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(54) Method for drying and smoothing clothes and garment items and apparatus for carrying out such method

(57) Method for drying and smoothing a plurality of garment and laundry items (3,203,303) and apparatus for carrying out such method, wherein said method comprises the steps of arranging the laundry and garment items (3;203;303) so as to have them lying between a plurality of panels (4;204;304) that are permeable to a heated working medium; subsequently inserting the thus formed arrangement in a chamber (2;202;302); causing a heated working medium to be circulated inside the chamber (2;202;302) and dehumidified; removing the dried and smoothed laundry and garment items (3;203;303) from the panels (4;204;304); and wherein the apparatus for carrying out said method comprises a chamber (2;202;302), means for circulating the heated working medium in the chamber (2,202,302), and de-humidification means (13,14,15,18;213,214,215,218;313,314,315,318) for de-humidifying the medium, said chamber (2;202;302) being adapted to removably accommodate a plurality of panels (4;204;304) lying above each other and permeable to the medium, so that the circulated medium is able to pass therethrough.

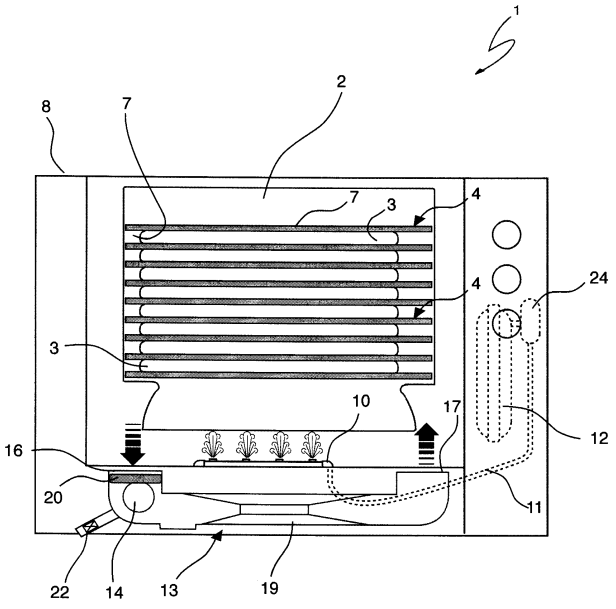

fig. 1

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Description

[0001] The present invention refers to a method for drying and smoothing clothes and garment items. It further refers to an apparatus for carrying out such method.

[0002] Machines designed to dry and smooth out clothes and garment items are largely known in the art; machines of this kind are for instance known from the disclosures in US5305484, EP0816552, EP1146162 and US2005/0115120.

[0003] These machines generally comprise a chamber, in which the clothes and garment items to be dried and smoothed are placed. In this chamber, such clothes and garment items are usually suspended on simple coat hangers, or the like, or put around inflatable dummies or even attached to proper clamps that hold the fabrics, which the garments are made with, duly stretched tight.

[0004] So as described for instance in EP11146162, prior-art methods used in the process generally call for steam to be introduced in the chamber to saturate the garments therewith, followed by the introduction of hot air provided for de-humidifying the garments, and the introduction of air at room temperature aimed at cooling down the interior of the chamber and enabling the user to fully safely remove the garments therefrom.

[0005] These machines, however, share a major drawback in that they are rather inconvenient, i.e. scarcely practical to use in a household environment, as well as excessively complicated and not capable of ensuring any effective, complete smoothing action on the garments themselves.

[0006] It is therefore a main object of the present invention to provide a method for drying and smoothing clothes and garment items, along with an apparatus for carrying out such method, which constitute an alternative to prior-art methods and apparatuses, further to being effective in doing away with the above-noted drawbacks of the cited prior art.

[0007] A purpose of the present invention within the above-cited main object is to provide a clothes drying and smoothing method that is simple and effective, as well as a related apparatus that is extremely practical and convenient in use, simple in construction, reliable in use and operation, and capable of being manufactured at fully competitive costs.

[0008] According to the present invention, these aims, along with further ones that will become apparent from the following disclosure, are reached in a method and an apparatus that incorporate the features as defined and recited in the claims appended hereto.

[0009] Features and advantages of the present invention will anyway be more readily understood from the description of a preferred, although not sole embodiment that is given below by way of illustrative and non-limiting example with reference to the accompanying drawings, in which:

- Figure 1 is a side elevational, cross-sectional view of an apparatus according to a first preferred embodiment of the present invention;
- Figure 2 is a schematical perspective view of the apparatus shown in Figure 1;
- Figure 3 is a schematical perspective view of the stacked configuration of the partitioning panels and the garment items according to the first preferred embodiment of the present invention;
- Figure 4 is an enlarged view of a partitioning panel of the invention according to the first preferred embodiment of the present invention;
- Figure 5 is an enlarged view of a different embodiment of a partitioning panel of the invention according to the first preferred embodiment of the present invention;
- Figure 6 is a schematical side elevational, cross-sectional view of an apparatus according to a second preferred embodiment of the present invention;
- Figure 7 is a schematical perspective and partially cross-sectional view of the apparatus shown in Figure 6;
- Figure 8 is a schematical perspective view of the stacked configuration of the panels supporting the garment items according to the second preferred embodiment of the present invention;
- Figure 9 is an enlarged, partially cross-sectional view of a support panel for garment items of the invention according to the second preferred embodiment of the present invention;
- Figure 10 is a schematical side elevational, cross-sectional view of an apparatus according to a third preferred embodiment of the present invention; and
- Figure 11 is a schematical perspective and partially cross-sectional view of the apparatus shown in Figure 10.

[0010] The method for drying and smoothing out a number of clothes and garment items according to the present invention takes substantially place through a sequence of operations starting with the clothes and garment items to be handled being arranged so as to lie between a plurality of removable panels that are adapted to be permeated by a medium. Such stacked arrangement is then capable of being placed into a chamber, where it is exposed to the medium being circulated within such chamber and de-humidified until a pre-set de-humidification level is eventually reached. Thereafter, the garment items are removed from the panels. For such

method to be carried out, an apparatus is provided that comprises a chamber adapted to accommodate a plurality of removable medium-permeable panels in a stacked arrangement, means for circulating the medium within the chamber, and medium-dehumidifying means. From a construction point of view, the chamber is provided so as to ensure that the medium is circulated substantially through the plurality of permeable panels.

[0011] Figures 1 through to 5 illustrate the apparatus for drying and smoothing clothes and garment items according to a first embodiment of the present invention. The apparatus, which is generally indicated with the reference numeral 1 in the Figures, comprises a chamber 2, adapted to accommodate the clothes and garment items 3 to be dried and smoothed, and de-humidification means provided to de-humidify, i.e. remove the moisture from the medium circulated in the chamber 2 and dry the clothes and garment items 3.

[0012] The apparatus further comprises a plurality of partitioning panels 4 that are removably arranged in the chamber 2 for supporting the clothes and garment items 3 placed above each other, i.e. piled in a stack, so that each such garment item 3 is pressed between two adjacent partitioning panels 4. Each such partitioning panel 4 comprises a structure that is permeable to air, so as to enable the medium circulated in the chamber 2 to pass through such structure and reach each garment item lying in a stacked arrangement between adjacent panels. The structure of the partitioning panels may for instance be a porous one or feature a number of micro-perforations.

[0013] In an alternative embodiment of the present invention, each partitioning panel may be hollow along the thickness dimension thereof, so as to define one or more aeration channels 5 extending parallel to the same panel, while aeration ports 6 fluidly communicating with said one or more aeration channels 5 are provided on each side of the panel 4 adapted to support garment items placed thereupon.

[0014] The inventive apparatus is further provided with delivery means 10 adapted to let steam into the chamber 2.

[0015] The apparatus comprises an outer casing 8, on which there is mounted a control panel 9 by means of which the user is capable of selecting among a number of different drying and smoothing programmes in accordance with the kind of fabrics of the garment items 3 to be handled. Within such outer casing 8 there is provided the chamber 2, where the clothes and garment items are dried and smoothed. A door (not shown in the Figures) provides access into the chamber 2 so as to be able to place the garment items thereinside to dry and smooth out, as well as remove them therefrom at the end of the process.

