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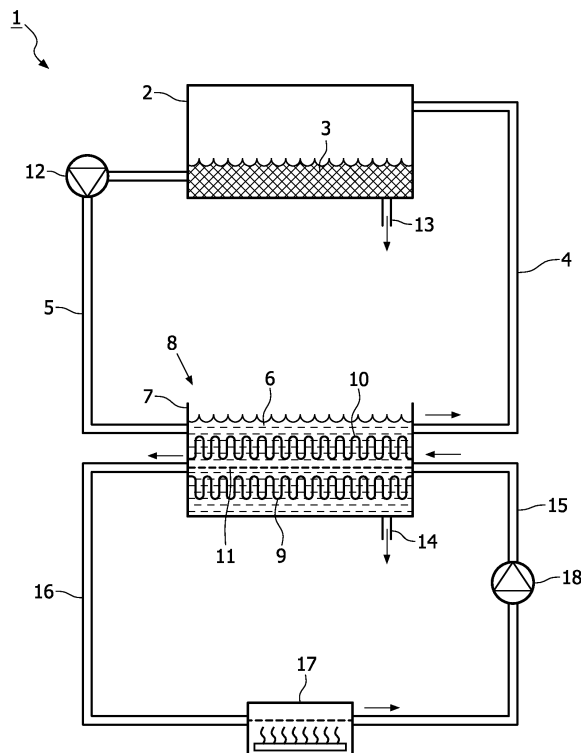
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(54) **System and method for heating washing water for use in a textile laundry**

(57) The invention relates to a system (1) for heating washing water (6) for use in a textile laundry. The inven-

tion further relates to a method for heating washing water for use in a textile laundry, in particular by making use of the system according to the invention.



**FIG. 1**

## Description

**[0001]** The invention relates to a system for heating washing water for use in a textile laundry. The invention also relates to the use of a heat exchanger in a system according to the invention. The invention further relates to a method for heating washing water for use in a textile laundry, in particular by making use of the system according to the invention.

**[0002]** Industrial textile cleaning is a service industry which responds to the need to be able to reuse textile in an attractive and hygienic manner. In industrial laundries diverse types of textile, usually formed by clothing, bed-clothes and towels and so on, are here washed in wet manner, wherein use is made of washing water which is provided with detergents and which is brought at increased temperature into intensive contact with the textile for cleaning. The alkaline washing water is here generally first heated by means of steam generated by a steam boiler, after which the washing water can actually be applied. The washing water is generally discharged after use. Discharge generally takes place via the sewage system or the surface water, usually after sand, textile fibres and other components have been separated by filtering from the waste water to be discharged. The use of a steam boiler to heat the washing water has several drawbacks however. A significant drawback of the steam boiler is that the use of a steam boiler is unfavourable from an energy viewpoint. The steam boiler moreover produces a relatively large amount of noise during operation. In addition to these adverse environmental effects, the steam boiler also has the drawback that it develops an increased pressure during operation, whereby there is a permanent risk of rupture and/or exploding of the steam boiler. The exploding of the steam boiler can here be the consequence of so-called steam explosions inside the steam boiler, which steam explosions will occur relatively quickly in the case for instance boiler scale is removed from the boiler wall, whereby water present in the steam boiler comes into direct contact with the relatively hot boiler wall, whereby instantaneous evaporation and therefore expansion of the water occur, this regularly resulting in disastrous consequences.

**[0003]** The invention has for its object to provide an improved system for heating washing water for use in a textile laundry.

**[0004]** The invention provides for this purpose a system of the type stated in the preamble, comprising: at least one washing chamber adapted to receive textile for washing, at least one first feed conduit for washing water connecting to the at least one washing chamber, at least one first discharge conduit for washing water connecting to the at least one washing chamber, at least one heat exchanger for heating the washing water to be used, comprising: a reservoir for throughflow of the washing water for heating which is connected to the first feed conduit and the first discharge conduit, and at least one axially rotatable, hollow shaft arranged in the reservoir for

