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(54) **Method and assembly for combined wet and dry treatment of textile articles in rope form**

(57) A method and assembly including a textile treatment apparatus (14) for combinatory wet and dry treatment of textile articles in the same apparatus (14) in endless rope form under vacuum and ventilation effect are disclosed. The assembly comprises a blower line (22), a process bath circulation line (33) and a vacuum line (42) that are independently controlled and constructed preferably without an interconnection therebetween. The lines (22, 33, 42) are connected to the apparatus (14) from different positions, thereby providing independent operation of each line and dynamic process control in the overall system.

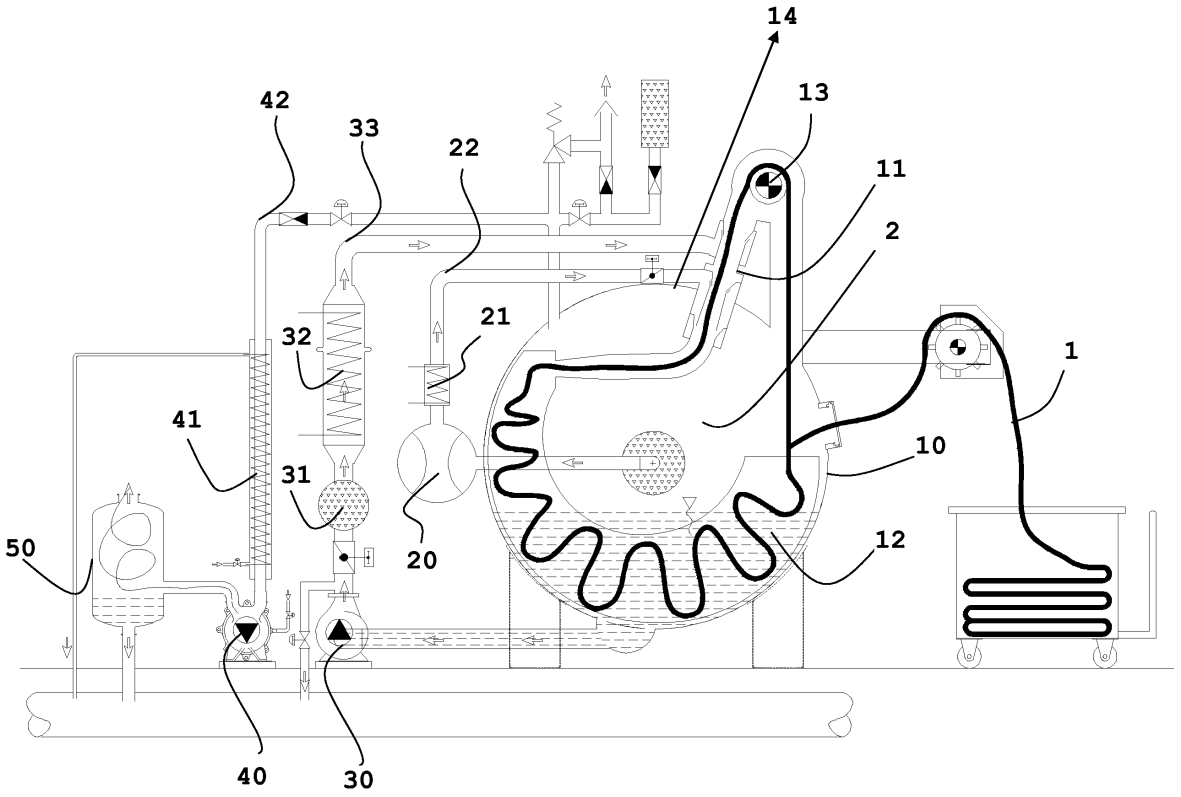

FIG. 1

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Description

Technical Field of the Invention

[0001] The present invention relates to a method in which wet and dry treatments of the textile articles i.e. fabrics are conducted in the same apparatus under vacuum effect and an assembly for performing such operation is disclosed. The method and assembly of the present invention enables to perform textile treatment operations such as dyeing, washing, drying and bleaching in a single apparatus in a combined and continuous manner. Dynamic process control during such treatment steps is the major advantage of the invention.