[0016] The above-mentioned delivery means 10 comprise at least one delivery port and preferably comprise a plurality of injectors, which, as arranged on the bottom wall of the chamber 2, are adapted to let steam into the same chamber.

[0017] In a preferred embodiment of the present invention, the steam delivery means 10 are connected - via appropriate ducts 11 - to steam generator means 12 that are integrally provided in the outer casing 8 of the apparatus. These steam generator means 12 may for instance comprise a water reservoir and one or more heating elements to produce steam.

[0018] Preferably, a decantation chamber 24, duly provided with a heating element of its own, is connected between the steam generator means 12 and the steam delivery means 10 for controlling the degree of humidity of the steam being let into the chamber 2.

[0019] However, in a further variation in the above embodiment of the present invention there is contemplated that the outer casing 8 of the inventive apparatus be provided with steam delivery means, while not including any built-in steam generator means. In such case, in fact, the steam delivery means are connectable to a remote steam generator, i.e. a self-standing steam generator located outside the outer casing 8 of the apparatus, as represented for example by a steam cleaning apparatus for home use.

[0020] The de-humidification means comprise at least a re-circulation conduit 13 provided to fluidly communicate with the chamber 2, blowing means 14 adapted to circulate the moisture-laden air between the chamber 2 and the re-circulation conduit 13, heating means 15, and condenser means 18 provided all along said re-circulation conduit 13 to de-humidify, i.e. remove moisture from the air in the chamber 2.

[0021] The chamber 2 and the re-circulation conduit 13 form a closed-loop circuit, through which the medium filling the chamber 2 is caused to circulate to be dried by the effect of the heating means 15 and the condenser means 18. The chamber 2 comprises at least one outflow port 16 and at least one inflow port 17, both of which are connected to the re-circulation conduit 13, and through which the medium is allowed to exit the chamber 2 for conveyance towards and along the condenser means 18 and the heating means 15, to be eventually let again into the chamber 2 in a de-humidified state after having flown through the heating means 15.

[0022] Preferably, the blowing means 14 are housed within, i.e. situated in the re-circulation conduit 13 downstream from the outflow port 16 in the direction of circulation of the medium along the re-circulation conduit 13. The blowing means 14 may for instance comprise a fan or impeller connected to a motor that is provided outside the re-circulation conduit 13.

[0023] The condenser means 18, which are provided to fluidly communicate with the re-circulation conduit 13 upstream to the heating means 15, are intended for collecting and removing the condensate that builds up as the medium flows through the condenser means 18, along the re-circulation conduit 13.

[0024] Advantageously, the heating means 15, which may for instance include one or more electric heating

elements, are situated in a portion 19 of the re-circulation conduit 13 that has a narrower, i.e. constricted cross-section so as to enhance the effectiveness of the de-humidifying process taking place there. Filtering means 20 are provided to filter the medium being let again into the chamber 2 from the re-circulation conduit 13. Advantageously, such filtering means 20 are situated upstream to the heating means 15 and close to the outflow port 16, so as to be able to retain impurities possibly carried along by the medium flowing through the re-circulation conduit 13.

[0025] In addition, the condenser means 18 are adapted to cool down the medium of the chamber 2, when such medium has in the meanwhile been substantially dried, so as to lower the inner temperature in the chamber 2 and, as a result, the temperature of the garment items being handled there, in a final phase of the drying and smoothing cycle according to the present invention, as this shall be explained in greater detail further on, in view of enabling the same garment items to be removed from the chamber 2 at an acceptably low temperature.

[0026] In a further variation in the above embodiment of the present invention, suction or intake means may be provided to selectively let into the re-circulation conduit 13 air taken in from the ambient outside the chamber 2 in view of causing the temperature inside the chamber 2 to be lowered prior to removing the dried and smoothed garment items 3 therefrom.

[0027] These intake means comprise an intake channel 21, which is provided to fluidly communicate with both the outside ambient and the re-circulation conduit 13, and which is adapted to use a venturi effect to let into the re-circulation conduit 13 ambient air flowing in from the room where the apparatus is installed.

[0028] The intake means further comprise at least one valve 22 that is selectively operable to connect the re-circulation conduit 13 with the ambient outside the chamber 2.

[0029] Sensors are provided to monitor the temperature and the degree of humidity, i.e. the moisture content of the medium circulating in the chamber 2, as well as to monitor the temperature of the medium that flows through the re-circulation conduit 13. These sensors are connected to a control unit of the apparatus, which - based on the humidity and temperature values it receives from the sensors - is adapted to selectively operate the steam delivery means and the de-humidification means to carry out the drying and smoothing cycle selected by the user accordingly.

[0030] In the case that the steam generator means 12 are of the built-in type, i.e. provided integrally with the apparatus, the control unit will be able to vary the degree of humidity of the steam being let into the chamber 2 by controlling the heating element in the decantation chamber 24 accordingly.

[0031] In fact, the apparatus according to the present invention is capable of performing a plurality of different drying and smoothing cycles that can be properly selected by the user in accordance with the type of fabrics, which the clothes and garment items to be dried and smoothed are made of.

[0032] The various drying and smoothing cycles available for selection call for different ranges of humidity and temperature values to be used or be prevailing inside the chamber 2, as well as different lengths of time, which the various phases of the drying and smoothing cycle are due to last, as this shall be explained in greater detail further on.

[0033] As mentioned hereinbefore, the inventive apparatus further comprises partitioning panels 4 that are adapted to be fitted into the chamber 2 for supporting the garment items 3 in a stacked arrangement, in which they lie above each other without contacting each other, so that each garment item 3 is laid between two adjacent partitioning panels.

[0034] Each such partitioning panel 4 is formed of a structure that is permeable to air and adapted to let the medium circulated in the chamber 2 to pass therethrough, so that the same medium is able to flow through the panels and reach each garment item lying in a stacked arrangement between the panels.

[0035] In other words, each partitioning panel 4 defines opposite resting surfaces 7 which are adapted to support the garment items to be treated, and through which the medium circulated in the chamber is free to pass in view of reaching each one of the garment items stacked above each other between adjacent panels.

[0036] Advantageously, each panel is formed of a highly porous or micro-perforated structure, which is so rigid as to be capable of keeping the resting surfaces 7 supporting the garment items 3 perfectly planar when said panels and the related garment items lying thereupon are piled into a stack.

[0037] In a different, alternative embodiment of the present invention, each one of said partitioning panels 4 is formed of a structure that is hollow along the thickness dimension thereof so as to define two opposite resting surfaces 7, which are adapted to support the garment items to be treated, and are separated from each other by one or more aeration channels 5 provided within the hollow thickness space of the structure of the panel, where they are arranged to extend parallel to said resting surfaces 7.

[0038] Cross partitions 23 are provided to keep the resting surfaces 7 spaced from each other, as well as to separate the aeration channels 5 from each other when there is provided a plurality of aeration channels 5, as this is exemplarily illustrated in Figure 5.

[0039] In each such resting surface 7 of a panel there are provided aeration holes 6 fluidly communicating with the aeration channels 5. Advantageously, each such resting surface 7 may be formed of a micro-perforated wall, with a multiplicity of micro-perforations distributed over each resting surface 7 so as to be fluidly communicating with said one or more aeration channels 5.

[0040] The aeration channels 5 and the aeration holes

6 are adapted to convey and distribute the medium circulated in the chamber so as to cause it to hit each garment item lying on such support panels to thereby ensure that all such garment items being treated in the chamber 2 are dried and smoothed in a uniform, even manner.

[0041] The way in which the inventive clothes drying and smoothing method works is described below.