throughflow of a substantially liquid heating medium. By heating the relatively cold washing water to be used in a special heat exchanger using a relatively warm heating liquid, the washing water can be heated in relatively safe and efficient manner without the use of a steam boiler being necessary here. In addition to the fact that applying a heat exchanger in which enthalpy is exchanged between two liquids is relatively safe, a substantial energy-saving of up to about 40% can in this way be realized. During the washing process the washing water is recirculated in the washing water circuit, wherein the washing water is heated in the heat exchanger, fed via the first feed conduit to the washing chamber and discharged via the discharge conduit to the heat exchanger, where the washing water to be used again is heated. Because contamination of the washing water occurs during this recirculation, it is necessary to apply a special heat exchanger provided with a hollow shaft which rotates axially during use in order to be able to prevent as far as possible the deposition of contaminants onto the heating hollow shaft. This is because deposition of contaminants onto the hollow shaft could result in a drastic reduction in the performance, and thereby the efficiency, of the applied heat exchanger. As a result of this reduced heat transfer deposition of contaminants onto the relatively hot hollow shaft could moreover result in overheating of the heating medium, which could result in hazardous situations. Relatively clean water, such as mains water, will generally be applied as heating medium guided through the hollow shaft, since mains water is relatively inexpensive and relatively safe in use. It is however also possible to envisage applying other types of liquid heating medium, such as for instance oil.

**[0005]** In a preferred embodiment the system comprises heating means for heating the heating medium for guiding through the hollow shaft of the heat exchanger. The heating means can optionally be arranged on, preferably inside, the hollow shaft. It is however generally recommended to have heating of the heating medium take place at a distance from the heat exchanger. From an energy and economic viewpoint it is generally particularly advantageous here to recirculate the heating medium in a heating circuit, wherein the heating means are connected to the hollow shaft of the heat exchanger via a second feed conduit and a second discharge conduit. The heating means can be of electrical nature, and comprise for instance one or more heating coils. The heating medium will however generally be heated by burning a fuel, such as for instance natural gas or fuel oil. Circulation of the heating medium in the heating circuit generally takes place by making use of a circulation pump. It would however also be possible to envisage no separate heating means being applied for the purpose of heating the heating medium; it is for instance also possible to envisage the hollow shaft being connected to a conduit already provided with relatively hot water. The relatively hot water can optionally be heated here outside the system according to the invention.

**[0006]** In order to increase the heat-exchanging surface area between the heating medium and the washing water for heating it is favourable for the hollow shaft of the heat exchanger to be provided with at least one hollow disc protruding relative to the hollow shaft. The hollow disc will be at least partially filled with the heating medium, whereby the surface area to volume ratio of the hollow shaft can be increased. In a particular preferred embodiment the hollow shaft of the heat exchanger is provided with a plurality of hollow discs mutually connected in series and protruding relative to the hollow shaft. The hollow discs will generally be arranged substantially transversely of the shaft. It can however also be advantageous to have the hollow discs enclose an angle differing from 90° with the shaft, whereby turbulence, and therefore an improved mixing, can be realized in the reservoir.

**[0007]** The washing water volume of the reservoir of the heat exchanger is preferably greater than the washing water volume of the washing chamber. The washing water volume of the reservoir is preferably at least 1.5 times greater than the washing water volume of the washing chamber. The washing water volume is understood to mean the volume of washing water which will be present during operation in respectively the reservoir and the washing chamber. By making the washing water volume of the reservoir greater than the washing water volume of the washing chamber a buffer of hot washing water is created which can be employed instantly for guiding through the washing chamber, this enhancing the speed and efficiency of the washing process.

**[0008]** The system will generally comprise a plurality of washing chambers connected in series, which together form a wash line, so that a complete washing process for washing textile can be performed as fully as possible. The textile will here generally be prewashed in a first washing chamber, after which the main wash will take place in a subsequent washing chamber. In a chamber following thereon the textile will generally be rinsed and then optionally treated with a neutralizing acid solution. The wash line here preferably forms a so-called continuous batch tunnel washer (CBW), wherein the textile is guided through the different washing chambers by means of an axially rotatable transport screw, in particular a worm (Archimedes) screw. An example of a continuous batch tunnel washer is described in the international patent application WO 03016608, which is wholly included herein by way of reference.