Background of the Invention / Prior Art

[0002] The present invention provides an improved method and assembly enabling wet and dry processing of textile articles in a single apparatus wherein the treatment steps are performed under vacuum and blowing effects depending upon the type of operation. Means for vacuum, ventilation and process bath circulation are provided through separate lines in which case dynamic process control i.e. operation of vacuum, ventilation and bath circulation are carried out independently.

[0003] Conventional rope fabric treatment machines are mainly used for the wet treatment of the textile articles such as dyeing and washing, and have been under active development in the past years. Those machines treat the fabric in endless rope form through jet units and circulate the same in a vat containing process liquor. In the last years, however, machines for wet processing and drying the textiles in a multifunctional apparatus have been improved for economical reasons. Such machines provided much more cost effectiveness and time saving as compared to the former machines found in the art. Methods and machines providing those mentioned features are for instance disclosed in EP 0 908 550, US 4,829,620, US 3,921,420 and US 5,524,359.

[0004] EP 0 908 550 discloses a process and machine for rope fabric treatment. The method and apparatus disclosed therein includes vacuum creating means adapted to create vacuum of a controlled amount in the vat. However, said method and apparatus are suitable only for wet treatment of fabrics and do not enable further drying/finishing step. Furthermore, vacuum and bath circulation lines are directly connected. This primarily causes the vacuum and circulation operations to be carried out sequentially but not simultaneously. Page 4 of the disclosure explains the procedure of this sequential operation during the preparation steps of the dyeing cycle.

[0005] US 4,829,620 discloses a process for drying textile material in rope form wherein drying of moist textile material is completed after a wet treatment in the same apparatus. The combined machine disclosed therein enables to implement superatmospheric pressure into a sealed system, and also includes means for providing hot air blowing and process bath circulation through the jet nozzle located on the machine. Moisture available on the treated fabric is removed with the supersaturated gas which is circulated by means of a blower, heated with a conventional heat exchanger and condensed by a trap. However, one skilled in the art would appreciate that superatmospheric pressure applied to the apparatus increases the energy consumption since higher pressure requires higher energy input, and higher temperature created in the process liquor causes serious damages in terms of product quality. Furthermore, costs and time duration of the drying operation considerably increases.

[0006] US 3,921,420 discloses a different method and means for dyeing textile strand material. Vacuum is applied to the suction type rolls for extracting foam and moisture, and treating liquor is fed along with an inert gas through the nozzle. Said vacuum applied to the roll is not performed for evacuating the vat, but is applied for extracting the moisture on the roll during the fabric movement. This causes the vacuum pump to suck not only the moisture but also dyeing liquor of the process. In another point of view, the construction of the system allows only wet treatment unlike the combined system of the present invention. Furthermore, the system is costly to operate due to the continuous inert gas supply requirement and higher energy consumption.

[0007] US 5,524,359 discloses a method and assembly having a different construction for treatment of fabric in a treatment device which is in the form of autoclave. Pressure within said autoclaves is adjustable to vacuum or superatmospheric conditions. Despite the specification includes drying of textile material in the same assembly, construction of the same neither provides blowing effect for convenient drying nor does it enable the feed lines to be operated independently for dynamic process control.

[0008] As a consequence, documents in the state of the art are silent about the technical problems which arise with the conventional systems. Neither of those documents provides dynamic process control opportunity in a system comprising bath circulation, vacuum and blowing means. In a preferred embodiment of the present invention said means are provided with separate lines which are operated in an independent and separate manner, therefore one, two or three of the mentioned operations can be performed in a certain combination mode depending on the type and nature of the treatment procedure. Features appearing hereby enable suitably to use apparatus of the present invention for both wet and dry treatment purposes.

Objects of the Invention

[0009] An object of the present invention is to provide an assembly including a textile treatment apparatus which can be utilized for wet and dry treatment of textile articles in a combined manner and in the same apparatus.

[0010] Another object of the present invention is to provide a textile treatment assembly which comprises means for providing bath liquor circulation, vacuum and blowing.

