



(11)

EP 4 417 899 A1

(12)

EUROPEAN PATENT APPLICATION
published in accordance with Art. 153(4) EPC

(43) Date of publication:

21.08.2024 Bulletin 2024/34

(21) Application number: **22881447.1**

(22) Date of filing: **15.04.2022**

(51) International Patent Classification (IPC):

F25B 21/02 ^(2006.01)

F24H 1/08 ^(2022.01)

F24H 1/50 ^(2022.01)

F24H 15/174 ^(2022.01)

(52) Cooperative Patent Classification (CPC):

F24H 1/08; F24H 1/50; F24H 15/174; F25B 21/02

(86) International application number:

PCT/RU2022/000124

(87) International publication number:

WO 2023/063846 (20.04.2023 Gazette 2023/16)

(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

Designated Validation States:

KH MA MD TN

(30) Priority: **12.10.2021 RU 2021129687**

(71) Applicant: **Electrophor, Inc.**
Woodmere, NY 11598 (US)

(72) Inventors:

- **SHMIDT, Joseph, L.**
11598 New York (US)
- **CHERNYI, Alexander Alexandrovich**
195252 Saint-Petersburg (RU)
- **OGDANSKIY, Ivan Ivanovich**
188353 Gatchinskiy r-n (RU)

(74) Representative: **Danubia Patent & Law Office LLC**
Bajcsy-Zsilinszky út 16
1051 Budapest (HU)

(54) **SYSTEM FOR HEATING AND COOLING A LIQUID**

(57) The invention relates to systems for heating and cooling liquids, such as water, in domestic conditions, office premises, catering establishments, country and garden plots, public institutions and is intended for heating and cooling liquids. Additionally, these systems may have a liquid purification function and/or a beverage preparation function. A liquid heating and cooling system, including a cooling container and a heating container, separated by a thermoelectric converter, is configured to circulate hot liquid through the hot liquid container, a hot liquid circulation pump, a heat exchanger equipped with a cooling means with a switching function for blowing the heat exchanger with air when the temperature rises. The temperature of the hot liquid in the hot liquid container is above the set level.

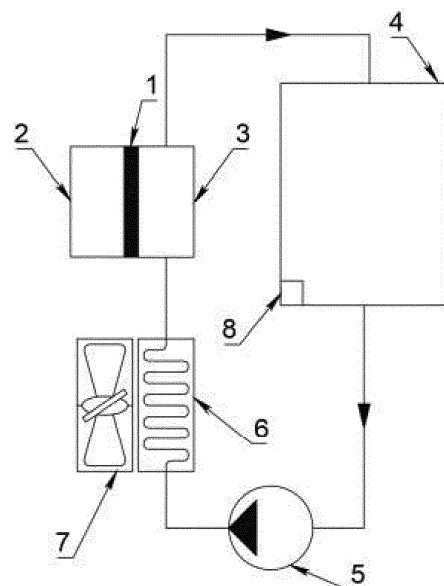


Figure 1

EP 4 417 899 A1

Description

[0001] The invention relates to systems for heating and cooling of liquids, for example liquids, in domestic conditions, office premises, catering establishments, country and garden plots, public institutions and is intended for heating and cooling liquids. Additionally, these systems may have a liquid purification function and/or a beverage preparation function.

[0002] Liquid heating and cooling systems with a separate heating element and a separate refrigerator are known from the state of the art. These systems are not effective, since when the refrigerator operates to cool the liquid, heat is generated and is released into the environment, which leads to energy loss, which, considering the energy costs for heating, makes these systems ineffective. Also, liquid heating and cooling systems, where liquid cooling and heating occurs due to a thermoelectric converter located between the cooling container and the heating container are known from the prior art.

[0003] A system for heating and cooling liquid according to patent application US 2009/0113898 [IPC F25B 21/02, publ. 05/07/2009] is known from the state of the art. This system includes a heating container, a cooling container, a heating and cooling unit located between the two containers, and an additional capacitor equipped with a cooling element. Both containers are made in the form of two closed reservoirs with insulation into which bottles with the raw liquid are inserted. The heating container is located above the cooling container. The heating and cooling unit is made of a capacitor and a heater, between which a thermoelectric converter is located. In this case, the heater is connected to the heating surface of the thermoelectric converter, and the capacitor is connected to the cooling surface. There is refrigerant inside the condenser and heater. The cooling container is connected to the condenser through a tube. The heating container is connected through a tube in series to an additional capacitor and to the heater. The system also has a cooling element made in the form of a fan, which is necessary for cooling the additional condenser.

