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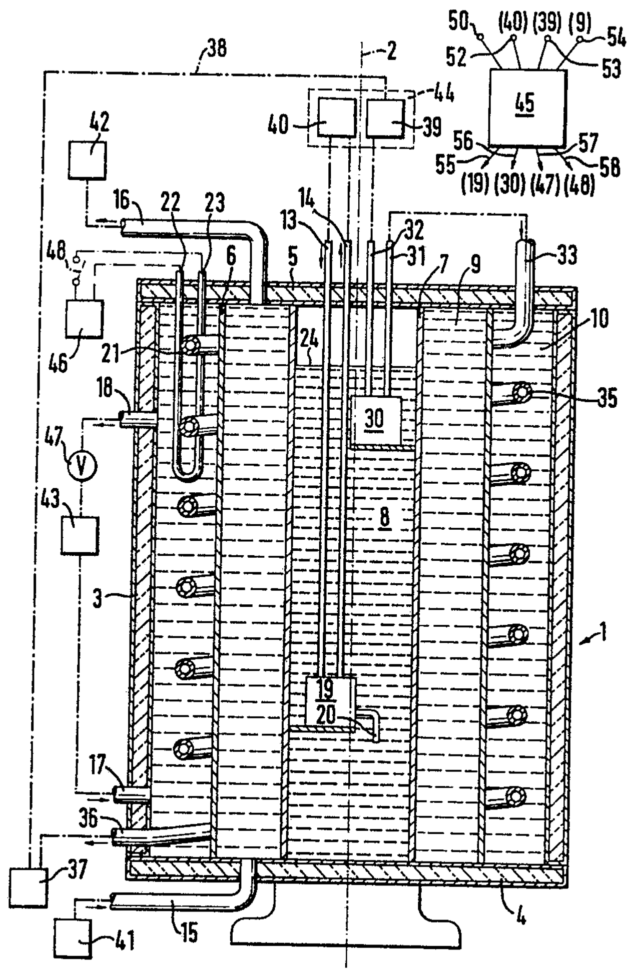
(71) Applicant
Electrolux-Loh GmbH, Welterstrasse 55—57, D-5900 Siegen, Federal Republic of Germany
(72) Inventor
Theo Sigmund
(74) Agent
W. H. Beck, Greener & Co

(54) Fluid Heater

(57) A fluid heater comprises a container 1 subdivided into a chamber 9 for said fluid, and chambers 8 and 10 each in heat exchange contact with the chamber 9.

Service fluid in chamber 9 (e.g. water for use at a consumer means 42) is heated by a fluid (e.g. an oil) circulated (e.g. by a pump 19) between the chamber 8 and a heat exchanger 40 utilizing solar heat or natural heat (e.g. of the atmosphere, or of the ground, or of groundwater or a water course). Chamber 10 also contains a heating fluid (e.g. water heated by the condenser 35 of a heat pump system 30—39).

In use, if the heat supplied from heat exchanger 40 to chamber 8 is insufficient to adequately heat the service water in chamber 9, then the heat pump system is switched on to utilize the heat of condenser 35 in chamber 10. If additional heat is still required, then a boiler 43 or an electric immersion heater 21 is operated to heat the fluid in chamber 10.