[0042] In the first place, immediately upon removing them from the drum of a washing machine at the end of a washing cycle, the user lays the clothes and garment items 3 on the partitioning panels 4, wherein each such garment item 3 is first folded, as if it were ready for storing in a drawer or wardrobe, and is then laid upon a resting surface 7 of a first partitioning panel 4. A second partitioning panel 4 is then positioned above said folded garment item and a further folded garment item is laid upon such second panel; then, in a similar way, a third partitioning panel is positioned above such further folded garment item laid on said second panel, and so on. Such arrangement is then repeated until a vertical stack of partitioning panels 4 is eventually formed, wherein a folded garment item 3 is arranged between each pair of adjacent panels. Advantageously, the partitioning panel forming the top layer of the stack may be used as a weighting mass aimed at ensuring a certain pressing effect upon the garment items therebelow. For example, with partitioning panels of approx. 150 grams each, use may be made of a top panel having a weight of approx. 2.0 to 2.5 kg.

[0043] The stack formed in the above-described manner is then placed into the chamber 2. A suitable perforated grille lying immediately above the steam delivery means is provided to act as a support member on which the stack can be placed to rest. In a variation of this embodiment of the present invention, guide members or runners are provided to extend along the side walls of the chamber 2 so as to slidably receive the bottom panel of the stack and sustain the same stack.

[0044] Once the access door of the chamber 2 is then shut, and the most appropriate drying and smoothing cycle has been selected to treat the particular garment items in the stack, the control unit energizes the blowing means 14 and the heating means 15 so as to carry out a preliminary drying phase. The medium in the chamber is continuously circulated along the closed-loop circuit defined by the chamber 2 and the re-circulation conduit 13. The medium that is so caused to flow through the heating means 15 and the condenser means 18 in the re-circulation conduit 13 is progressively de-humidified, thereby drying up.

[0045] The pores or micro-perforations, or the aeration channels 5 and aeration holes 6, according to and depending on the different embodiments of the air-permeable structure forming the partitioning panel 4, enable the medium (i.e. hot air drying progressively up) to flow through and between the partitioning panels 4 to thereby reach and hit each garment item lying upon a respective panel in the stack, so as to ensure an effective, even drying result.

[0046] This particular drying phase is performed at a power input rate of anywhere between 1100 and 1400 W max.

[0047] Via the sensors located downstream from the heating means 15, as well as those located inside the chamber, the control unit is able to continuously monitor the degree of humidity of the medium. Based on the so detected humidity values and the particular cycle selected by the user, the control unit determines the moment at which the preliminary drying phase has to be brought to conclusion by de-energizing the heating means 15 and the blowing means 14.

[0048] At the end of such preliminary drying phase, some kinds of fabrics may turn out as being thoroughly dry and smoothed out owing to just the above-mentioned circulation of the medium through the pores or micro-perforations, or the aeration channels 5 and the aeration holes 6, in the support panels. Therefore, in the case that the specific drying and smoothing cycle for clothes and garment items made of such fabrics has been selected, the same cycle will reach its end upon the conclusion of said preliminary drying phase, so that the user has nothing else to do than removing the stack from the chamber 2 and store the treated garment items in the wardrobe or chest of drawers.

[0049] For fabrics that do not succeed in drying up and smoothing out to any acceptable extent through just a preliminary drying phase, proper drying and smoothing cycles are provided.

[0050] In these cycles, at the end of the preliminary drying phase the control unit is programmed to operate the steam delivery means so as to let steam into the chamber. In the case that the steam generator means 12 are provided integrally with the apparatus, i.e. within the outer casing 8 thereof, the control unit operates the steam generator and, when the latter is able to produce steam, it is set into fluid communication with the chamber 2 through the actuation of the delivery means, e.g. by opening the injectors 10 in the embodiment being described as an example to illustrative purposes. In addition, by means of the afore-described decantation chamber 24, the control unit is adapted to adjust the degree of humidity of the steam being let into the chamber 2.

[0051] Based on the selected cycle, the control unit controls the steam delivery means 10 to selectively open and close so as to obtain pre-defined humidity and temperature values inside the chamber, as specifically required by the selected cycle. By means of the afore-cited sensors, the control unit is able to continuously monitor the progress, i.e. change pattern vs. time of the moisture content and the temperature of the medium in the chamber 2, and to open and close the steam delivery means 10 at such time intervals as determined based on the actual conditions being detected by the sensors inside the chamber 2.

[0052] This steam inlet phase has a duration ranging from 10 to 20 minutes, depending on the particular cycle

selected, while the temperature at the end of this phase reaches up to and stabilizes at values situated anywhere between approx. 85°C and 105°C. Preferably, the steam let into the chamber is at a pressure that is slightly above the atmospheric pressure, typically amounting to 2 to 4 atmospheres. This phase is performed at a power input rate of anywhere between 800 and 1500 W max.

[0053] The medium, which is hot air saturated with steam in this case, flows through the pores or the micro-perforations, or through the aeration channels 5 and the aeration holes 6, as the case may be, to eventually reach the individual garment items laid upon the panels. In this way, the steam is able to evenly settle onto, i.e. impregnate each garment item in the stack, in a uniform manner all over it.

[0054] Upon conclusion of this steam treatment phase, the control unit of the apparatus cuts off steam inlet by actuating the steam delivery means 10 into closing and - if this is the case - by switching off the steam generator means 12 that are possibly provided in the apparatus in a built-in arrangement. Then, the same control unit switches on the blowing means 14 and the heating means 15 for a final drying phase to be carried out. In this phase, the medium in the chamber is continuously circulated along the afore-mentioned closed-loop circuit defined by the chamber 2 and the re-circulation conduit 13, wherein the medium that is in this way caused to flow through the heating means 15 and the condenser means 18 in said re-circulation conduit 13 is progressively de-humidified, thereby drying up.

[0055] The pores or micro-perforations, or the aeration channels 5 and aeration holes 6, as the case may be, enable the medium (i.e. hot air drying progressively up) to flow through and between the partitioning panels 4 to thereby reach and hit each garment item lying upon a respective panel in the stack, so as to ensure an effective, most uniform drying result.

[0056] This drying phase is performed at a power input rate of anywhere between 600 and 1200 W max.

[0057] Via the sensors located in the re-circulation conduit 13, as well as those located inside the chamber, the control unit is able to continuously monitor the degree of humidity of the medium. Based on the so detected humidity values and the particular cycle selected by the user, the control unit determines the moment at which the final drying phase reaches its conclusion by de-energizing the heating means 15, while the blowing means 14 keep operating.

[0058] A cooling-down phase is therefore started and carried out, in which the blowing means 14 cause the - by now dry - medium in the chamber 2 to circulate to and from the same chamber and the re-circulation conduit 13, where the condenser means 18 cool down said medium. Accordingly, the temperature inside the chamber keeps lowering and, as a result, even the garment items on the panels cool down. Once the final cooling-down temperature, i.e. the temperature that is considered adequate in view of enabling the garment items to be conveniently and safely removed from the chamber, is detected to be eventually reached, the control unit determines the conclusion of the selected drying and smoothing cycle and de-energizes the blowing means 14. At this point, the dried and smoothed garment items are ready for removal from the chamber 2 and storage in a wardrobe or chest of drawers.

[0059] In an alternative variation in the above embodiment of the present invention, the conclusion of the final drying phase is preferably followed by a short stabilization phase, in which the blowing means 14 keep operating to cause the medium to further circulate to and from the same chamber and the re-circulation conduit 13. Thereafter, the cooling-down phase is started, in which - with the blowing means 14 still operating - the intake means are also operated to selectively let fresh air at room temperature, as taken in from the outside ambient, into the chamber 2 and bring about a decrease in the temperature of the garment items in the stack. In practice, the intake valve 21 is opened for short time intervals so as to enable the intake conduit 22 to make use of a venturi effect to take in air from the room, in which the apparatus is installed, and let it into the re-circulation conduit 13, where it mixes up with the medium flowing through the same re-circulation conduit 13. The cooling air is let into the chamber 2 intermittently for short time periods so as to control and substantially "measure out" the amount of air being let in, to the purpose of preventing the relative humidity inside the chamber 2 from rising, as it on the contrary would certainly do in the case that the cooling air is let in in an abrupt, uncontrolled manner.