[0011] Another object of the present invention is to provide a textile treatment assembly in which the bath liquor circulation, vacuum and blowing are operated independently through separate lines for dynamic process control.

[0012] A further object of the present invention is to provide a textile treatment assembly in which the bath liquor circulation and blowing lines are fed to separate points of the jet nozzle of said apparatus.

[0013] One another object of the present invention is to provide a textile treatment assembly wherein a vacuum line comprising two or more vacuum pumps tailored for wet and dry treatment steps is provided.

[0014] Still a further object of the present invention is to provide a process for combined wet and dry treatment of a textile article in a single apparatus wherein the bath liquor circulation, vacuum and blowing lines are operated independently for dynamic process control.

Summary of the Invention

[0015] Objects of the invention are achieved through providing of a vacuum line for evacuating the vat of the apparatus below the ambient pressure, a process liquor circulation line, and a blower line fed to the nozzle for controlling the temperature of the gas medium inside the vat and assisting drying of the textile article as well as assisting the same to move readily through the nozzle with an aspiration effect. Three lines mentioned above are connected to the apparatus via separate lines, preferably without interconnection therebetween for independent operation. Resulting system allows operating the individual lines depending on the needs of the treatment step, for instance; vacuum line can be operated simultaneously with the bath circulation line during a dyeing operation of the apparatus. Additionally blowing line also can be utilized during such a treatment process for adjusting the temperature of the saturated gaseous medium inside the vat and/or providing the fabric movement with aspiration effect. Such variations can be implemented depending on the treatment process and its required process dynamic parameters.

[0016] A further advantage of the present invention arises in a drying process wherein vat of the apparatus is evacuated by a vacuum pump and the saturated gas thereby sucked is condensed by a separator. Blower of the apparatus continuously sucks the saturated gas inside the vat and feeds the same to the nozzle after heating up to a desired temperature. Therefore, drying process time and energy consumption of the apparatus considerably decreases.

[0017] Consequently, inventive mode of the invention underlies the fact that providing a process and assembly for multipurpose implementations i.e. wet and dry treatment of the fabric, in a single apparatus wherein vacuum, bath circulation and blower lines are dynamically and independently controlled. Details and further advantages of the preferred embodiments are given below in the detailed description part.

Brief Description of the Figures

[0018] Accompanying figures are given solely for the purpose of schematically exemplifying the principle embodiments of the present invention.

[0019] Fig. 1 is a schematic diagram of the system comprising an apparatus (14), a blower line (22), a bath circulation line (33) and a vacuum line (42) having a single vacuum pump (40) according to one embodiment of the present invention; Fig. 2 similarly represents schematic diagram of the system comprising an apparatus (14) a blower line (22), a bath circulation line (33) and a vacuum line (42) having two vacuum pumps (43, 44) according to another embodiment of the present invention.

Detailed Description of the Invention

[0020] As the conventional methods and devices for treating textiles in endless rope form fail to provide dynamic process control and suitably constructed multipurpose utilization, one embodiment of the present invention do hereby provides a system in which textile articles are treated in a single machine without the need for transporting said article to another machine so as to finish the same.

[0021] With reference to Figure 1 and 2, a textile article (1) is treated in the vat (10) of the apparatus (14). Textile article i.e. fabric (1) is suitably loaded into the apparatus (14) by attaching the both ends of the fabric (1) so as to form an endless loop. Said loop of fabric (1) can be exposed to treatment or sequence of treatments such as washing, dyeing, bleaching and drying in the same apparatus (14) without the need to transfer the fabric into different treatment devices. Thus, one of the economical and time saving advantages of the present invention is thereby provided.

[0022] In one embodiment of the present invention, fabric (1) is exposed to one or more wet treatment steps in the presence of process liquor (12) containing one or more of the group of components such as auxiliary chemicals, dye, water and bleaching agents. Fabric (1) in endless rope form is circulated with the roller (13) located on the apparatus (14). A vacuum pump (40) is employed on a vacuum line (42) for evacuating the inside medium of the vat (10). During the operation of the vacuum line (42), inside pressure of the vat (10) is maintained below the ambient pressure, thus evaporation temperature of the process liquor decreases. Further, the oxidation caused by the presence of air is substantially eliminated. As a consequence, operation temperature of the process and also the heat required for conducting such process considerably decreases whereby less energy is consumed thanks to this effect. Furthermore, decreasing the oper-

ation temperature mostly improves the product quality, particularly the quality of polyester and polyester/woolen fabrics that are quite sensitive to higher temperatures. Saturated gas in the evacuated medium which is sucked by the vacuum pump (40) is fed to the separator (50) for condensation in order to create a continuous cycle of evaporation.