**[0009]** In a preferred embodiment the system comprises at least one outlet for removing washing water from the system. The system will generally comprise a plurality of outlets, wherein the at least one washing chamber is provided with at least one outlet, and wherein the reservoir of the heat exchanger is provided with at least one outlet. In this way used, and generally contaminated, washing water can be removed relatively simply from the system.

**[0010]** In order to enable optimizing of the heat transfer in the heat exchanger, it is advantageous that the wash-

ing water for heating and the heating medium are guided in mutual counterflow through the heat exchanger.

**[0011]** The circulation of the washing water in the washing water circuit preferably take place by applying a circulation pump. The pump is preferably coupled here to the first feed conduit for pumping washing water from the heat exchanger into the washing chamber.

**[0012]** In order to enable further optimizing of the washing process, the system preferably comprises a temperature sensor for detecting the temperature of the washing water for guiding into the washing chamber. By detecting the washing water temperature before it is guided into the washing chamber it is possible to monitor whether the washing water has a correct optimum temperature. In a particular preferred embodiment the heat exchanger comprises a temperature sensor for detecting the inlet temperature of the washing water, a temperature sensor for detecting the outlet temperature of the washing water, a temperature sensor for detecting the inlet temperature of the heating medium, and a temperature sensor for detecting the outlet temperature of the heating medium. The full process of heating the washing water can be tracked by arranging a temperature sensor at multiple critical locations in the system. The system can furthermore be regulated on the basis of the information collected by the temperature sensors, for instance by modifying the flow rate of the circulation pump of the washing water circuit, modifying the flow rate of the circulation pump of the heating circuit, modifying the power of the heating means and/or modifying the rotation speed of the hollow shaft. The hollow shaft of the heat exchanger is preferably coupled to drive means, in particular an electric motor, for axially rotating the hollow shaft. Control of the system according to the invention generally takes place by applying a control unit.

**[0013]** The invention also relates to the use of a heat exchanger in a system according to the invention. A commercially known EMSROTOR heat exchanger as described on the internet page [http://www.emsrotor.nl/en/index\\_en.html](http://www.emsrotor.nl/en/index_en.html) is preferably applied in the system according to the invention. Structural measures of the EMSROTOR are wholly incorporated by way of reference in this patent specification.

**[0014]** The invention also relates to a method for heating washing water for use in a textile laundry, in particular by making use of a system according to the invention, comprising the steps of: A) guiding a substantially liquid heating medium through a rotating hollow shaft of a heat exchanger, B) guiding washing water for heating through a reservoir of the heat exchanger, the reservoir enclosing the hollow shaft, C) guiding the heated washing water from the heat exchanger through at least one washing chamber adapted to wash textile, and D) returning to the reservoir washing water guided through the washing chamber. The method preferably also comprises step E), comprising of heating the heating medium using heating means prior to guiding the heating medium through the hollow shaft as according to step A). The method pref-

erably also comprises step F), comprising of returning the heating medium to the heating means after guiding the heating medium through the hollow shaft as according to step A). A heating circuit is in this way generated, this being advantageous from an energy and business economic viewpoint. The method preferably also comprises step G), comprising of detecting in or close to the heat exchanger the inlet temperature and the outlet temperature of both the washing water and the heating medium. During step C) the heated washing water is pumped out of the heat exchanger into the at least one washing chamber, preferably using a pump. In a particular preferred embodiment the pump flow rate of the pump is regulated on the basis of the detected inlet temperatures and outlet temperatures. Advantages and further embodiment variants of the method according to the invention have already been described at length in the foregoing.

**[0015]** The invention will be elucidated on the basis of non-limitative exemplary embodiments shown in the following figures. Herein:

figure 1 is a schematic view of a first embodiment of a system according to the invention, and  
figure 2 is a schematic view of a second embodiment of a system according to the invention.

