condensing temperature of the heat transfer medium, in that the lower the temperature, that is, the lower the pressure at which the condensing commences, the higher the efficiency. If the primary water is heated to, for example, 35° with a 10kW heat pump, the so-called coefficient of performance (COP) of the heat pump, that is the ratio between output and input, can be 5, when it is heated to 50° it can be 3.4 and when it is heated to 60° it can be 2.5.

There are limits to the temperature to which the heat pump disclosed in fig. 1 can heat the primary water, at least in an economical way, which leads to limitations in how much the secondary water, the hot tap water, can be heated up by the primary water. The disclosed heat pump further has the disadvantage that it becomes unnecessarily expensive due to the large amount of components.

In Fig. 2 is shown a heat pump 30 according to an exemplary embodiment of the present invention that, when compared to the prior art, has an improved design.

Just as the heat pump in fig. 1, the heat pump 30 comprises a heat pump circuit and a water tank 31 having an inlet 33 at
the bottom portion of the tank for entering water that is to be heated up and an outlet 34 at the top portion of the tank for discharging heated water. Also in this example, a circulating heat transfer medium 32 takes up heat from a heat source, evaporates and is compressed. In this case, the primary water is circulated through a unit 36, which constitutes a condenser/subcooler, wherein the heat transfer medium gives off its heat to the primary water during condensation/subcooling, wherein the primary water is heated for circulation by means of a circulation pump 41 through a heat emission system, such as a radiator system, an underfloor heating system and/or a fan coil unit system. In the figure, a radiator system is shown. The primary water also passes an electric heater cartridge 39, which can be utilised if required. In contrast to the prior art, wherein heat and hot water are alternately generated by changing the flow by means of the change-over valve 30 in fig. 1, two separate circuits are used according to the present invention, wherein a first circuit 44 is used to heat the water in the water tank, while a second circuit 43 is used to circulate water through the property's radiator system.

Liquid in the circuit 44 is circulated through a heat exchanger 35 in which it is heated to a higher temperature. After passage through the heat exchanger 35 the liquid is supplied to the upper portion of the water tank 31 and is led through a pipe coil 40 which runs through the water tank 31. During the passage of the liquid through the pipe coil heat is given off to the surrounding water, which is heated while at the same time liquid in the pipe coil 40 is cooled off. The liquid in the circuit self-circulates through the coil. The self-circulation arises due to the fact that colder water have higher density than hotter water, and therefore water heated by the heat exchanger 35 will rise to the top of the circuit
to then get heavier and heavier when giving off heat to the surrounding water, and therefore flow towards the bottom of the tank and further on to the heat exchanger to be heated again. This solution has the advantage that no change-over valve is required to change flows between radiator circuit and hot water heating, neither is a circulation pump required to circulate the water in the circuit 44, which thus results in a, for manufacturing reasons, more economical heat pump. The closed circuit is advantageously hermetically sealed. Yet, the solution disclosed in fig. 2 have further advantages. The disclosed solution admits a more economical production of hot water. A hot gas heat exchange can be obtained in the heat exchanger 35 with a very high temperature of the flow as a result. Since the flow in the case of self-circulation is limited by the flow speed that can be obtained by the self-circulation, and accordingly can be kept substantially lower as compared to the prior art, this leads to a substantially increased ratio between heat transfer surface and flow, and the flow can thereby be heated up to very high temperatures with an economical production of hot water as a result. The most common operational conditions of the heat pump can be used when dimensioning the circuit 44. In this way, a very favourable heat pump efficiency can be obtained. Performance of the heat pump disclosed in fig. 2 can be further enhanced if the circuit 44 is not completely filled with liquid. For example, the circuit 44 can be emptied from air at first, so that a vacuum arises, to then be filled, e.g., to the half by liquid. By doing this a lower pressure is obtained in the circuit, which, in turn, has as result that liquid at least partially will be evaporated in the heat exchanger 35. This evaporation, in turn, has as result that steam and not liquid enters the water reservoir, which thus has as result that the heat transfer to the water in the
reservoir at least partially will take place in form of a condensation. This heat emission by means of condensation allows considerably higher heat transfer efficiency as compared to the case with solely cooling of liquid when passing through the circuit.