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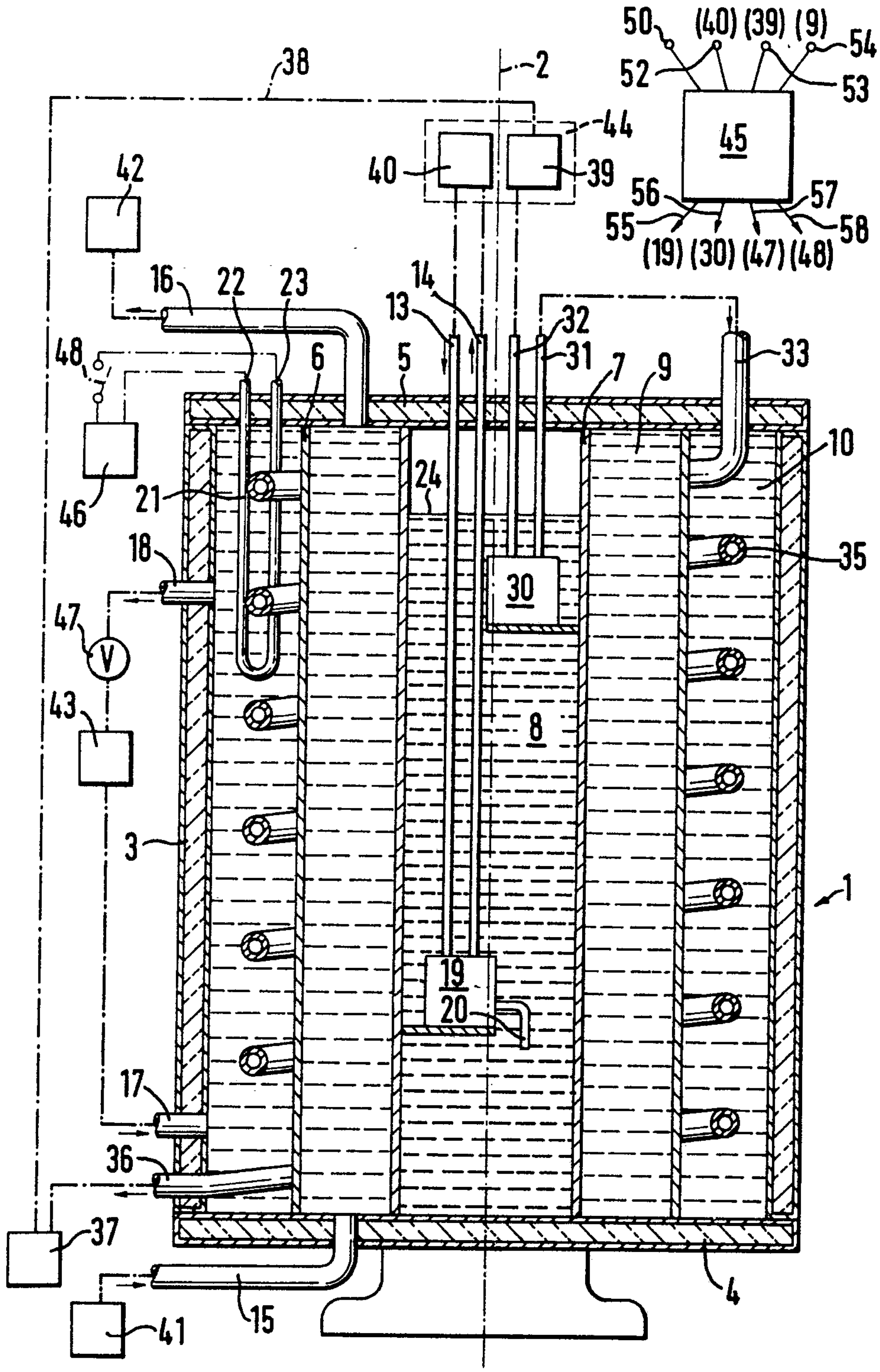

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SPECIFICATION
Fluid Heater

The invention relates to a fluid heater of the kind having a container, whose outer wall is thermally insulating and which container has a service fluid chamber and a heating fluid chamber, said chambers being in thermally conductive contact with one another so that the service fluid is heated by the heating fluid. The invention has particular, but not exclusive application, to water heaters.

In a known water heater of the aforementioned type, the service water chamber is surrounded by the insulating outer wall and the heating fluid chamber is the inside of a spiral pipe which projects into the service water chamber. All the thermal energy required is obtained from a heating water supply system, which can be operated by, for example, an oil burner. In modern water heaters, every effort is however made to obtain the necessary thermal energy from natural sources such as solar radiation, the atmosphere, the soil or ground water. However, in practice, this can only be realised in combination with a conventional heating system used as a booster when necessary. Therefore, depending on the ambient conditions, it is necessary to change from one operating mode to the other or to operate the system on a mixed basis.