[0004] The system works as follows. Bottles with the raw liquid are installed in the heating and cooling containers. During operation of the thermoelectric converter, heat is transferred from the heating surface to the heater, where the refrigerant is located, which heats up and turns into steam. Steam enters the heating container through a tube, heat is transferred from the refrigerant vapor to the walls of the container, and then through the walls of the bottle to the liquid, thus heating the liquid, while the refrigerant condenses and through the same tube through which the steam passes, through the additional capacitor is returned to the heater. In parallel, the process of cooling the liquid occurs. Due to the operation of the thermoelectric converter, the refrigerant in the condenser is cooled. The refrigerant enters the cooling container, through the walls of the bottle heat is transferred from the liquid to the refrigerant, and accordingly it is cooled.

In this case, the refrigerant heats up, turns into steam and returns through the tube to the condenser. Upon reaching the set temperature, one of the bottles or both bottles are removed by the consumer from the containers for heating and cooling. The main disadvantage of the system is that heating and cooling of the liquid occurs indirectly through a completely different medium, which itself needs to be heated and cooled, this leads to energy loss, which is ineffective. In addition, the use of refrigerant makes the system environmentally unfriendly, which is also a disadvantage of the system.

[0005] A system for heating and cooling liquids is known from the state of the art according to patent EP1571121 [IPC B67D 1/08, priority 02/21/2005]. The system consists of a heating container, a cooling container connected by a tube, a heat exchanger, two thermoelectric converters, temperature sensors and a fan. The heating container is in contact with the heating surface of one of the thermoelectric converters, and its cooling surface is in contact with the heat exchanger, which, in turn, is in contact with the heating surface of the second thermoelectric converter, the cooling surface of which is in contact with the cooling container. The fan cools the heat exchanger. The system according to patent EP 1571121 works as follows. The raw liquid is poured into the cooling container, which flows through a tube into the heating container. After filling both containers, the system is turned on. A simultaneous process of heating and cooling occurs, and due to the heat exchanger with a cooling element, the temperature difference at the heating and cooling surfaces of two thermoelectric converters is compensated. The main disadvantage of the system is that the system consumes a large amount of energy for heating, cooling and removing excess heat. At the same time, there is no direct and simple mechanism for controlling the temperature of the liquid in the containers, which is also a disadvantage of the system.

[0006] A system for heating and cooling liquids is known from the state of the art according to RU patent 2654548 [IPC F25B 21/02, prior. 04.052.2016], chosen by the applicant as the closest analogue. The system consists of a cooling container and a heating container, separated by a thermoelectric converter. Within the framework of its distinctive features, the system works as follows. Both containers are filled with liquid, after filling both containers the system is turned on. A simultaneous heating and cooling process occurs. At the same time, due to the difference in the volume of the containers, the difference in the release of heat and cold is compensated. That is, one thermoelectric converter is enough to operate the system, which makes the closest analogue more efficient compared to other known systems. At the same time, the disadvantage of the closest analogue is that it is not possible to regulate the temperature of the hot liquid, that is, if the amount of liquid in the heating container is insufficient, for example, if the selection for consumption of hot liquid occurs faster than cold liquid, overheating of the hot liquid occurs. That is, the consumer

receives too hot a liquid, which is inconvenient. In this case, the only way to adjust the temperature of the liquid is to forcefully replace the hot liquid with the original one in the heating container or add the original liquid to the heating container. This method of regulating the temperature of a hot liquid is inaccurate and inconvenient, which is a disadvantage of the closest analogue.

[0007] The purpose of the invention and the technical result achieved when using. The invention is the development of a new system for heating and cooling liquids with improved ergonomic properties by eliminating the supply of overheated liquid for consumption, without significant losses in efficiency.

[0008] The set task and the required technical result are determined by the fact that the liquid heating and cooling system, including a cooling container and a heating container, separated by a thermoelectric converter, characterized in that it is designed to circulate hot liquid through a container for hot liquid, a hot liquid circulation pump, a heat exchanger equipped with a cooling means with a switching function for blowing air onto the heat exchanger when the temperature of the hot liquid in the hot liquid container rises above a predetermined level and the cooling means is made in the form of a fan, or an air pump, or a compressor and a temperature sensor is installed in the container for hot liquid, functionally connected to the cooling means. The liquid heating and cooling system may additionally contain a container for cold liquid with a temperature sensor and a cold liquid circulation pump and may additionally contain a cold liquid supply line and/or a hot liquid supply line which can be additionally equipped with a hot/cold liquid tap and/or a hot/cold liquid supply pump.

Brief description of drawings.

[0009]

Figure 1 shows an example of a liquid heating and cooling system.