In order to optimise heating of the hot water in the tank at various operating conditions, e.g., due to the temperature in the water reservoir, which can vary depending on if a large hot water discharge recently has occurred or not, the arrangement can be provided with means for controlling the ratio of the quantity of liquid in the closed circuit that evaporates. The greater the underpressure, the larger quantity of the liquid will evaporate. This can, for example, be achieved by having a portion of the circuit volume constituting a cylinder in which a piston is arranged, so that the total volume of the circuit, and thereby the ratio between the quantity of liquid and quantity of gas, can be controlled using the piston.

The liquid in the circuit 44 can consist of water, which can be desirable since a possible leak will not contaminate the water in the tank 31. The liquid can, however, consist of other liquids as well, or a mixture of various liquids having different evaporation and condensation points, so that desired properties for absorbing heat and giving off heat is obtained. In using various liquids the relative difference in density can be taken into consideration, which means that the flow rate through the circuit, and the heat transfer, can be influenced. In general, a lower flow increases the ratio between heat transfer surface and flow, which has as result that the flow, and thereby the water in the tank, can be heated to a higher temperature. By using the above mentioned control method, the properties in the circuit can be
controlled such that a specific liquid is totally or partially evaporated, while another liquid is not evaporated at all, or that the various liquids are evaporated to a desired extent.

The system can be arranged such that the heat exchanger 35 constitutes a hot gas heat exchanger when the heat pump simultaneously is used for heating the property and heating hot water. The heat exchanger 36 then operates as a condenser/subcooler. This has as result that the hot water can be heated to a high temperature at the same COP that according to the prior art would result in a substantially lower temperature. This has, in addition, the advantage that the danger of the growth of legionella bacteria, and other microorganisms, can be considerably reduced, as the water is heated to a higher temperature. In addition, the tank can be heated through to a high temperature by operation of the heat pump, which further improves total economy.

Of course, the heat exchanger 35 can be used to give off heat through condensation, and, e.g., during hot water heating, the total heat pump power can, if desired, be taken out from the heat exchanger 35, i.e., the heat exchanger then acts both as hot gas heat exchanger, condenser and subcooler. If the hot water production has been going on for a longer period of time without any hot water being drawn off from the tank, the water tank will become fully charged, i.e., the whole tank will have substantially the same temperature. In this case no considerable heat transfer will occur from the circuit, which thus means that no considerable heat absorption from the heat exchanger 35 will occur, which, in turn, means that the total heat pump power can be taken out from the heat exchanger 36 and be used for heating.

A peculiarity with the above embodiment of the present invention is that if a hot water tap is left slightly open, or
if hot water may any other ways leaks out in the system, the heat demand in the accumulator tank can increase to such extent that the required power in the water tank exceeds the total power that is available from the heat pump. This means that there will be no energy left for heating radiator water via the condenser, which, in turn, can lead to the property being cooled off. This peculiarity, however, can easily be remedied, either by using the electric heater cartridge or, e.g., by using a throttle valve arranged on the circuit so that the self-circulating flow can be stopped when required. The throttle valve can be controlled by the heat pump control computer and be turned off, e.g., when the heat in the house sinks below a certain temperature.

In an alternative embodiment, the liquid in the closed circuit is not circulated using self-circulation, but using a circulation pump (not shown) arranged in the circuit. This has the advantage that the flow of the circuit can be completely controlled as desired, and thereby at all times be adjusted on the basis of prevailing operational conditions. This embodiment also has the advantage that the circulation pump can turn off the liquid flow if a hot water leakage arises in the system.

The present invention also has the advantage that the radiator water can be kept in circulation all the time instead of, as in current heat pumps, wherein hot water and heat is alternately produced, stand still for, e.g., 20 minutes when hot water is produced, with undesired crackings as a result. By controlling various control parameters, the heating process can at all times be controlled using the heat pump control computer. Examples of control parameters can consist of one or more of:

- the temperatures of the water flows before and after the
respective heat exchanger part,
- the flow of the radiator water flow,
- the flow of the closed circuit,
- one or more temperatures (i.e., at different positions) in the water reservoir,
- the temperature of the hot gas,
- the withdrawal of hot water,
- the pressure of the cold medium circuit on the high and low pressure sides respectively,
- the power delivered by the compressor,
- the current setting of the throttle valve.