**[0016]** Figure 1 shows a schematic view of a first embodiment of a system 1 according to the invention. System 1 comprises a washing chamber 2 in which textile 3 for washing is received. Washing chamber 2 is coupled to a first feed conduit 4 and a first discharge conduit 5 for respective feed and discharge of washing water 6. Washing water 6 is heated in a reservoir 7 of a heat exchanger 8 coupled to first feed conduit 4 and first discharge conduit 5. An axially rotatable hollow shaft 9 provided with a plurality of hollow discs 10 is arranged in reservoir 7 for throughflow of a relatively hot liquid heating medium 11. A first circulation pump 12 connected to first feed conduit 4 pumps washing water 6 out of washing chamber 2 to reservoir 7. An additional pump (not shown) can optionally be used to pump washing water 6 out of the reservoir to washing chamber 2. Because hollow shaft 9 rotates during operation deposition of fouling present in washing water 6 onto hollow shaft 9 can be countered. Washing chamber 2 is provided with a closable outlet 13 to enable optional removal of washing water 6 from system 1. In addition, reservoir 7 is also provided with a closable outlet 14 to enable removal of washing water 6 from system 1. Hollow shaft 9 connects to a second feed conduit 15 and to a second discharge conduit 16 for respective feed and discharge of heating medium 11. Second feed conduit 15 and second discharge conduit 16 connect to each other via a heating element 17. A second circulation pump 18 circulates heating medium 11 in the formed (second) circuit. In this exemplary embodiment the inlet temperature of heating medium 11 in the heat exchanger amounts to 90°C, and the outlet

temperature of heating medium 11 in the heat exchanger to 70°C. Washing water 6 is guided into heat exchanger 8 at a temperature of 58°C and is heated two degrees in heat exchanger 8 to 60°C. This latter temperature is generally an ideal temperature for a main wash program during washing of textile 3. About three litres of washing water 6 will generally be employed here per kilogram of textile 3 for the purpose of washing the textile 3. When 50 kilograms of textile 3 have to be washed, about 150 litres of washing water 6 will therefore then be required. The washing water volume in reservoir 7 preferably amounts to at least 1.5 times the washing water volume in washing chamber 2 in order to enable buffering of sufficient heated washing water 2, whereby the washing water volume in reservoir 7 amounts to about 225 litres.

**[0017]** Figure 2 is a schematic view of a second embodiment of a system 19 according to the invention. System 19 comprises a plurality of washing chambers 20 which are connected in series and together form a wash line 21, in particular a continuous batch tunnel washer, which is adapted to clean textiles and similar goods. The washing chambers are designated with the Roman numerals I to VI. An axially rotatable, helical transport screw 22 is arranged in wash line 21 for displacement from the first washing chamber (I) 20 to the last washing chamber (VI) 20. The first two washing chambers (I and II) 20 here form prewash chambers, the following two washing chambers (III and IV) 20 here form main wash chambers. The subsequent washing chamber (V) 20 forms a rinsing chamber and the final washing chamber (VI) 20 forms a neutralization chamber. It is noted that only one exemplary embodiment is shown here. Many variants to this modular structure of wash line 21 can be envisaged. The prewash chambers (I and II) 20 and the main wash chambers (III and IV) 20 are coupled to a first feed conduit 23 and a first discharge conduit 24 for respective feed and discharge of washing water 25. Washing water 25 is heated by applying a special heat exchanger 26 as also shown in figure 1. Heat exchanger 26 comprises a reservoir 27 for washing water 25, and an axially rotating, profiled hollow shaft 28 arranged in reservoir 27 for passage of relatively hot mains water 29. The mains water 29 is pumped through hollow shaft 28 and through a heating element 31 using a circulation pump 30. First discharge conduit 24 is also provided with a circulation pump 32 for pumping washing water 25 out of washing chambers 20 to reservoir 27 of heat exchanger 26. First feed conduit 23 and first discharge conduit 24 are provided with temperature sensors 33 to enable detection of the inlet temperature and the outlet temperature of washing water 25. Temperature sensors 34 are also arranged in or close to heat exchanger 26 for the purpose of there detecting the current inlet temperatures and outlet temperatures of washing water 25 and the relatively hot mains water 29. Temperature sensors 33, 34 are coupled to a control unit (not shown) to enable regulating of system 19 on the basis of the detected temperatures. Regulation parameters here are for instance the flow rate of

circulation pump 30, 32, the power of heating means 31, the rotation speed of hollow shaft 28 and the rotation speed of transport screw 22. Using the steam-free system 19 according to the invention textile can be cleaned in relatively safe, advantageous, and therefore efficient manner.