Figure 2 shows an example of a liquid heating and cooling system with additional elements.

[0010] The liquid heating and cooling system includes a cooling container (2) and a heating container (3), between which a thermoelectric converter (1) is located. Both containers are made of heat-conducting material, such as stainless steel, brass or other metal alloys. In this case, the cooling container (2) is in contact with at least part of one of the walls with the cooling side of the thermoelectric converter (1). The heating container (3) can also contact at least part of one of the walls with the heating surface of the thermoelectric converter (1), or the thermoelectric converter (1) and the wall of the heating container (3) can be in parallel with an air gap of at least 1 mm, but not more than 3 cm.

[0011] The heating container (3) is connected in series

with the hot liquid container (4), the hot liquid circulation pump (5) and the heat exchanger (6), which is equipped with a cooling means (7). In this case, the cooling means (7) has the function of switching on for blowing the heat exchanger (6) with air and can be made, for example, but not limited to the listed options, in the form of a fan, or an air pump, or a compressor. The hot liquid container (4) can be made of plastic, for example polypropylene, polyethylene or a mixture of polyolefins, or PET, or, for example, stainless steel. The hot liquid container (4) contains a temperature sensor (8).

[0012] Within the framework of its distinctive features, the proposed system works as follows. The heating container (3) and the cooling container (2) are filled with the raw liquid. After filling, the system is turned on. Due to the thermoelectric converter (1), the liquid is heated and cooled at the same time. The heating container (3) communicates with the hot liquid container (4). An option is possible where the liquid flows by gravity between the container for heating the liquid (3) and the container for hot liquid (4). Or preferably, by means of a hot liquid circulation pump (5), the liquid circulates from the heating container (3) through the hot liquid container (4), through the hot liquid circulation pump (5) and the heat exchanger (6). In this case, the cooling means (7) is switched off. The temperature sensor (8) located in the hot liquid container (4) records the temperature of the liquid in the hot liquid container (4). When the temperature of the hot liquid in the hot liquid container (4) reaches a predetermined value, for example, preferably but not limited to 60-65°C, or 80-85°C, or 70-75°C, the cooling means (7) is turned on to blow heat exchanger air (6). If a version of the system is implemented where the liquid flows by gravity between the heating container (3) and the hot liquid container (4), then when the specified liquid temperature is reached, simultaneously with the cooling means (7), the hot liquid circulation pump (5) is turned on, ensuring circulation of the hot liquid from the heating container (3) through the hot liquid container (4), through the hot liquid circulation pump (5) and the heat exchanger (6), blown with air due to the operation of the cooling means (7). If the system is implemented in the preferred embodiment with the circulation of hot liquid from the heating tank (3) through the hot liquid tank (4), through the hot liquid circulation pump (5) and the heat exchanger (6), then when the set temperature of the hot liquid is reached, the hot liquid circulation pump liquid (5) continues to circulate; only the cooling means (7) is additionally turned on. When the cooling means (7) is turned on, air is blown onto the heat exchanger (6), due to which the temperature of the hot liquid decreases. When the hot liquid reaches the set temperature, the cooling means (7) is switched off. Thus, the temperature of the hot liquid is maintained within the specified range and overheating of the hot liquid is prevented. That is, the consumer always receives hot liquid at the required temperature, which makes the system more ergonomic compared to the closest analogue. In addition, in this way, an optimal temperature balance is

maintained, and the more heat is removed from the hot side of the thermoelectric converter (1), the more efficient the cooling on the opposite side occurs. Thus, the efficiency of the system increases, which compensates for the work of the cooling means (7), that is, compared to the closest analogue, the system does not lose in efficiency.

[0013] Additionally, the system may include a container for cold liquid (9) with a temperature sensor (16) and a cold liquid circulation pump (15). In this case, by circulating cold liquid from the cooling tank (2) through the cold liquid tank (9) and the cold liquid circulation pump (15), the temperature of the cold liquid is maintained in a given range, for example, but not limited to the listed options 8- 12°C, or 10-15°C, or 6-11 °C, thus maintaining a consumer-friendly temperature of the cold liquid, which increases the convenience of the system. In addition, maintaining the temperature of the cold liquid in a given range increases the efficiency of the thermoelectric converter (1), which compensates for the costs of introducing additional elements, that is, the efficiency of the system does not decrease.

[0014] Additionally, the system may include a cold liquid supply line (not indicated in the figures), which allows cold liquid to be withdrawn for consumption during system operation. For user convenience, the cold liquid supply line (not indicated in the figures) can be additionally equipped with a cold liquid tap (14), allowing the user to adjust the amount of cold liquid supplied, and/or a cold liquid supply pump (10), providing a user-friendly supply rate cold liquid.