The control can thus be arranged to give priority to different things at different times. For example, on certain occasions hot water production can be given priority, while in other cases heating of the property can be given priority. In addition, the compressor can consist of a capacity-regulated compressor. This has, for example, the advantage that when hot water has been drawn off, the capacity of the compressor can be increased, provided that it is not already working at maximal capacity, so that more power can be utilised for hot water production without substantially affecting the heating capacity of the radiator water.

The solution disclosed in fig. 2 has been described in connection to a heat pump that is utilised both for radiator water production and hot water production. This embodiment can, however, equally well be utilised at a heat pump that is used only for hot water production. In this case, the two heat exchanger parts can consist of a single heat exchanger part since no radiator circuit then is connected to the heat pump.

In the above description, the heat transfer to the water in the water tank is carried out using a pipe coil. Fig. 3 discloses an alternative embodiment of the present invention...
that further simplifies the heat pump. As in fig. 2, the heat pump 50 comprises a heat pump circuit and a water tank 51 having an inlet 53 at the bottom portion of the tank for entering water that is to be heated up and an outlet 54 at the top portion of the tank for discharging heated water. Further, as before, the primary water can be heated for circulation through e.g., an underfloor heating system.

Instead of, as in fig. 2, use a closed circuit that runs through the water tank and is used to heat the water in the water tank, a circuit is used in the embodiment shown in fig. 3, wherein the hot water that is to be heated circulates through the heat exchanger 55. The water in the tank will have a lowest temperature in the bottom, and the water is therefore led through an outlet in or near the bottom to the heat exchanger 55 to be brought back to the tank through an inlet arranged in or near the top of the tank after heating.

Just as above, a self-circulation will occur due to the temperature differences between tank bottom and top, which self-circulation continuously will circulate water through the heat exchanger 55, or at least until the water in the tank is fully heated to a maximum temperature.

Also this solution has the advantage that no change-over valve is required to change flows between radiator circuit and hot water heating.

Also in this embodiment the water can be circulated using a circulation pump (not shown) instead of self-circulation, which also in this embodiment results in increased possibilities to obtain a desired heating process according to prevailing operating conditions. Further, just as above, the system can be controlled in such a way that the heat exchanger 55 constitutes a pure hot gas heat exchanger.
By the use of the heat pump's control computer, the temperatures in the above disclosed heat exchanger 35, 55 can be controlled by controlling the flows and the compressor, which enables a certain amount of condensing to take place in the hot gas heat exchanger, or alternatively enables the condenser/undercooler 36, 56 to be used partially as a hot gas heat exchanger. The system can thus be optimized in all situations for the conditions prevailing at that time.

In the solution shown in fig. 3 a heat pump used both for radiator water production and hot water production has been described. Also this embodiment can, however, equally well be utilised for a heat pump that is only used for hot water production. In this case, the two heat exchanger parts can consist of a single heat exchanger part since no radiator circuit then is connected to the heat pump.

Further, in the description above, the heat exchangers have been described as separate units. These can, however, also consist of an integrated unit, where one flow is taken through a part of the integrated unit, and the other flow is taken through a different part of the unit.
CLAIMS

1. Device intended for use with a system comprising a heat pump with an evaporator and a condenser, in which, in use, a heat transfer medium in a heat transfer circuit, heated up by means of the evaporator and a compressor, is arranged, at least in a heating mode, to give off heat to a first liquid flow via a first heat exchanger part, wherein said system further comprises a second heat exchanger part to, at least in a heating mode, give off heat to a second liquid flow, wherein said second liquid flow is arranged for circulation through a heat emission system, wherein the device includes means to, at least in a heating mode, heat water in a water reservoir, wherein said reservoir includes an inlet for entering water to be heated and an outlet for discharging heated water, wherein, at least in a heating mode, the water in the reservoir is heated by means of said first liquid flow, characterised in a closed circuit, separated from said heat emission system, to circulate said first liquid flow through said first heat exchanger part, wherein the circuit for heat emission passes through the water reservoir, wherein the device is arranged such that said first liquid flow is arranged to self-circulate through the first heat exchanger part.

2. Device according to claim 1, wherein said heat emission system consists of any from the group: radiator system, underfloor heating loop system and/or fan coil unit system.

3. Device according to claim 1 or 2, characterised in that it further comprises means for circulating said first
liquid flow and said second liquid flow independently from each other.

4. Device according to any of the claims 1-3, characterised in that the circuit through the water reservoir consists of a pipe loop, wherein said pipe loop extends substantially through the water carrying height of the water reservoir.