[0023] According to the mentioned embodiment regarding the wet treatment process and assembly of the present invention, said assembly further comprises a blower line (22) comprising a heat exchanger (21) and a pump (20) for ventilation. Saturated gaseous medium (2) inside the vat (10) is circulated through said blowing line (22) and is fed to the jet nozzle (11) after heating the same by a heat exchanger (21).

[0024] The system of the present invention further comprises a bath liquor circulation line (33) comprising a pump (30), a filter (31) and a heat exchanger (32). As already well known from the state of the art said circulation line (33) circulates the process bath liquor (12) from bottom of the vat (10) through the jet nozzle (11) for efficient wet treatment. It is an essential feature of the invention that blowing line (22) and bath circulation line (33) are attached to said jet nozzle (11) from different points. Reason is that the fabric (1) moves much more readily under a ventilation effect compared to some conventional machines in which process bath and ventilated gas is fed to the nozzle by means of a single line as a mixture.

[0025] According to a second embodiment of the present invention dry treatment of fabric (1) is also performed in the same apparatus (14) of the present invention. After removing the bath liquor (12) of the wet treatment procedure from the vat (10), drying operation is started for finishing the product. In this process step, bath liquor circulation line (33) is stopped, blowing line (22) and vacuum line (42) are operated continuously or discontinuously depending on the required process control parameters. Both the vacuum line (42) and blowing line (22) are operated as described in the first embodiment of the present invention. Blowing line (22) provides heated gas to be fed through the nozzle (11), whereas vacuum line (42) removes the moisture containing gas from the inside medium of the vat (10).

[0026] According to a third embodiment of the present invention the vacuum line (42) of the present invention is operated with two vacuum pumps (43, 44) wherein said vacuum pumps (43, 44) are intended to be operated in wet and dry treatment steps separately. The first vacuum pump (43) as illustrated in Figure 2 is operated in wet treatment and the second pump (44) is operated in dry treatment. The first vacuum pump (43) has preferably lower volumetric flow rate capacity compared to the second pump (44) and is able to provide lower pressure i.e. as low as 33 mbar inside the vat (10). This pump is suitable for the required evacuation since it sucks only the gaseous medium but not the process bath liquor. The second pump (44) is the one which has higher volumetric flow and is capable to create a vacuum medium but not a lower pressure compared to the first vacuum pump (43). The negative pressure created by this pump (44) can be as low as 700 mbar and it sucks more volume of gas to remove the moisture from the fabric (1). Therefore, the preferred third embodiment of the invention enables to operate the vacuum line (42) not only before/after the wet treatment, but also during the wet treatment. Therefore, it is a clear consequence of this embodiment that the system enables to implement the vacuum suction during a wet fabric treatment i.e. dyeing, bleaching, washing; in other words, vacuum line (42) can be operated simultaneously with the bath circulation line (33) and blower line (22). It will be appreciated that neither a technical problem regarding simultaneous operation of vacuum pump and bath circulation line during a wet treatment, nor a solution i.e. use of two vacuum pumps having different characteristics tailored for wet and dry treatment has been proposed in the art. To this end, dynamic process control during both the wet and dry treatment steps can be applied, for instance, vacuum line (42) can be operated continuously or discontinuously during the active bath circulation and blowing operations. This optional utilization can also be implemented for bath circulation and blowing lines (33, 22) by selectively operating the same.

[0027] According to a fourth embodiment of the present invention the combined process for treating the fabric (1) in a single apparatus can be controlled by conventional process control means wherein the necessary parameters for controlling said combined process are fed to said means. The necessary input parameters include at least the temperature of the gaseous medium, pressure of the gaseous medium and total volume of the liquid phase inside the vat (10). Accordingly, the process control means receives the necessary input and converts them into suitable output values. The vacuum line (42), bath circulation line (33) and blowing line (22) are independently controlled according to the predetermined control parameters thereby.