The problem of the invention is to so develop a water heater of the type defined hereinbefore that it is suitable for the different operating modes and permits the utilisation of the thermal energy obtained with minimum losses.

The invention is characterised in that a heat transfer fluid chamber is provided which is connectable to a heat exchanger, which is externally in thermal contact with the ambient environment, and is surrounded by and in thermally conductive contact with the service fluid chamber, and in that the service fluid chamber is surrounded by the heating fluid chamber.

The heat transfer fluid chamber is used for transporting heat absorbed from the ambient environment, i.e. the atmosphere, solar radiation, the soil, ground water or another external heat source and which within the fluid heater can be supplied to the service fluid in the service fluid chamber. The heating of the service fluid by the heating fluid heated by for example an external oil burner or the like can take place independently or together with the heating by the heat transfer fluid whereby naturally the heating fluid supply is stopped when sufficient heat is provided by the heat transfer fluid. Usually the service fluid, heating fluid and heat transfer fluid will be a liquid, especially water in the case of the service and heating fluids and oil in the case of the heat transfer fluid.

According to a preferred embodiment of the invention, the energy losses by direct contact between the heating fluid chamber and the heat transfer fluid chamber are minimized by making the heat transfer fluid chamber circular cylindrical and through making the two other chambers annular and coaxial thereto.

It is necessary to pump round the heat transfer fluid for transferring heat from the external heat exchanger to the heat transfer fluid chamber and it is recommended that the necessary pump, preferably an oil feed pump, is arranged within the heat transfer fluid chamber, so that tha heat transfer fluid contained therein flows round it. In this way, it is possible to make advantageous use of the heat due to the energy losses unavoidably occurring during the operation of the pump. The heat transfer fluid preferably is an electrically insulating liquid which is able to flow at temperatures up to —30°C. Generally, the heat transfer liquid is oil preferably transformer oil, which also reduces the bearing wear of the pump and ensures a uniform pump operating temperature.

A large number of heat exchangers for absorbing energy from natural energy sources such as solar radiation, air, ground water or the soil are equipped with heat pump evaporators in order to increase the operating efficiency of the heat absorption. Account is taken of this in a further development of the invention which is characterised in that the condenser of a heat pump is located within the heat transfer fluid chamber, so that the heat transfer fluid contained therein flows round it and the condenser of this heat pump is arranged in the form of a multiple pipe spiral within the heating fluid chamber, so that the heating fluid contained therein flows round it. Furthermore, an outwardly directed pressure connection and a fluid connection for connecting an external evaporator of the heat pump are provided for the refrigerating medium of said heat pump.

The heat due to energy losses necessarily occurring in the operation of the compressor is not lost and is in this case supplied to the heat transfer fluid and can be utilised by the latter. This also ensures a uniform operating temperature for the compressor and its susceptibility to faults due to wear is reduced. This also makes it possible to use simple enclosed compressors for the heat pump. Overheating as a result of the considerable loading of these compressors and which could lead to the oil becoming unstable are avoided because the oil bath keeps the enclosed compressor at a uniform low operating temperature. The low operating temperature at which the compressor functions also reduces its power consumption.

Cases are conceivable when thermal energy must be supplied from the heating fluid chamber to the service fluid chamber and the heating apparatus for the heating fluid, e.g. the oil burner is not in operating because, due to the low power consumption, it is not commercially viable to maintain in a constant state of operational readiness a relatively large heating apparatus, e.g. an oil burner. For such cases, which can for example occur in summer when a normal space heating system is not operating, it is recommended that an electrically operable immersion heating system with externally accessible power connections are provided positioned within the heating fluid chamber, so that the heating fluid contained therein flows round them.

The condenser and/or immersion heating system are located in the heating fluid chamber. In this way, the heating fluid always acts as a thermal accumulator and makes it unnecessary to provide devices in the service fluid chamber which could possibly be destroyed by corrosive service fluid.

The thermal energy storage accumulator in the form of the heating fluid, service fluid and heat transfer fluid can also supply, when necessary, its stored thermal energy to space heater such as a hot water radiator.