5. Device according to any of the claims 1-4, characterised in that the closed circuit is arranged to only partially be filled with liquid.

6. Device according to any of the claims 1-5, characterised in that said liquid in the circuit consists of water or a mixture of various liquids.

7. Device according to any of the claims 1-6, characterised in that the liquid in the circuit is arranged to at least partially evaporate when passing through the first heat exchanger part, wherein the liquid vapour can give off heat to water in the reservoir through condensation and/or cooling when passing the water reservoir.

8. Device according to any of the claims 1-7, characterised in that it further comprises means, such as a piston, to control the ratio between the quantity of liquid and quantity of gas.

9. Device according to any of the claims 1-8, characterised in that the device is arranged such that said second liquid flow is arranged to be circulated by means of a circulation pump.
10. Device according to any of the preceding claims,  
    characterised in that it further comprises means for  
    turning off the first liquid flow.

11. Device according to any of the preceding claims,  
    characterised in that it further includes control means,  
    wherein control of the device using said control means  
    can be carried out on the basis of one or more of the  
    criteria:
    - the temperatures of the water flows before and after  
      the respective heat exchanger part,
    - the flow of the second water flow,
    - the flow of the closed circuit,
    - one or more temperatures in the water reservoir,
    - the temperature of the hot gas,
    - the withdrawal of hot water,
    - the pressure of the cold medium circuit on the high and  
      low pressure sides respectively,
    - the power delivered by the compressor,
    - the current setting of the throttle valve.

12. Device according to any one of the preceding claims,  
    characterised in that, at least in a heating mode, the  
    first heat exchanger part consists essentially of a hot  
    gas heat exchanger, and the second heat exchanger part  
    consists essentially of a condenser.

13. Device according to any one of the preceding claims,  
    characterised in that the first heat exchanger part and  
    the second heat exchanger part consist of separate units.

14. Device intended for use with a heat pump with an  
    evaporator and a condenser, wherein a heat transfer  
    medium in a heat transfer circuit, heated up by means of  
    the evaporator and a compressor, is arranged, at least in
a heating mode, to give off heat to a first liquid flow via a first heat exchanger part, wherein the device includes means for, at least in a heating mode, heat water in a water reservoir, wherein said water reservoir have an inlet for entering water that is to be heated up and an outlet for discharging heated water, wherein water in the reservoir is heated by means of said first liquid flow, characterised in that the device comprises means for diverting water to be heated in the water reservoir, preferably through an outlet in the bottom portion of the reservoir, for passage through said first heat exchanger part, wherein the device further comprises means for bringing back said water to the water reservoir through an inlet, preferably arranged in the top portion of the water reservoir, after passage through said heat exchanger part.

15. Device according to claim 14, characterised in that the device is arranged such that said first liquid flow is arranged to self-circulate through the first heat exchanger part.

16. Device according to claim 14, characterised in that the device is arranged such that said first liquid flow is arranged to be circulated through the first heat exchanger part by means of a circulation pump.

17. Device according to any one of the claims 14-16, wherein the heat transfer circuit further comprises a second heat exchanger part, wherein said second heat exchanger part, at least in a heating mode, is arranged to be used for giving off heat to a second liquid flow, characterised in that the device is arranged to, at least in a heating
mode, circulate said second liquid flow through a heating system.

18. Device according to claim 17, wherein said heating system consists of any from the group: radiator system, underfloor heating loop system and/or fan coil unit system.

19. Device according to claim 17 or 18, characterised in that it further comprises means for circulating said first liquid flow and said second liquid flow independently from each other.

20. Device according to any of the claims 14-19, characterised in it further comprises means for turning off the first liquid flow.

21. Device according to any of the claims 14-20, characterised in that it further includes control means, wherein control of the device using said control means can be carried out on the basis of one or more of the criteria:
- the temperatures of the water flows before and after the respective heat exchanger part,
- the flow of the second water flow,
- one or more temperatures in the water reservoir,
- the temperature of the hot gas,
- the withdrawal of hot water,
- the pressure of the cold medium circuit on the high and low pressure sides respectively,
- the power delivered by the compressor,
- the current setting of the throttle valve.

22. Device according to any one of the claims 14-21, characterised in that, at least in a heating mode, the
first heat exchanger part consists essentially of a hot
gas heat exchanger, and the second heat exchanger part
consists essentially of a condenser.