[0028] According to a fifth embodiment of the present invention, a combined process for treating the textile articles in a single apparatus is provided. Process parameters include temperature and pressure of the gaseous medium and bath circulation rate of the process liquor, and are adjusted by means of a dynamic and independent process control. Obviously, such parameters can also include the moisture content of the gaseous medium which can well be controlled by a combinational operation of the vacuum and blowing lines (42, 22).

[0029] According to all embodiments of the present invention given in detail above, the system so obtained enables to conduct the wet treatment of fabric in a temperature ranging from 25 °C to 100 °C in the saturated vapor phase under a vacuum effect. For instance, operation temperature for conducting the dyeing process of the conventional polyester is at around 100 °C /101,33 kPa and the conventional processes for dyeing polyester

are conducted at around 130 °C / 270,13 kPa. The lower temperature process conditions enable to use less chemicals and energy input, and to prevent the deformations caused by relatively higher temperatures. Furthermore, with the combined process of the present invention drying of fabric is completed in considerably shorter time durations in the same apparatus (14) of the system.

[0030] Inventive concept of the present invention lies in the fact that the system and process disclosed hereby presents multipurpose use i.e. wet and dry treatment with the specific construction of the overall assembly in which selective and combinational use of blowing line (22), bath liquor line (33) and vacuum line (42) are possible. Use of those lines (22, 33, 42) also includes the selective utilization of all components (pumps, heat exchangers, valves etc.) present on those lines. Therefore the process control means can control not only the on/off function of said lines, but also may control the on/off functions and quantitative adjustments of said components depending on the process nature. It is also one of the inventive elements of the present invention that blower line (22), bath liquor line (33) and vacuum line (42) are connected to the apparatus with separate lines preferably without interconnection therebetween wherein blower line (22) and bath liquor circulation line (33) are connected to the jet nozzle from different points. Feeding them from different points of the jet nozzle (11) provides the advantage of, first spraying dye liquor onto the fabric (1) for wet treatment and moving the same with the ventilation effect of the blowing pump (20).

[0031] In such an assembly wherein the three mentioned lines (22, 33, 42) are independently fed to the apparatus (14) from different points without an interconnection, enables the operator and/or automatic process control means to keep the process in the most ideal state in accordance with the predetermined parameters such as temperature of the process liquor, temperature of the evacuated medium, pressure inside the vat, moisture percent of the gaseous medium, level and flow rate of the process liquor, flow rate of the heated air in the blowing line (22), evacuation rate etc.

[0032] Further advantages of the present invention would be apparent to those skilled in the art when the above given embodiments are examined in combination with the appended drawings.

Claims

1. An assembly for combinatory wet and dry treatment of textile articles in endless rope form in a single apparatus comprising at least a vat (10), a roll (13), a jet nozzle (11), a blower line (22), a process bath circulation line (33) and a vacuum line (42) connected to said vat from a suitable position for sucking substantially gaseous medium from inside said vat (10) **characterized in that** the blower line (22), the process bath circulation line (33) and the vacuum line (42) are arranged to be operable independently as separate lines for providing dynamic process control.

2. An assembly for wet and dry treatment of textile articles according to claim 1 wherein the assembly further comprises means for automatically controlling at least the blower line (22), process bath circulation line (33) and vacuum line (42).

3. An assembly for wet and dry treatment of textile articles according to claim 1 wherein the blower line (22), process bath circulation line (33) and vacuum line (42) are arranged to be independently operated depending on the predetermined process control parameters.

4. An assembly for wet and dry treatment of textile articles according to claim 1 wherein said blower line (22) comprises at least a blowing pump (20) and a heat exchanger (21).

5. An assembly for wet and dry treatment of textile articles according to claim 1 wherein said bath circulation line (33) comprises at least a pump (30), a filter (31) and a heat exchanger (32).