**[0018]** It will be apparent that the invention is not limited to the exemplary embodiments shown and described here, but that within the scope of the appended claims numerous variants are possible which will be self-evident to the skilled person in this field.

## Claims

1. System for heating washing water for use in a textile laundry, comprising:

- at least one washing chamber adapted to receive textile for washing,
- at least one first feed conduit for washing water connecting to the at least one washing chamber,
- at least one first discharge conduit for washing water connecting to the at least one washing chamber,
- at least one heat exchanger for heating the washing water to be used, comprising:

- o a reservoir for throughflow of the washing water for heating which is connected to the first feed conduit and the first discharge conduit, and

- o at least one axially rotatable, hollow shaft arranged in the reservoir for throughflow of a substantially liquid heating medium.

2. System as claimed in claim 1, **characterized in that** the system comprises heating means for heating the heating medium for guiding through the hollow shaft of the heat exchanger.

3. System as claimed in claim 2, **characterized in that** the heating means are connected to the hollow shaft of the heat exchanger via a second feed conduit and a second discharge conduit.

4. System as claimed in any of the foregoing claims, **characterized in that** the hollow shaft of the heat exchanger is provided with at least one hollow disc protruding relative to the hollow shaft.

5. System as claimed in any of the foregoing claims, **characterized in that** the system comprises a plurality of washing chambers connected in series and that the system comprises transport means at least partially incorporated in the wash line for transporting the textile from one washing chamber to another washing chamber.

6. System as claimed in claim 5, **characterized in that** the washing chambers are connected integrally to each other in a wash line.

7. System as claimed in claim 6, **characterized in that** the transport means comprise an axially rotatable, helical transport path.

8. System as claimed in claim 6 or 7, **characterized in that** the wash line is formed by a continuous batch tunnel washer.

9. System as claimed in any of the foregoing claims, **characterized in that** the first feed conduit is provided with a pump for pumping washing water from the heat exchanger into the washing chamber.

10. System as claimed in any of the foregoing claims, **characterized in that** the heat exchanger comprises a temperature sensor for detecting the inlet temperature of the washing water, a temperature sensor for detecting the outlet temperature of the washing water, a temperature sensor for detecting the inlet temperature of the heating medium, and a temperature sensor for detecting the outlet temperature of the heating medium.

11. Method for heating washing water for use in a textile laundry, in particular by making use of a system as claimed in any of the claims 1-10, comprising the steps of:

- A) guiding a substantially liquid heating medium through a rotating hollow shaft of a heat exchanger,

- B) guiding washing water for heating through a reservoir of the heat exchanger, the reservoir enclosing the hollow shaft,

- C) guiding the heated washing water from the heat exchanger through at least one washing chamber adapted to wash textile, and

- D) returning to the reservoir washing water guided through the washing chamber.

12. Method as claimed in claim 11, **characterized in that** the method also comprises step E), comprising of heating the heating medium using heating means prior to guiding the heating medium through the hollow shaft as according to step A).

13. Method as claimed in claim 11 or 12, **characterized in that** the method also comprises step F), comprising of returning the heating medium to the heating means after guiding the heating medium through the hollow shaft as according to step A).

14. Method as claimed in claim 13, **characterized in that** the method also comprises step G), comprising

of detecting in or close to the heat exchanger the inlet temperature and the outlet temperature of both the washing water and the heating medium.

15. Method as claimed in any of the claims 11-14, **characterized in that** during step C) the heated washing water is pumped out of the heat exchanger into the at least one washing chamber using a pump.