23. Device according to any one of the claims 14-22,

characterised in that the first heat exchanger part and
the second heat exchanger part consist of separate units.

24. Control method intended for use with a heat pump with an
evaporator and a condenser, wherein a heat transfer
medium in a heat transfer circuit, heated up by means of
the evaporator and a compressor, at least in a heating
mode, gives off heat to a first liquid flow via a first
heat exchanger part, wherein, at least in a heating mode,
a second heat exchanger part gives off heat to a second
liquid flow, wherein said second liquid flow is
circulated through a heat emission system, wherein, at
least in a heating mode, water in a water reservoir is
heated, wherein said water reservoir includes an inlet
for entering water to be heated and an outlet for
discharging heated water, wherein, at least in a heating
mode, the water in the reservoir is heated by means of
said first liquid flow, characterised in that the method
further comprises the step of circulating said first
liquid flow through a closed circuit, separated from said
heat emission system, wherein the circuit for heat
emission passes through the water reservoir, wherein said
first liquid flow self-circulates through the first heat
exchanger part.

25. Control method intended for use with a heat pump with an
evaporator and a condenser, wherein a heat transfer
medium in a heat transfer circuit, heated up by means of
the evaporator and a compressor, at least in a heating
mode gives off heat to a first liquid flow via a first heat exchanger part, wherein, at least in a heating mode, water in a water reservoir is heated, wherein said water reservoir has an inlet for entering water that is to be heated up and an outlet for discharging heated water, wherein water in the reservoir is heated by means of said first liquid flow, **characterised in** that the method comprises the steps of:
- diverting water to be heated in the water reservoir, preferably through an outlet in the bottom portion of the reservoir, for passage through said first heat exchanger part, and
- bringing back said water to the water reservoir through an inlet, preferably arranged in the top portion of the water reservoir, after passage through said heat exchanger part.

26. Heat pump, **characterised in** that it comprises a device according to any one of claims 1-23.

27. Heating system, **characterised in** that it comprises a device according to any one of Claims 1-23.
### INTERNATIONAL SEARCH REPORT

**A. CLASSIFICATION OF SUBJECT MATTER**

**IPC:** see extra sheet
According to International Patent Classification (IPC) or to both national classification and IPC.

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

**IPC:** F24D, F25B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

**EPO-INTERNAL, WPI DATA, PAJ**

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

<table>
<thead>
<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
</table>
| X         | US 4364239 A (CHAPELLE ET AL), 21 December 1982  
(21.12.1982), column 2, line 64 - column 3,  
line 11; column 4, line 29 - line 43; column 5,  
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27 November 1997 (27.11.1997), whole document | 3 |

Further documents are listed in the continuation of Box C.

See patent family annex.

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Date of the actual completion of the international search

25 January 2007

Date of mailing of the international search report

25 -01" 2007

Name and mailing address of the ISA/
Swedish Patent Office
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Facsimile No. +46 8 666 02 86

Authorized officer

Inger LÖFving / JA A
Telephone No. +46 8 782 25 00

Form PCT/ISA/210 (second sheet) (April 2005)
INTERNATIONAL SEARCH REPORT

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. □ Claims Nos.:
   because they relate to subject matter not required to be searched by this Authority, namely:

2. [ ] Claims Nos.:
   because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. □ Claims Nos.:
   because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

This International Searching Authority found multiple inventions in this international application, as follows:

The following separate inventions were identified:
1. Claims 1-13, 24, and 26-27 is directed to a device with a heat pump intended to heating water in a tank with a closed circuit, and to heat a heat rejection system.
2. Claims 14-23, and 26-27 directed to a device with a heat pump intended to heating water in a tank with an open circuit, and to heat a heat rejection system.

1. □ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. [ ] As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. [ ] As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.: 

4. □ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.: 

Remark on Protest

1-[] The additional search fees were accompanied by the applicant’s protest and, where applicable, the payment of a protest fee.

[] The additional search fees were accompanied by the applicant’s protest but the applicable protest fee was not paid within the time limit specified in the invitation.

[] No protest accompanied the payment of additional search fees.
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International patent classification (IPC)

F24D 11/02 (2006.01)
F24D 3/08 (2006.01)
F24D 3/18 (2006.01)
F25B 40/00 (2006.01)

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Cited literature, if any, will be enclosed in paper form.
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