6. An assembly for wet and dry treatment of textile articles according to claim 1 wherein said vacuum line (42) comprises at least a vacuum pump (40), a separator (50) and a cooling heat exchanger (41).

7. An assembly for wet and dry treatment of textile articles according to claim 1 wherein said vacuum line (42) comprises a vacuum pump (43) for wet treatment, an additional vacuum pump (44) for dry treatment, a separator (50) and a cooling heat exchanger (41).

8. An assembly for wet and dry treatment of textile articles according to claim 7 wherein the vacuum pump (43) for wet treatment has lower volumetric flow rate and higher vacuum capacity compared to the vacuum pump (44) of the dry treatment.

9. An assembly for wet and dry treatment of textile articles according to claim 1 wherein the blower line (22) and the process bath circulation line (33) are connected to the jet nozzle (11) of the apparatus (14) from substantially different locations of said nozzle.

10. A method for combinatory wet and dry treatment of textile articles in endless rope form in a textile treatment assembly comprising a vat (10), roll (13), jet nozzle (11) and additionally a blower line (22), a process bath circulation line (33) and a vacuum line (42) for suitably conducting such combinatory treatment steps, said process comprising the steps of:

loading the fabric (1) to be treated into the vat (10) of the apparatus (14),
exposing the fabric (1) to wet treatment in a substantially liquid medium where the bath liquor of the process bath circulation line (33) and circulated gas of the blower line (22) are separately fed to the jet nozzle (11) from different positions, and said vacuum line (42) is simultaneously operated with the bath circulation line (33) and the blower line (22) for evacuating the gaseous medium (2) of the vat (10), and
applying dry treatment on said fabric (1) in an evacuated medium wherein the bath circulation line (33) is stopped, and blower line (22) and vacuum line (42) are operated simultaneously in the same apparatus (14).

11. A method for combinatory wet and dry treatment of textile articles according to claim 10 wherein the evacuation in the wet and dry treatment steps is conducted with different vacuum pumps, the vacuum pump (43) used in the wet treatment having lower volumetric flow rate and higher vacuum capacity compared to the vacuum pump (44) used during the dry treatment.