[0015] Additionally, the system may include a hot liquid supply line (not indicated in the figures), which allows hot liquid to be withdrawn for consumption during system operation. For user convenience, the hot liquid supply line (not indicated in the figures) can be additionally equipped with a hot liquid tap (13), allowing the user to adjust the amount of hot liquid supplied, and/or a hot liquid supply pump (11), providing a user-friendly supply rate hot liquid, and/or flow heater (12). The presence of a flow-through heater (12) allows the user, if necessary, to heat the hot liquid to a higher temperature and/or produce steam from the hot liquid, which expands the possibilities of using the system for preparing drinks.

[0016] The present description of the invention presents a preferred embodiment of the invention. Changes can be made to it, within the stated formula, which makes it possible for it to be widely used.

Claims

1. A liquid heating and cooling system, including a cooling container and a heating container, separated by a thermoelectric converter, **characterized in that** the system is designed to circulate hot liquid through a container for hot liquid, a hot liquid circulation pump, a heat exchanger equipped with a cooling

means with a switching function for blowing air onto the heat exchanger when the temperature of the hot liquid in the hot liquid container rises above a predetermined level.

2. The liquid heating and cooling system according to claim 1, **characterized in that** the cooling means is made in the form of a fan, or an air pump, or a compressor.
3. The liquid heating and cooling system according to claim 1, **characterized in that** a temperature sensor is installed in the container for hot liquid, functionally connected to the cooling means.
4. The liquid heating and cooling system according to claim 1, **characterized in that** said system may additionally contain a container for cold liquid with a temperature sensor and a cold liquid circulation pump.
5. The liquid heating and cooling system according to claim 1, **characterized in that** said system may additionally contain a cold liquid supply line and/or a hot liquid supply line.
6. The liquid heating and cooling system according to claim 5, **characterized in that** the cold liquid supply line can be additionally equipped with a cold liquid tap and/or a cold liquid supply pump.
7. The liquid heating and cooling system according to claim 5, **characterized in that** the hot liquid supply line can be additionally equipped with a hot liquid tap, and/or a hot liquid supply pump, and/or a flow-through heater.