[0060] A power input rate situated anywhere between approx. 50 and 200 W max. is used during this cooling-down phase.

[0061] Even during this phase - by flowing through the pores or micro-perforations, or the aeration channels 5 and aeration holes 6, as the case may be, in the afore-described manner - the medium is of course able to reach and hit each one of the garment items in the stack to evenly distribute thereupon.

[0062] The control unit continuously monitors the temperature and the relative humidity inside the chamber 2 to determine the end-of-cycle condition of the drying and smoothing cycle selected. The blowing means 14 are then switched off.

[0063] At this point, the dried and smoothed garment items are ready for removal from the chamber 2 and storage in a wardrobe or chest of drawers.

[0064] Figures 6 to 9 illustrate the apparatus for drying and smoothing clothes and garment items according to a second preferred embodiment of the present invention. In this case, the apparatus 201 comprises a chamber 202, in which there are accommodated a plurality of planar, horizontal panels 204 lying above each other and spaced from each other. Each such panel 204 is adapted to support one or more clothes or garment items 203 as appropriately arranged or laid upon the same panel, wherein such garment items 203 are dried and smoothed

through a circulation of a hot working medium, which is let into the chamber 202 and circulated there in a closed-loop pattern. A door (not shown in the Figures) provides access into the chamber 202 for the garment items to be treated to be placed thereinside and be then removed therefrom at the end of the process.

[0065] According to the invention, the chamber 202 is closed on all sides thereof and is provided - in a side or rear wall thereof - with a sequence of slits 250 arranged to lie at intermediate levels between each pair of adjacent panels 204 lying above each other. Such slits 250 fluidly connect the chamber 202 with a first header 260, through which the hot medium is let into the same chamber.

[0066] According to another feature of the invention, the panels 204 are made so as to enclose a hollow space or cavity 270 thereinside, while the top surface thereof is at least partially provided with a plurality of small aeration bores 206; in addition, via aeration channels 205 the inner cavity 270 fluidly communicates with a second header 280, through which the working medium flows out to be re-circulated. Preferably, this second header 280 forms the closing wall of the chamber 202 lying opposite to the wall in which the slits 250 letting in the working medium into the chamber 202 are provided.

[0067] The inner cavity 270 and the aeration bores 206 in the panels 204 are adapted to convey and distribute the medium circulated in the chamber 202 so as to cause it to hit each garment item lying on such support panels to thereby ensure that all such garment items being treated in the chamber 202 are dried and smoothed in a uniform, even manner.

[0068] In practice, the working medium flowing in from the first header 260 is let into the chamber 202 through the slits 250 to fill up all spaces comprised, i.e. lying between the panels 204. The working medium itself is then forced to flow through the garment items laid upon the panels 204 to enter the inner cavity 270 of each panel 204. From such inner cavity 270, the working medium is able to solely flow out through the aeration channels 205 to eventually flow into the second header 280 through outflow slits 290 provided in the chamber 202 in correspondence to the aeration channels 205.

[0069] The closed-loop circuit of the working medium comprises - as provided in a series arrangement between the header 280 and the header 260 - a filter 220, a blower 214, a condenser 218, and a heater 215.

[0070] The apparatus further comprises a steam generator 212 adapted to deliver steam into the header 260 through an arrangement of injectors 210. Preferably associated to this steam generator 212 there is a decantation chamber 224 that enables the degree of humidity in the steam being let into the drying and smoothing circuit to be properly adjusted.

[0071] The filter 220 is provided to filter the working medium that leaves the chamber 202 through the aeration channels 205 of the panels 204. Advantageously, the filter 220 is provided upstream to the heater 215, close to the outlet of the header 280, so as to retain the impurities that may possibly be carried along by the medium flowing through the re-circulation conduit.

[0072] Preferably, the blower 214 is housed in the re-circulation conduit 213 downstream from the header 280 provided to receive the working medium exiting the chamber 202, and may be driven by a motor (not shown) provided outside the re-circulation conduit itself.

[0073] The condenser 218, provided upstream to the heater 215, is intended to collect and dispose of the condensate which results from the moisture being is removed from the garment items during drying and smoothing, and which builds up as the working medium is re-circulated. The condenser 218 is furthermore adapted to cool down the medium of the chamber 202, when such medium has in the meanwhile already been substantially dried, so as to lower the inner temperature in the chamber 202 and, as a result, the temperature of the garment items being treated there, in a final phase of the drying and smoothing cycle according to the present invention, as this shall be explained in greater detail further on, in view of enabling the same garment items to be removed from the chamber 202 at an acceptably low temperature.

[0074] Advantageously, the heater 215, which may for instance include one or more electric heating elements, is situated in a portion of the re-circulation conduit that has a narrower, i.e. constricted cross-section, so as to enhance the effectiveness of the de-humidifying process taking place there.

[0075] Sensors (not shown) are provided to monitor the temperature and the relative humidity, i.e. the moisture content of the medium circulating in the chamber 202, as well as to monitor the temperature of the medium that flows through the re-circulation conduit 213. These sensors are connected to a control unit of the apparatus, which - based on the humidity and temperature values it receives from the sensors - is adapted to selectively operate the steam delivery means and the de-humidification means to carry out the drying and smoothing cycle selected by the user accordingly.

[0076] In the case that the steam generator 212 is of the built-in type, i.e. provided integrally with the apparatus, the control unit will be able to vary the relative humidity of the steam being let into the chamber 202 by controlling the heating element in the decantation chamber 224 accordingly.

[0077] In fact, the apparatus according to the present invention is arranged to be capable of performing a plurality of different drying and smoothing cycles that can be properly selected by the user in accordance with the type of fabrics, which the clothes and garment items to be dried and smoothed are made of.

[0078] The various drying and smoothing cycles available for selection by the user call for different ranges of humidity and temperature values to be used or be prevailing inside the chamber 2, as well as different lengths of time, which the various phases of the drying and smoothing cycle are due to last, as this shall be explained in greater detail further on.

[0079] The way in which the inventive clothes drying and smoothing method works is described below.

[0080] In the first place, immediately upon removing them from the drum of a washing machine at the end of a washing cycle, the user lays the clothes and garment items 203 upon the panels 204, wherein each such garment item 203 is first folded, as if it were ready for storing in a drawer or wardrobe, and is then laid upon the perforated aeration surface 206 of a panel 204. Such arrangement process is then repeated until all panels 4 contained in the chamber 202 are eventually occupied.

[0081] Once the access door of the chamber 202 is then shut, and the most appropriate drying and smoothing cycle has been selected to treat the particular garment items placed in the chamber, the control unit energizes the blower 214 and the heater 215 so as to carry out a preliminary drying phase. The working medium in the chamber is continuously circulated along the closed-loop circuit defined by the chamber 202 and the headers 260 and 280. The medium that is so caused to flow through the condenser 218 and the heater 215 in the re-circulation conduit 213 is progressively de-humidified, thereby drying up.

[0082] The working medium flowing into the chamber 202 from the header 260 fills up all spaces comprised, i.e. lying between the panels 204, permeates and flows through the garment items 203, and enters the inner cavities 270 of the panels 204 to eventually flow out through the aeration channels 205 into the header 280. From the latter, the working medium flows back into the re-circulation conduit 213 where it passes through the filter 220, the blower 214, the condenser 218 and the heater 215.

[0083] Through the sensors located downstream from the heater 215, as well as those located inside the chamber 202, the control unit is able to continuously monitor the relative humidity of the medium. Based on the so detected humidity values and the particular cycle selected by the user, the control unit determines the moment at which the preliminary drying phase has to be brought to conclusion by de-energizing the heater 215 and the blower 214.

[0084] At the end of such preliminary drying phase, some kinds of fabrics may turn out as having been thoroughly dried and smoothed out by the effect of just the above-mentioned circulation of the medium through the hollow panels 204. Therefore, in the case that the specific drying and smoothing cycle for clothes and garment items made of such fabrics has been selected, the same cycle will reach its end upon the conclusion of said preliminary drying phase, so that the user has nothing else to do than removing the treated garment items from the chamber 202 and storing them in the wardrobe or chest of drawers.