The following is a description, by way of example only and with reference to the accompanying drawing, of an embodiment of the present invention. In the drawing, the single figure is a cross-section of a water heater in accordance with said embodiment.

Referring to the drawing, a water heater comprises a circular cylindrical container 1 having a cylinder axis 2. The outer wall 3, bottom 4 and top 5 of the container 1 are constructed as double walls and the space between them is filled with insulating foam or evacuated. Container 1 contains two partition walls 6 and 7, which are coaxial to axis 2 and divide the container in liquid-tight manner into three coaxial chambers 8, 9 and 10. The central chamber 8 serves as a heat transfer liquid (e.g. oil) chamber; the intermediate chamber 9, which surrounds the latter in annular manner serves as a service water chamber; and the outer chamber 10 which surrounds the latter in annular manner serves as a heating water chamber. The walls 6 and 7 are thermally conductive and are for example made from metal.

Respective supply and discharge pipes 13—18, which are accessible from the outside, lead into the chambers 8, 9 and 10. Supply pipe 13 and discharge pipe 14 lead into the oil chamber 8; supply pipe 15 and discharge pipe 16 into the service water chamber 9; and supply pipe 17 and discharge pipe 18 into the heating water chamber 10. The supply pipe 13 is connected to the pressure side of an electrically operable oil pump 19 located within the oil chamber 8 below an oil level 24 and whose intake connection 20 issues into the oil chamber 8 below the oil level 24. In operation, the two other chambers 9 and 10 are completely filled with water.

An electrically operable immersion heater 21 is arranged in the heating water chamber 10 and can be connected to a power supply 46 by means of externally accessible electrical connections 22 and 23. An electrically operable compressor of a refrigerator is designated by the reference numeral 30 and is located within the oil chamber 8 so that it is at least partly below the oil level 24. A condenser is arranged in the form of a multiple pipe spiral 35 coaxial to axis 2 within the water heating chamber 10 and is connected via a gas pressure connection 33 to pressure connection 31 leading to the compressorr 30. The pipe spiral 35 is connected also to an outwardly directed liquid connection 36. Liquid connection 36 leads to a refrigerating medium collector 37 and from there an external line 38 leads to an evaporator 39 for absorbing heat from the atmosphere, solar radiation, the soil or the ground water or a watercourse. The evaporator is connected also to via a vacuum connection 32 to the compressor 30. The supply pipe 15 is used for supplying cold fresh water from an external fresh water supply 41 and discharge connection 16 takes up the heated service water and supplies it to a consumption means 42. If necessary, supply pipe 17 can be used for supplying hot heating water, for example from the boiler 43 of a dwelling, and the cooled heating water flows back via discharge pipe 18 to the boiler 43 where it is again heated.

The supply pipe 13 is connected via a spiral pipe leading to discharge pipe 14 and arranged in an external heat exchanger 40 which is used to absorb heat from solar radiation, the soil, the atmosphere, the ground water or a watercourse. The evaporator 39 and the heat exchanger 40 can be located in a combined external appliance 44.

The external pipes which are connected in operation are shown by dotted lines in the drawing. The water heater is preferably operated as follows. The cheapest heat source is via the oil circuit, 13, 19 and 14, because this only requires primary energy for operating the oil pump 19. In this most economic operating procedure, the oil is constantly pumped through the heat exchanger 40 and is thereby heated by the ambient environment, e.g. solar radiation, and then heats the service water in the service water chamber 9. The heat due to energy losses of oil pump 19 is also used for heating the oil. Only if the energy supply to the water heater is sufficient, all the other devices are switched off. If the energy obtained in this way is not sufficient, then the refrigerator, comprising the compressor 30, the condenser formed by spiral pipe 35, the evaporator 39 and the refrigerating medium collector 37, is also switched on. The refrigerator functions as a heat pump and at evaporator 39 absorbs heat from the ambient environment and supplies it in spiral pipe 35 to the heating water of heating water chamber 10, which in turn heats the service water in service water chamber 9. The unavoidable heat due to energy losses of compressor 30 is used for heating the oil in the oil chamber 8. This operation is advantageous, because only primary energy is needed for operating the compressor 30 and the simultaneously still switched on oil pump 19. Only when this energy is not sufficient is the boiler 43 switched on in order to further heat the heating water of heating water chamber 10. If in such a case the boiler 43 is not in operation, e.g. in summer, and it is not in certain circumstances economic to switch it on especially for this purpose, it is possible to heat electrically the heating water by means of the immersion heater 21, which is then switched on instead of the boiler 43. This ensures that the water in service water chamber 9 is always heated using the cheapest energy source.