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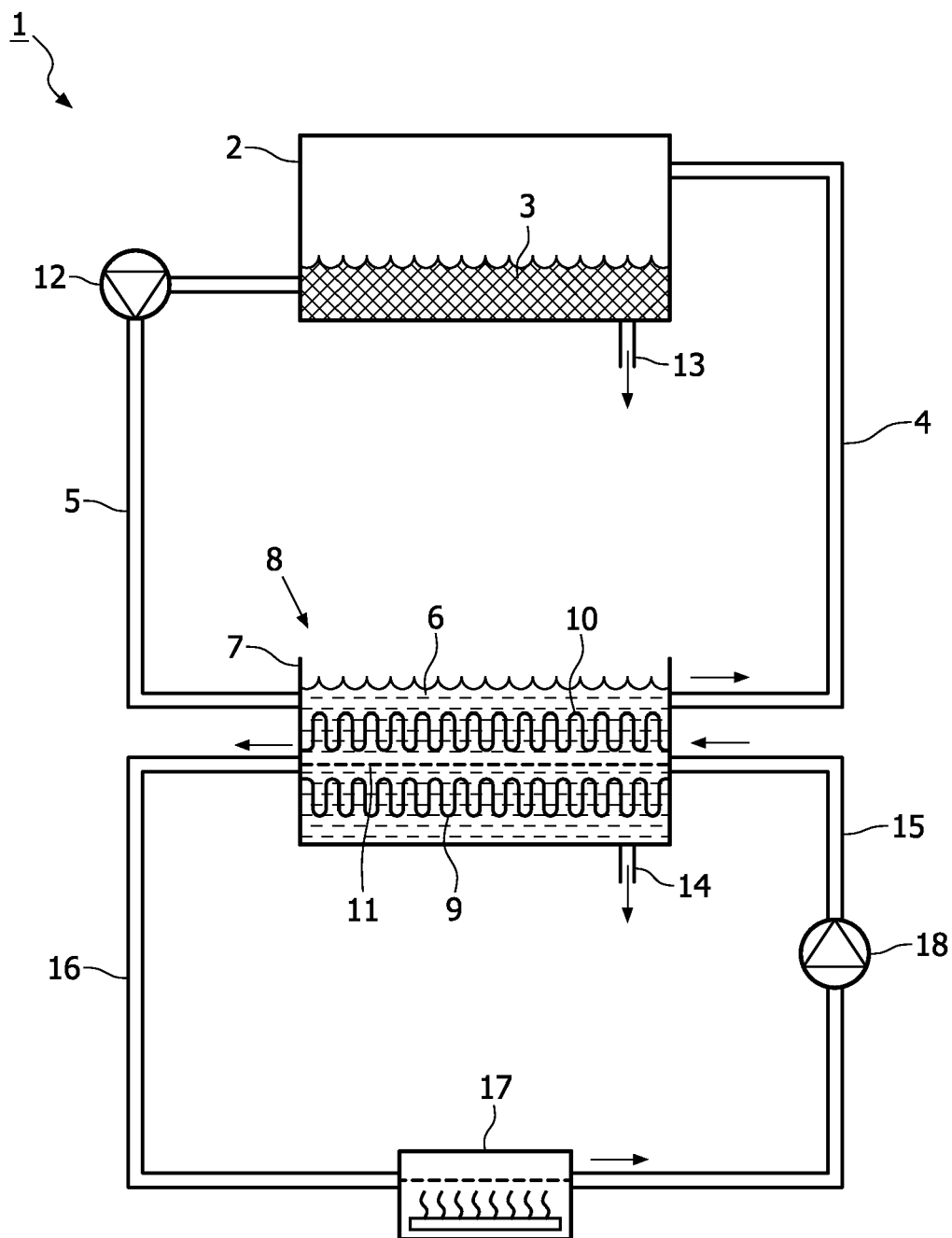