[0085] For fabrics that do not succeed in drying up and smoothing out to any acceptable extent through just a preliminary drying phase, proper drying and smoothing cycles are provided.

[0086] In these cycles, at the end of the preliminary drying phase, the control unit is programmed to operate the steam delivery means so as to let steam into the chamber 202. In the case that the steam generator means 212 are provided integrally with the apparatus, the control unit operates the steam generator and, when the latter is able to produce steam, it is set into fluid communication with the chamber 202 through the actuation of the delivery means, e.g. by opening the injectors 210 in the particular embodiment being described as an illustrative example. In addition, by means of the afore-described decantation chamber 224, the control unit is adapted to adjust the degree of humidity, i.e. the relative humidity of the steam being let into the chamber 202.

[0087] Based on the selected cycle, the control unit controls the steam delivery means 210 to selectively open and close so as to obtain pre-defined humidity and temperature values inside the chamber, as specifically required by the selected cycle. By means of the afore-cited sensors, the control unit is able to continuously monitor the progress, i.e. change pattern vs. time of the moisture content and the temperature of the medium in the chamber 202, and to open and close the steam delivery means 210 at such time intervals as determined based on the actual conditions being detected by the sensors inside the chamber 202.

[0088] This steam inlet phase has a duration ranging from 10 to 20 minutes, depending on the particular cycle selected, while the temperature at the end of this phase reaches up to and stabilizes at values situated anywhere between approx. 85°C and 105°C. Preferably, the steam let into the chamber is at a pressure that is slightly above the atmospheric pressure, typically amounting to 2 to 4 atmospheres. This phase is performed at a power input rate of anywhere between 800 and 1500 W max.

[0089] The medium, which is hot air saturated with steam in this case, flows through the pores or the micro-perforations 206 to reach the individual garment items laid upon the panels. In this way, the steam is able to evenly settle onto, i.e. impregnate each garment item in the stack, in a uniform manner all over it.

[0090] Upon conclusion of this steam treatment phase, the control unit of the apparatus cuts off steam inlet by actuating the steam delivery means 210 into closing and - if this is the case - by switching off the steam generator means 212 that are possibly provided in the apparatus in a built-in arrangement. Then, the same control unit switches on the blower means 214 and the heating means 215 for a final drying phase to be carried out. In this phase, the medium in the chamber is continuously circulated along the afore-mentioned closed-loop circuit defined by the chamber 202, the headers 260 and 280, and the re-circulation conduit 213, wherein the medium that is in this way caused to flow through the condenser 218 and the heater 215 in said re-circulation conduit 213 is progressively de-humidified, thereby drying up.

[0091] This drying phase is performed at a power input rate of anywhere between 600 and 1200 W max.

[0092] Through the sensors located in the re-circula-

tion conduit 213, as well as those located inside the chamber 202, the control unit is able to continuously monitor the degree of humidity, i.e. the relative humidity of the medium. Based on the so detected humidity values and the particular cycle selected by the user, the control unit determines the moment at which the final drying phase reaches its conclusion and de-energizes the heater means 215 accordingly, while the blower means 214 keep operating.

[0093] A cooling-down phase is then started and carried out, in which the blower means 214 cause the - by now dry - medium in the chamber 202 to circulate to and from the same chamber and the re-circulation conduit 213, where the condenser means 218 cool down said medium. Accordingly, the temperature inside the chamber keeps lowering and, as a result, even the garment items on the panels cool down. Once the final cooling-down temperature, i.e. the temperature that is considered adequate in view of enabling the garment items to be conveniently and safely removed from the chamber, is detected to be eventually reached, the control unit determines the conclusion of the selected drying and smoothing cycle and de-energizes the blower means 214. At this point, the dried and smoothed garment items are ready for removal from the chamber 202 and storage in a wardrobe or chest of drawers.

[0094] Figures 10 and 11 illustrate the apparatus for drying and smoothing a number of garment items according to a third preferred embodiment of the present invention. The apparatus may include all of the construction and operating parts and features described in connection with the afore-considered embodiments and related variations, so that a further detailed description thereof at this point is intentionally omitted. Explained in detail shall in particular be only the structural feature that really distinguishes this third preferred embodiment from the other ones.

[0095] The apparatus comprises a chamber 302 accommodating a plurality of removable panels 304 that are arranged to form a group or set, in which they lie again above each other. In the case that the chamber 302 accommodates several groups or sets of panels, it also includes partition walls 399 that, being impervious to the working medium, separate each such set of panels 304 from each other, as this is clearly illustrated in Figure 10. Preferably, in this third preferred embodiment of the invention, the panels 304 are of the kind featuring a porous structure, and each such panel 304 is adapted to support one or more garment items 303 laid thereupon, wherein it should be appreciated that the panels 304 might be of the kind featuring a hollow structure, i.e. of the kind provided with inner ducts for the passage of the medium, as well. With reference to the flow direction of the medium, in a wall 392 on the upstream side of the chamber 302 there is provided a first plurality of inflow slits 350, while in a wall 394 on the downstream side of the chamber 302 there is provided a second plurality of outflow slits 390. As this can be most clearly noticed in Figure 11, each such slit 350, 390 extends in a horizontal direction with reference to an insertion plane of each individual panel 304. Furthermore, having again reference to such plane of insertion, each individual slit 350 in the wall 392 on the upstream side of the chamber 302 is provided in a vertically offset position relative to the consecutive slit 390 in the wall 394 on the downstream side of the chamber 302, so that a first set of panels 304 can be fitted between such slits 350, 390.

[0096] In particular, the slit 350 must be situated at a higher level above said first set of panels, whereas the slit 390 must be situated at a lower level relative to said set of panels.

[0097] It can be most readily appreciated that the apparatus may contain more than a single set of panels 304; preferably, it accommodates three such sets (only two sets of panels are illustrated in Figures 10 and 11 for reasons of greater simplicity) in a vertical arrangement above each other; in this case, corresponding inflow slits 350 and outflow slits 390 shall of course be provided for each such set of panels, so as to ensure that each such set will be duly exposed to the working medium. These slits 350 and 390 shall be vertically offset relative to each other, as this has been described above and shown in Figures 10 and 11. In addition, the chamber 302 is divided internally by means of partition walls 399 that are impervious to the working medium, so as to form a corresponding number of distinct compartments, each one of which is adapted to accommodate a set of panels 304. Each one of said compartments includes a medium inflow slit 350 situated at a level above the set of panels 304, and a medium outflow slit 390 situated at a level below the same set of panels, in such manner as to ensure that the working medium is able to flow into and exit the compartment by passing through the set of panels 304 accommodated therein.

[0098] The slits 350 and 390 enable the chamber 302 to fluidly communicate with a first inflow header 360 and a second outflow header 380, respectively, wherein such headers are included in a circulation circuit of the working medium as described in connection with the afore-considered embodiments.

[0099] The way in which the drying and smoothing method according to this embodiment of the invention works calls for at least one - possibly folded - garment item 303 to be laid upon each surface 307 of each panel 304, until a first set of overlying panels is formed, in which the garment items 303 are lying therebetween. Advantageously, the thus formed set of panels is pressed. In a similar manner a further set of panels is then possibly formed, wherein each such set of panels prepared as described above is accommodated inside a corresponding compartment of the chamber 302 so as to fit there between two consecutive slits 350, 390 following each other in the vertical direction. In this way, the working medium being let thereinto through the slit 350 from the header 360 is able to substantially transversally flow through each set of panels 304 duly loaded with the gar-

ment items 303 to be dried and smoothed, and eventually exit the compartment by flowing out through the slit 390 and into the header 380, thereby establishing a continuous circulation pattern.

[0100] The other process phases concerning the operation of the drying and smoothing method are similar to the ones that have been described hereinbefore in connection with the afore-considered embodiments, so that they shall not be described again to any further extent.

[0101] Fully apparent from the above description is therefore the ability of the present invention to effectively reach the aims and advantages cited afore, through the provision of a drying and smoothing method and an apparatus for carrying out the same, which are particularly simple to implement.