A central control unit 45 is used for controlling the optimum operation. Control unit 45 has an external thermostat 50 for sensing the outside temperature of the atmosphere, a thermostat 52 for sensing the heat exchanger temperature, a thermostat 53 for sensing the evaporator temperature and a thermostat 54 for sensing the heated service water temperature. By means of a first control line 55 control unit 45 switches the oil pump 19 on and off; by means of a second control line 56 switches the compressor 30 on and off; by means of a third control line 56 switches a stop valve 47 in the heating water return flow on and off; and by means of a control line 58 switches a switch 48 in the power supply to the immersion heater 21 on and off.

It will be appreciated that the invention is not restricted to the particular details described above with reference to the drawing but that numerous modifications and variations to those details can be made without departing from the scope of the invention as defined in the following Claims.

Claims

1. A fluid heater of the kind having a container whose outer wall is thermally insulating and which container has a service fluid chamber and a heating fluid chamber, said chambers being in thermally conductive contact with one another so that the service fluid is heated by the heating fluid wherein a heat transfer fluid chamber is provided which can be connected to an external heat exchanger, which is in thermal contact with the ambient environment, and is surrounded by and is in thermally conductive contact with the service fluid chamber and wherein the service fluid chamber is surrounded by the heating fluid chamber.

2. A liquid heater as claimed in Claim 1 wherein said service fluid, heating fluid and heat transfer fluid are liquids.

3. A water heater as claimed in Claim 1 or Claim 2 wherein said service fluid is water.

4. A water heater as claimed in Claim 3 wherein said heating fluid is water.

5. A fluid heater as claimed in any one of the preceding Claims wherein the heat transfer fluid is an electrically insulating liquid able to flow at temperatures up to —30°C.

6. A fluid heater as claimed in any one of the preceding Claims wherein the heat transfer fluid is on oil.

7. A fluid heater as claimed in any one of the preceding Claims wherein the heat transfer liquid chamber is circular cylindrical and the said two other chambers are constructed in annular manner coaxial thereto.

8. A fluid heater as claimed in any one of the preceding Claims wherein a feed pump is provided to pump the heat exchange fluid between the said external heat exchanger and the heat transfer fluid chamber and is positioned within the heat transfer fluid chamber so that the heat transfer fluid contained therein flows round it.

9. A fluid heater as claimed in any one of the preceding Claims wherein a compressor of a heat pump is located inside the heat transfer fluid chamber, so that the heat transfer fluid contained therein flows round it, a condenser of said heat pump is placed in the heating fluid chamber so that the heating fluid contained therein flows round it, and means are provided for connecting to said compressor and condenser an external evaporator of the said heat pump for the refrigerating medium of said heat pump.

10. A fluid heater as claimed in Claim 9 wherein the said condenser is a multiple pipe spiral.

11. A fluid heater as claimed in any one of the preceding Claims, wherein an electrically operable immersion heater is provided and arranged within the heating fluid chamber, so that the heating fluid contained therein flows round it.

12. A fluid heater as claimed in Claim 1 and substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

13. A fluid heater as claimed in any one of the preceding Claims in combination with the said external heat exchanger operably connected thereto.

14. A fluid heater as claimed in Claim 12 wherein the heat exchanger is adapted to absorb heat from solar radiation, the atmosphere, the soil or ground water.

15. A fluid heater as claimed in Claim 13 and substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

16. A method of heating a fluid which comprises passing the fluid as the service fluid through a fluid heater as claimed in any one of Claims 13 to 15.

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