50

55

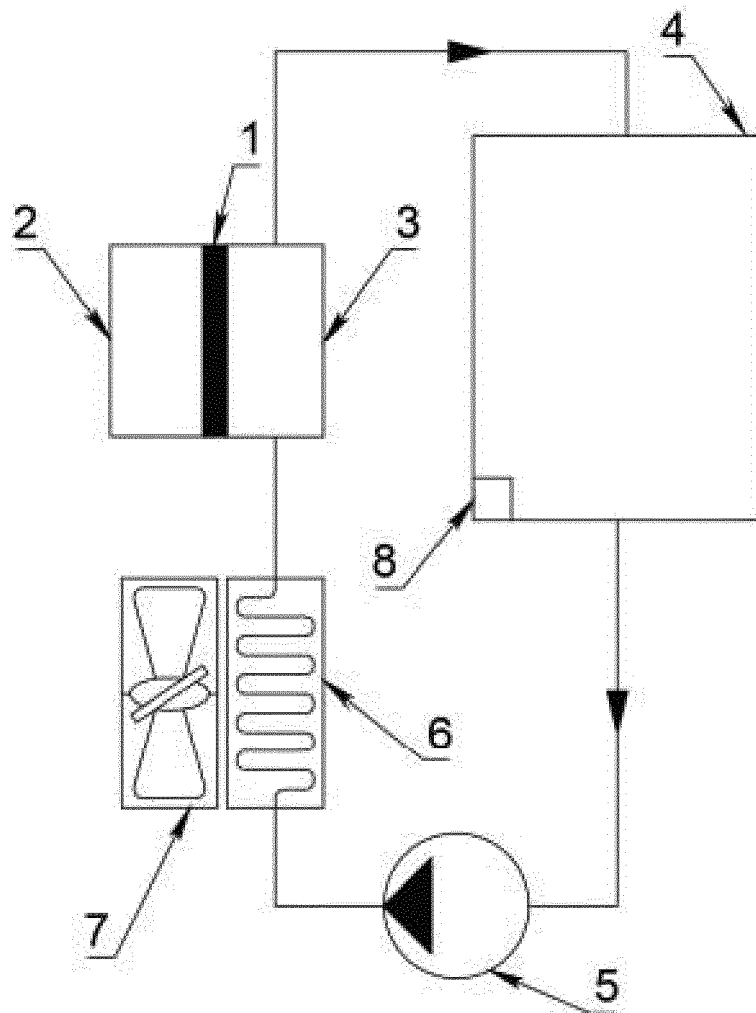


Figure 1

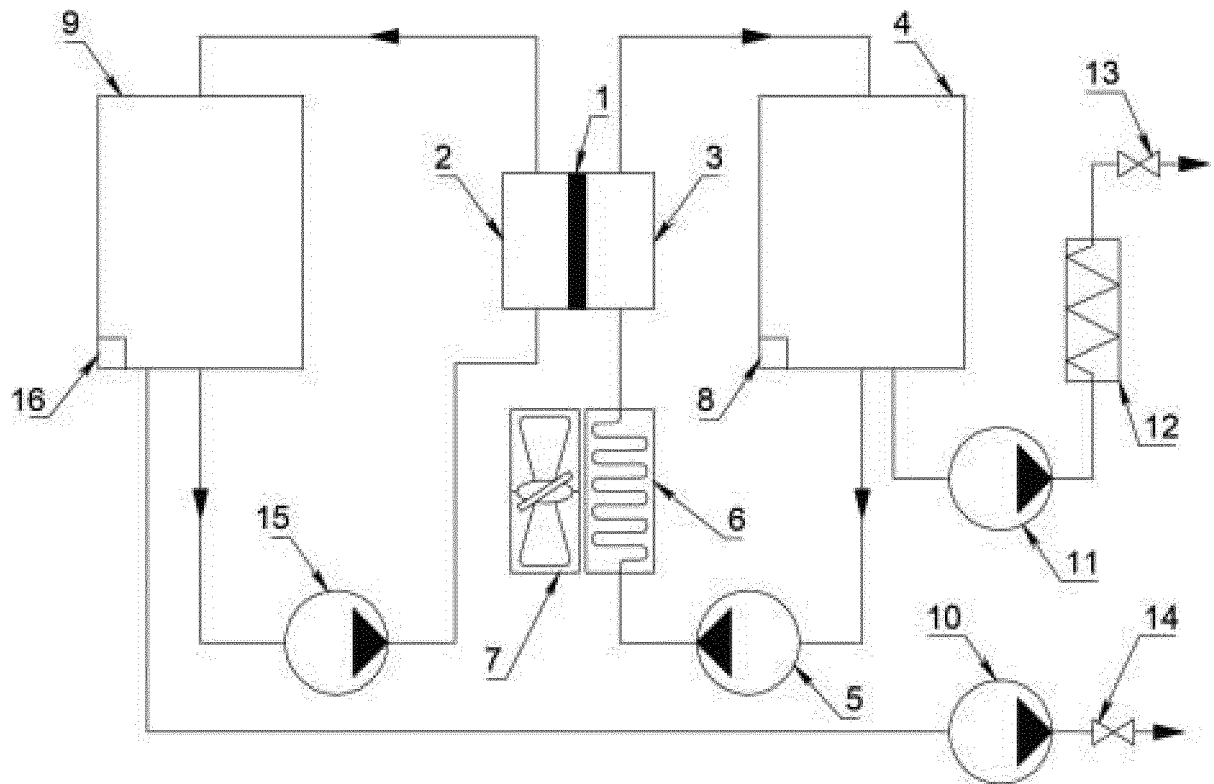


Figure 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/RU 2022/000124

A. CLASSIFICATION OF SUBJECT MATTER F25B 21/02 (2006.01); F24H 1/08 (2022.01); F24H 1/50 (2022.01); F24H 15/174 (2022.01) 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) F25B 21/00, 21/02, F24H 1/08, 1/50, 15/174 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) PatSearch (RUPTO internal), USPTO, PAJ, Esp@cenet, DWPI, EAPATIS, PATENTSCOPE		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	RU 2654548 C2 (OOO "AKVAFOR ") 21.05.2018	1-7
A	SU 1764094 A1 (POLIANSKY ALEKSANDR VIKTOROVICH et al.) 23.09.1992	1-7
A	RU 6430 U1 (NAUCHNO-PROIZVODSTVENNOE MALOE PREDPRIIATIE "SIGMA") 16.04.1998	1-7
A	RU 2154782 C2 (OOO MAK-BET) 20.08.2000	1-7
A, D	EP 1571121 A1 (AQUA PYRENEES S A S SOC) 07.09.2005	1-7
☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 12 July 2022 (12.07.2022)		Date of mailing of the international search report 04 August 2022 (04.08.2022)
Name and mailing address of the ISA/ RU		Authorized officer
Facsimile No.		Telephone No.

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 20090113898 A [0003]
- EP 1571121 A [0005]
- RU 2654548 [0006]