[0102] The air-permeable structure of the partitioning panels 4; 204; 304 is such as to ensure that all garment items are effectively hit in a uniform, even and complete manner by the working medium circulated in the chamber 2; 202; 302 during the various phases of the drying and smoothing cycle being carried out by the apparatus. The aeration channels 5; 205 and the aeration bores or microperforations 6; 206 contribute to a smoother, more effective circulation of the working medium in the chamber 2; 202; 302 by conveying and directing it towards each one of the garment items being treated in such manner as to ensure that each such garment item is reached in a uniform, even and complete manner by the working medium with the result of a really enhanced drying and smoothing effect being reached on the same garment items.

[0103] It shall be appreciated that the inventive method and apparatus as described above may of course be the subject of a number of modifications and may be embodied in a number of different manners without departing from the scope of the present invention, wherein all aforecited details may furthermore be replaced with technically equivalent elements.

[0104] Finally, it goes without saying that the materials used, as well as the shapes and the sizing of the individual details and items of the inventive method and apparatus as described above may each time be selected so as to more appropriately meet the particular requirements or suit the particular application.

Claims

1. Method for drying and smoothing a plurality of garment and laundry items (3; 203; 303) inside a chamber (2; 202; 302), in which there is circulated a heated working medium, **characterized in that** it comprises following steps:

   - laying the laundry and garment items (3; 203; 303) to be treated upon a plurality of removable panels (4; 204; 304) that are permeable to the heated working medium;
   - inserting the panels (4; 204; 304), on which there have been arranged said laundry and garment items (3; 203; 303) to be treated, in said chamber (2; 202; 302) so as they are positioned to lie above each other;
   - causing the heated working medium to be circulated inside the chamber (2; 202; 302), while de-humidifying the thus circulated medium until the laundry and garment items (3; 203; 303) being treated eventually reach a pre-determined degree of dryness;
   - removing the panels (4; 204; 304) from the chamber and the dried and smoothed laundry and garment items (3; 203; 303) therefrom.

2. Method according to claim 1, wherein the step involving the heated working medium being caused to circulate inside the chamber (2; 202; 302) comprises the sub-steps of:

   - de-humidifying the medium circulating in the chamber (2; 202; 302) until a pre-determined, lower degree of relative humidity is eventually reached in the same medium, in view of effecting a preliminary drying of the laundry and garment items (3; 203; 303);
   - letting steam into the chamber (2; 202; 302) for a period of time, whose length depends on the type of fabrics which the laundry and garment items (3; 203; 303) being treated are made of;
   - de-humidifying the medium circulating in the chamber (2; 202; 302) until a further pre-determined, lower degree of relative humidity is eventually reached in the same medium, in view of effecting a final drying of the laundry and garment items (3; 203; 303); and
   - cooling down the medium circulating in the chamber (2; 202; 302) until an acceptably low temperature is eventually reached for the laundry and garment items (3; 203; 303) to be conveniently and safely removed.

3. Method according to any of the claims 1 or 2, wherein the heated working medium is circulated in a substantially vertical direction within the chamber (2; 202; 302), while passing through the medium-permeable panels (4; 204; 304) and the laundry and garment items (3; 203; 303) placed thereupon.

4. Method according to any of the claims 1 or 2, wherein the heated working medium is circulated in a substantially horizontal direction through the laundry and garment items (203) and through channels (205) provided inside the panels (204).

5. Method according to claim 4, wherein the medium is let into the chamber (202; 302) through an inflow

header (260; 360) and is let out from the chamber (202; 302) through an outflow header (280; 380), said headers being provided on opposite sides of the chamber (202; 302).

6. Method according to claim 5, wherein the panels (304) are arranged in the chamber (302) in the form of stacked sets of panels, and the medium is let into the chamber (302) at a point located above each such set of panels to be eventually let out at a point located below each such set of panels.

7. Method according to claim 1 or 2, wherein each one of the laundry and garment items (3; 303) placed on a respective panel (4; 304) is pressed between two adjacent panels (4; 304).

8. Apparatus for drying and smoothing laundry and garment items (3; 203; 303), comprising a chamber (2; 202; 302) adapted to receive and contain the laundry and garment items (3; 203; 303) to be dried and smoothed, means for circulating a heated working medium in the chamber (2; 202; 302), and de-humidification means (13, 14, 15, 18; 213, 214, 215, 218; 313, 314, 315, 318) for de-humidifying the medium circulated in the chamber (2; 202; 302), **characterized in that** in said chamber (2; 202; 302) there are removably accommodated a plurality of panels (4; 204; 304) lying above each other, on which said laundry and garment items (3; 203; 303) are duly placed, said panels being permeable to the medium circulated in said chamber (2; 202; 302) so as to enable said medium to reach and pass through the laundry and garment items (3; 203; 303) placed thereupon.

9. Apparatus according to claim 8, wherein each panel (4; 204; 304) is comprised of an internally hollow structure defining opposite resting surfaces (7; 207; 307) adapted to support the laundry and garment items (3; 203; 303) and separated from each other by a plurality of aeration channels (5; 205) provided in the internal cavity of the structure where they extend parallel to said resting surfaces (7; 207; 307), aeration bores (6; 206) being provided in each such resting surface (7; 207; 307) so as to fluidly communicate with said aeration channels (5; 205), said aeration channels (5; 205) and said aeration bores (6; 206) being adapted to convey the working medium circulated in the chamber (2; 202; 302) and distribute it in correspondence to each laundry and garment items (3; 203; 303).

10. Apparatus according to claim 8 or 9, wherein said de-humidification means (13, 14, 15, 18; 213, 214, 215, 218; 313, 314, 315, 318) comprise at least one re-circulation conduit (13; 213; 313) fluidly communicating with the chamber (2; 202; 302) to form a closed-loop circuit containing blower means (14; 214; 314) adapted to circulate the medium let into the chamber (2; 202; 302) along said closed-loop circuit, heating means (15; 215; 315) and condenser means (18; 218; 318) for the same medium.

11. Apparatus according to any of the claims 8 to 10, wherein intake means (21; 221; 321) are provided to let air taken in from the ambient outside the chamber (2; 202; 302) into the re-circulation conduit (13; 213; 313) via at least one selectively operable valve (22; 222; 322).

12. Apparatus according to any of the claims 8 to 11, wherein filter means (20; 220; 320) are provided to filter the medium being let into the chamber (2; 202; 302) as it flows in from the re-circulation conduit (13; 213; 313).

13. Apparatus according to any of the claims 8 to 12, comprising delivery means (10; 210; 310) connected to steam generator means (12; 212; 312) for letting steam into the chamber (2; 202; 302).

14. Apparatus according to any of the claims 8 to 13, wherein sensors are provided to monitor the temperature and the relative humidity of the medium circulating in the chamber (2; 202; 302), and to monitor the temperature of the medium flowing in the re-circulation conduit (13; 213; 313) downstream from the heating means (15; 215; 315).

15. Apparatus according to claim 14, wherein said sensors are connected to a control unit that, based on the humidity and temperature values detected and sent in by the sensors, is adapted to selectively operate the delivery means (10; 210; 310), the de-humidification means (13, 14, 15, 18; 213, 214, 215, 218; 313, 314, 315, 318), and the air intake means (21, 22; 221, 222; 321, 322) in a manner as required to carry out the drying and smoothing cycle selected by the user.

16. Apparatus according to any of the claims 13 to 15, comprising a decantation chamber (24; 224; 324) provided with an electric heating element of its own and connected between the steam generator means (12; 212; 312) and the steam delivery means (10; 210; 310) to control and adjust the relative humidity of the steam being let into the chamber (2; 202; 302).

17. Apparatus according to any of the claims 8 to 16, wherein the chamber (202; 302) is connected to an inflow header (260; 360), from which the working medium flows into the chamber through slits (250; 350) provided in a wall of the same chamber (202; 302), and an outflow header (280; 380), into which the medium exiting the chamber (202; 302) is able to flow

through slits (290; 390) provided in a wall lying opposite to the former one to complete said closed-loop circuit of the working medium in the apparatus, said slits (250, 290; 350, 390) being provided at intermediate levels between overlying panels (204; 304).