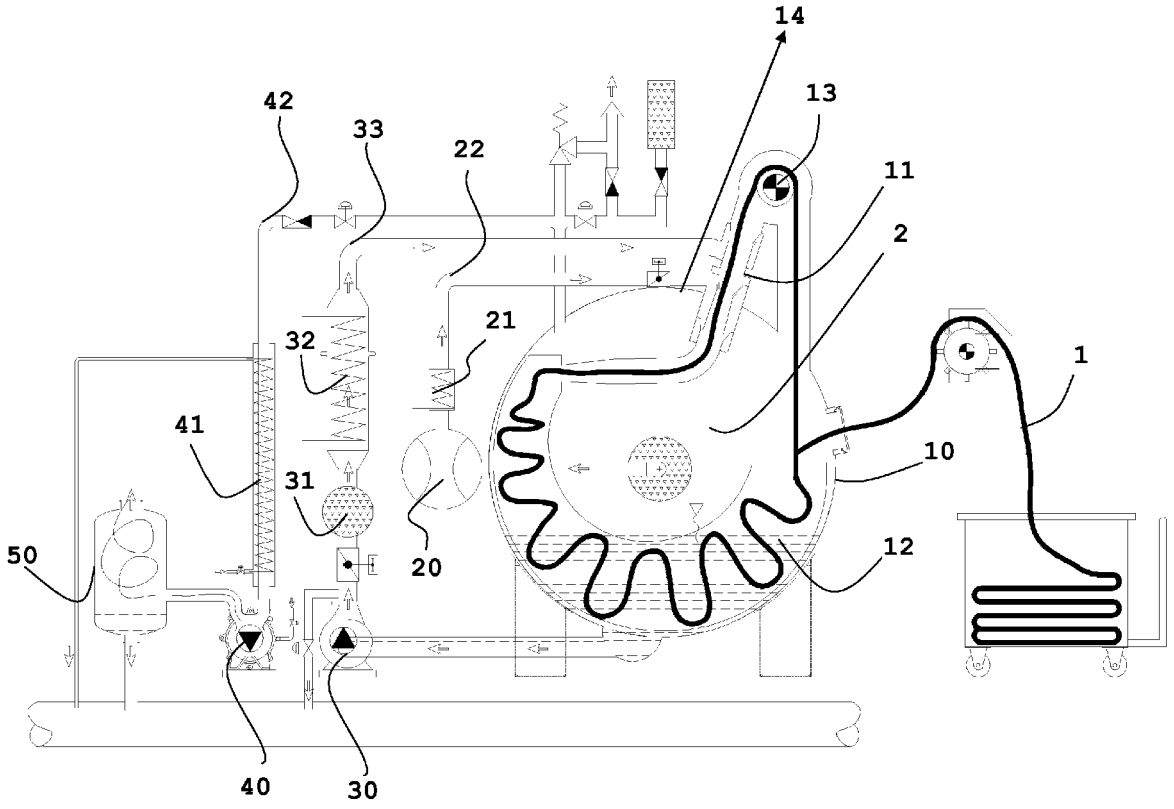

FIG. 1

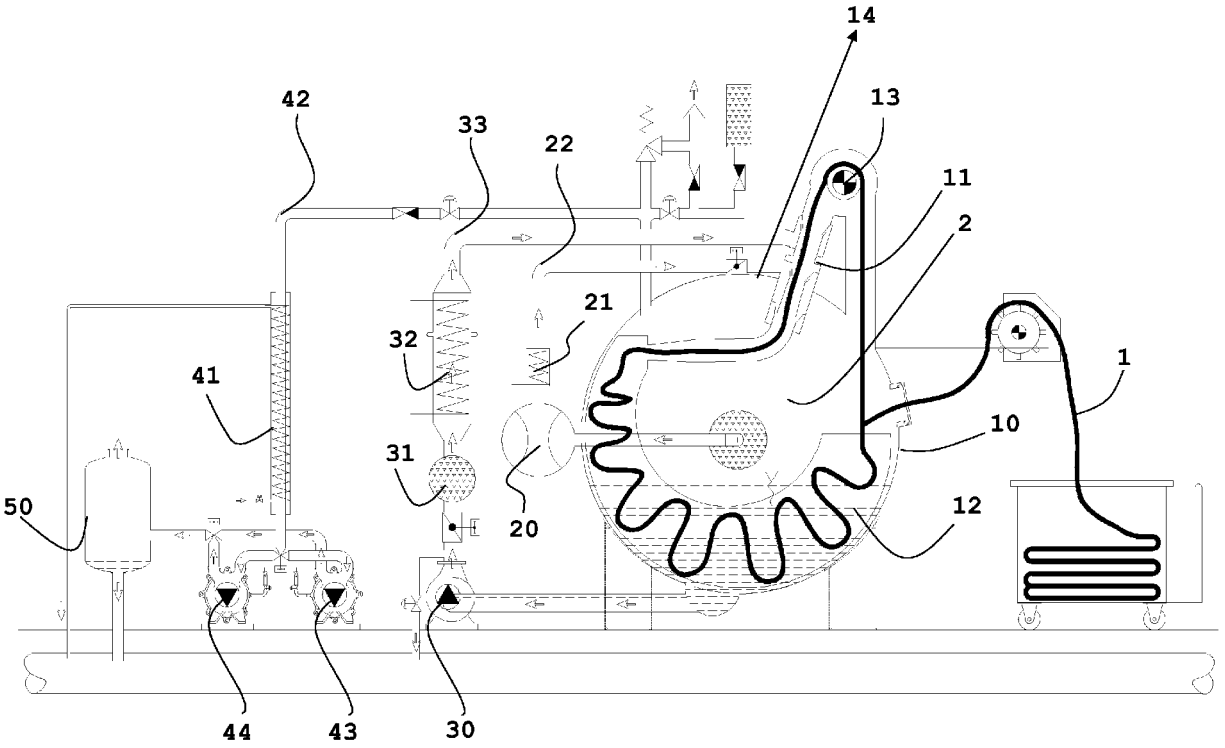

FIG. 2

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	21 July 2006	Goodall, C

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X : particularly relevant if taken alone
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