FIG. 1

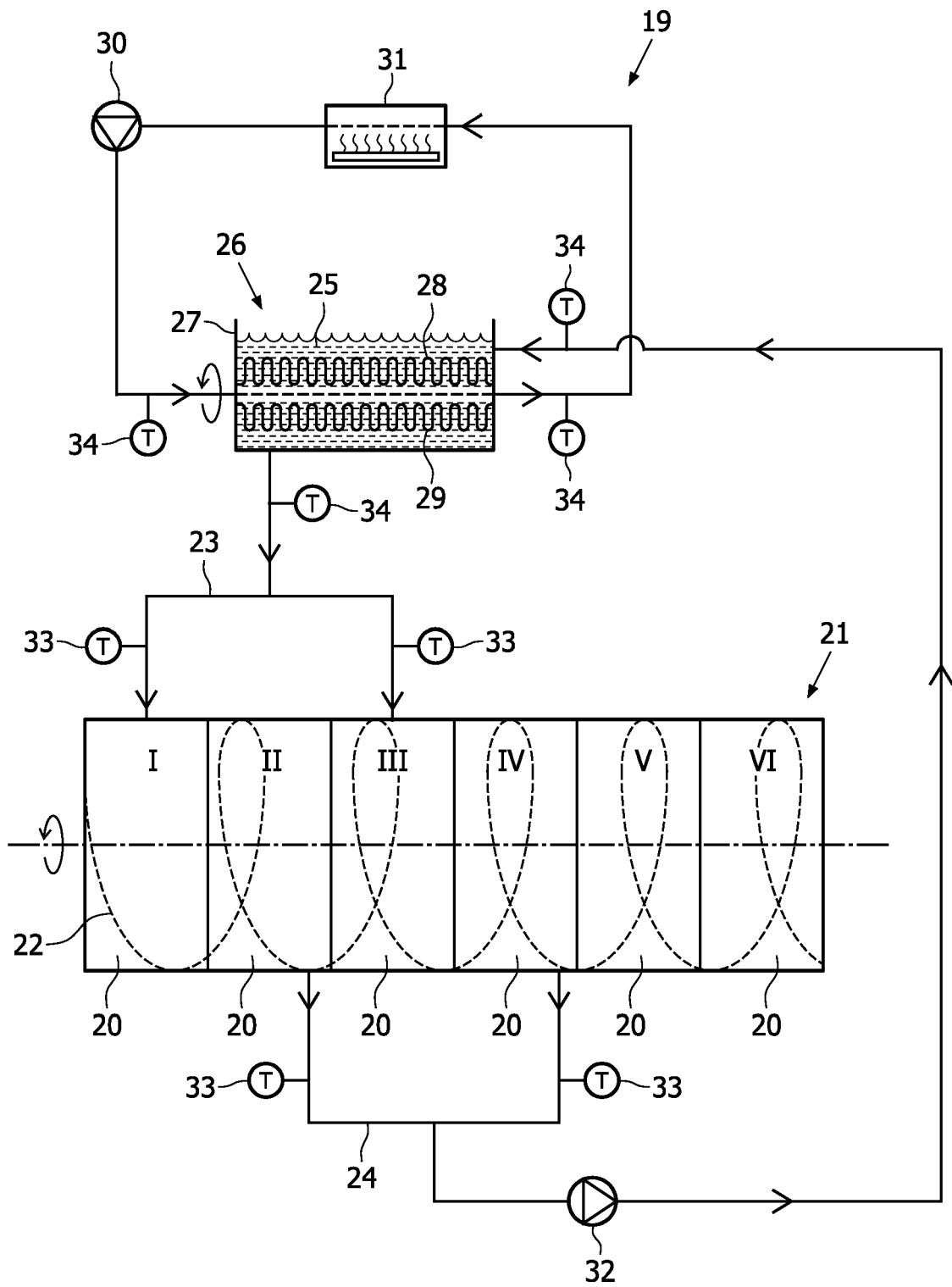


FIG. 2



## EUROPEAN SEARCH REPORT

Application Number  
EP 09 17 2993

| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                              |                                                      |                                                 |
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| Place of search<br>Munich                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                              | Date of completion of the search<br>14 December 2009 | Examiner<br>Pollet, Didier                      |
| CATEGORY OF CITED DOCUMENTS<br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document<br>T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>& : member of the same patent family, corresponding document |                                                                                                                                                              |                                                      |                                                 |

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**ANNEX TO THE EUROPEAN SEARCH REPORT  
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EP 09 17 2993

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
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