18. Apparatus according to any of the claims 8 to 17, wherein the aeration channels (205) are fluidly communicating with the outflow header (280) via slits (290) in the chamber (202).

19. Apparatus according to any of the claims 8 to 18, wherein the panels (4; 304) are removably arranged in the chamber (2; 302) so as to support the laundry and garment items (3; 303) in mutually overlying positions in such manner that each laundry and garment items (3) is pressed between two adjacent panels (4; 304).

20. Apparatus according to any of the claims 8 to 19, wherein the chamber (302) is divided internally into a plurality of distinct compartments by means of partition walls (399) that are impervious to the working medium, each such compartment being adapted to accommodate a set of panels (304).

21. Apparatus according to claim 20, wherein each compartment formed in the chamber (302) includes an inflow slit (350) and an outflow slit (390).

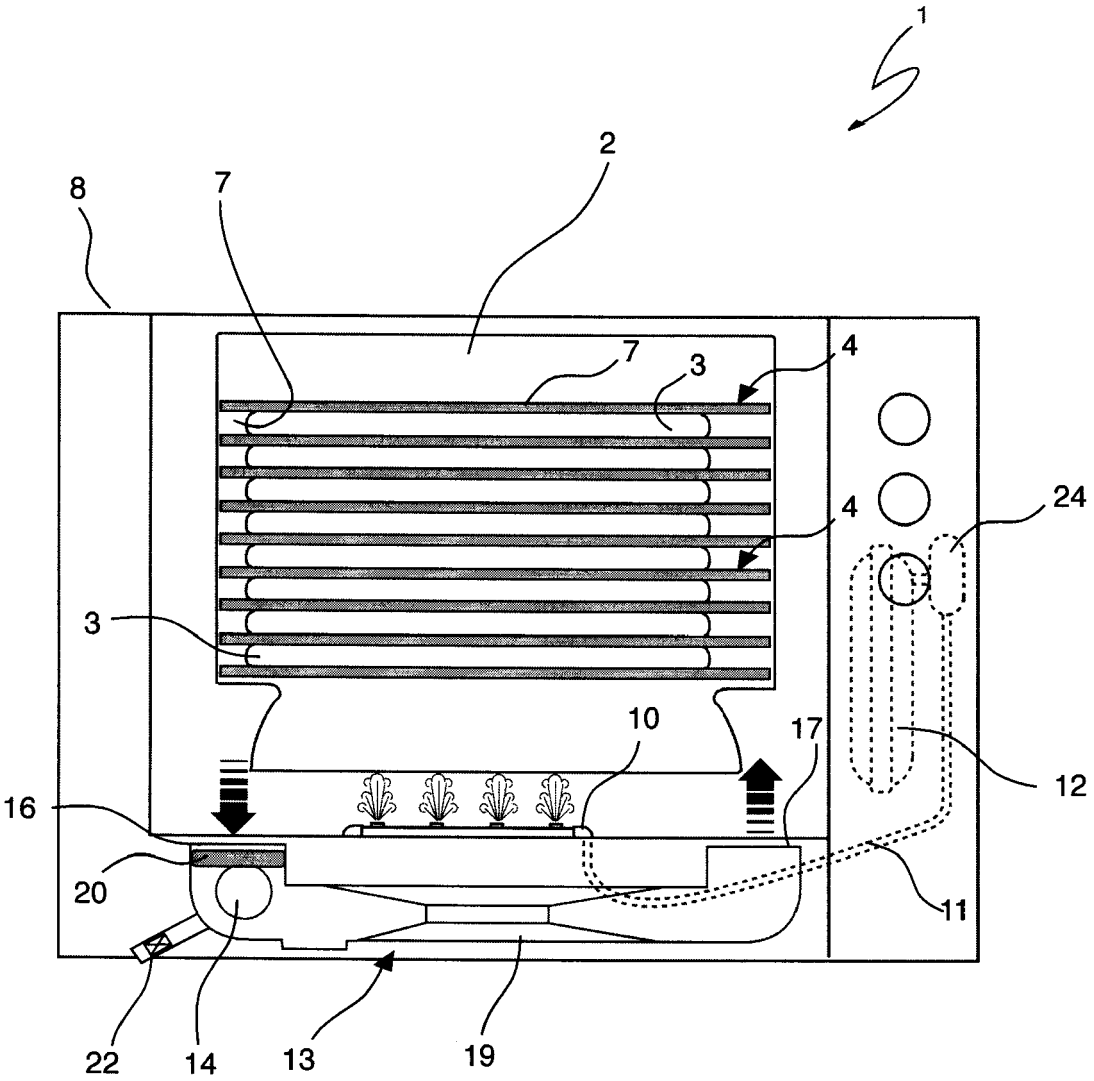


fig. 1

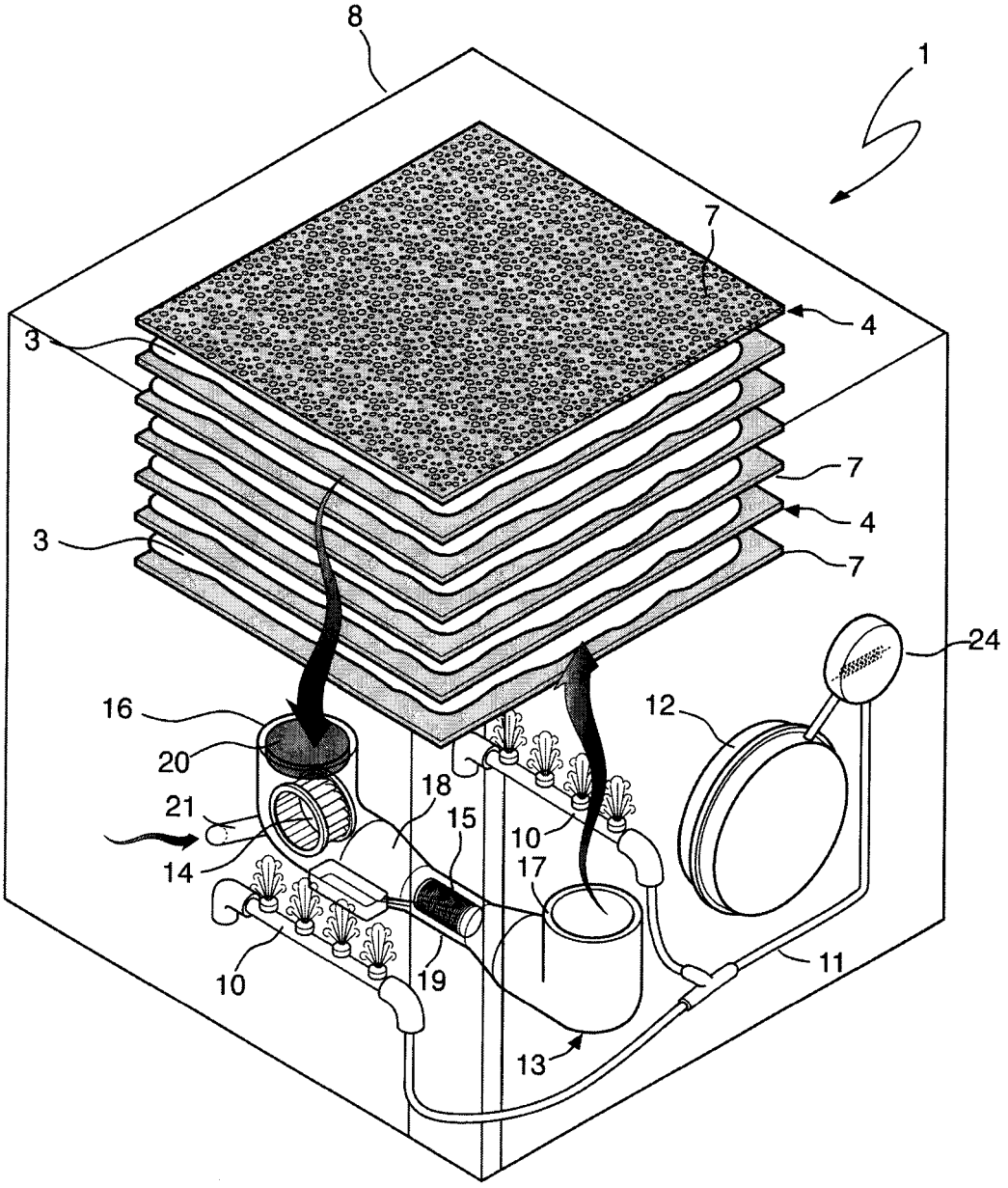


fig. 2

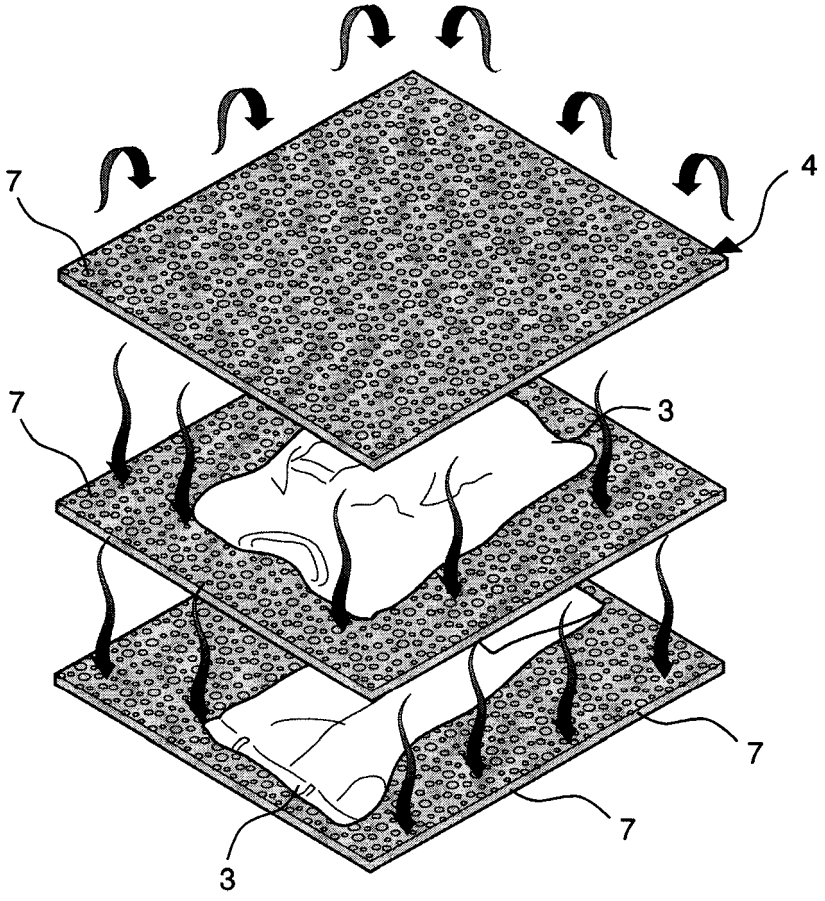


fig. 3

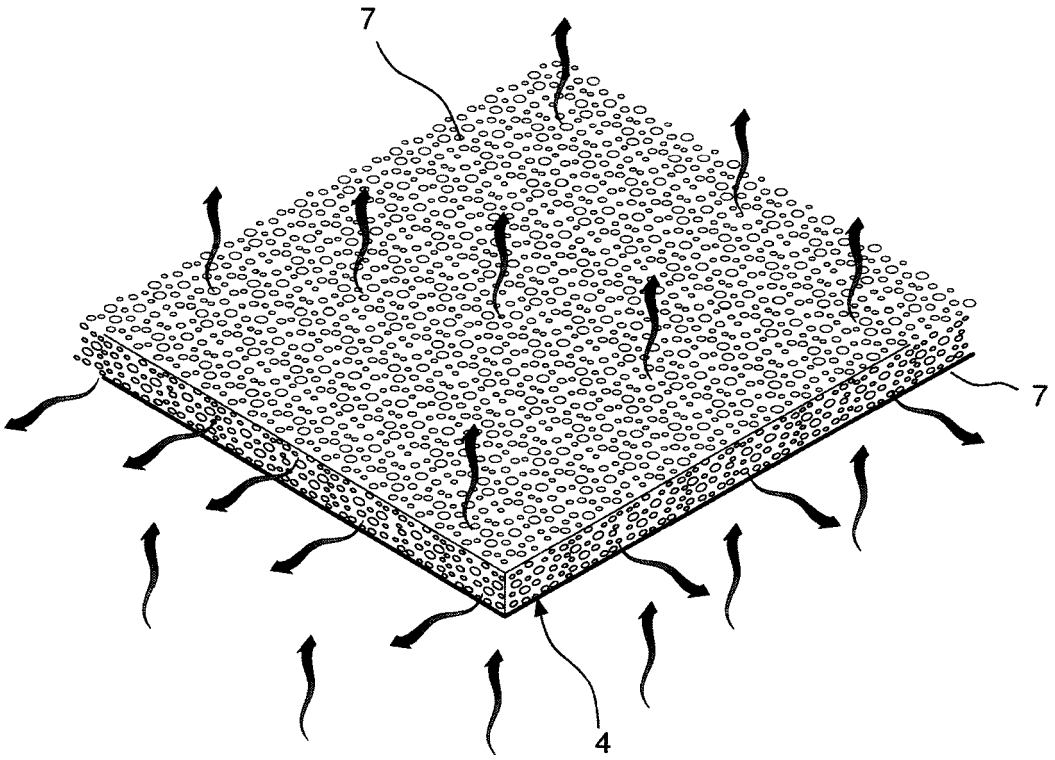


fig. 4

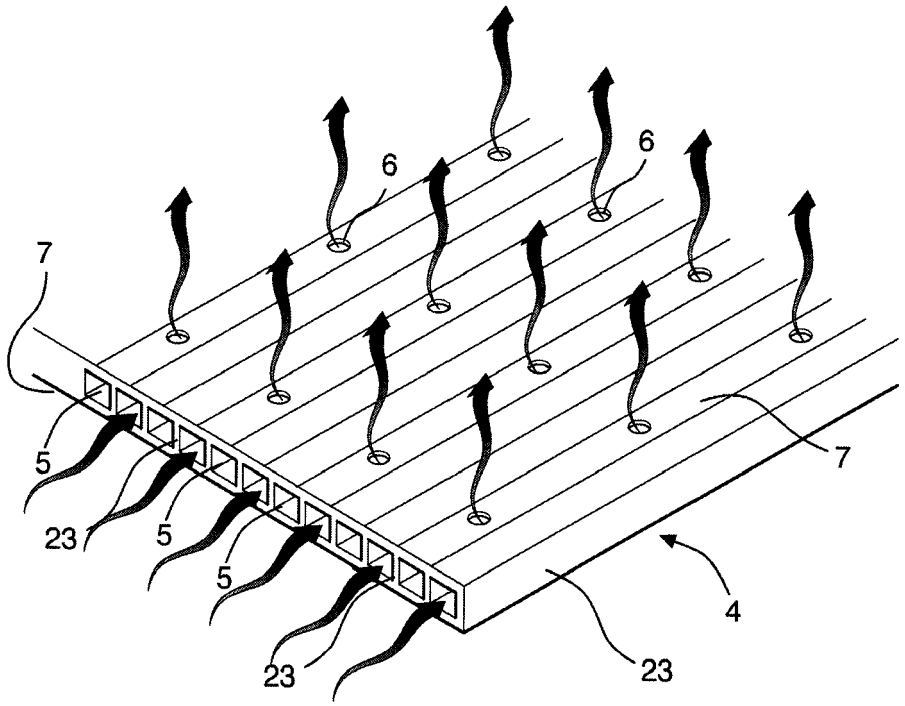
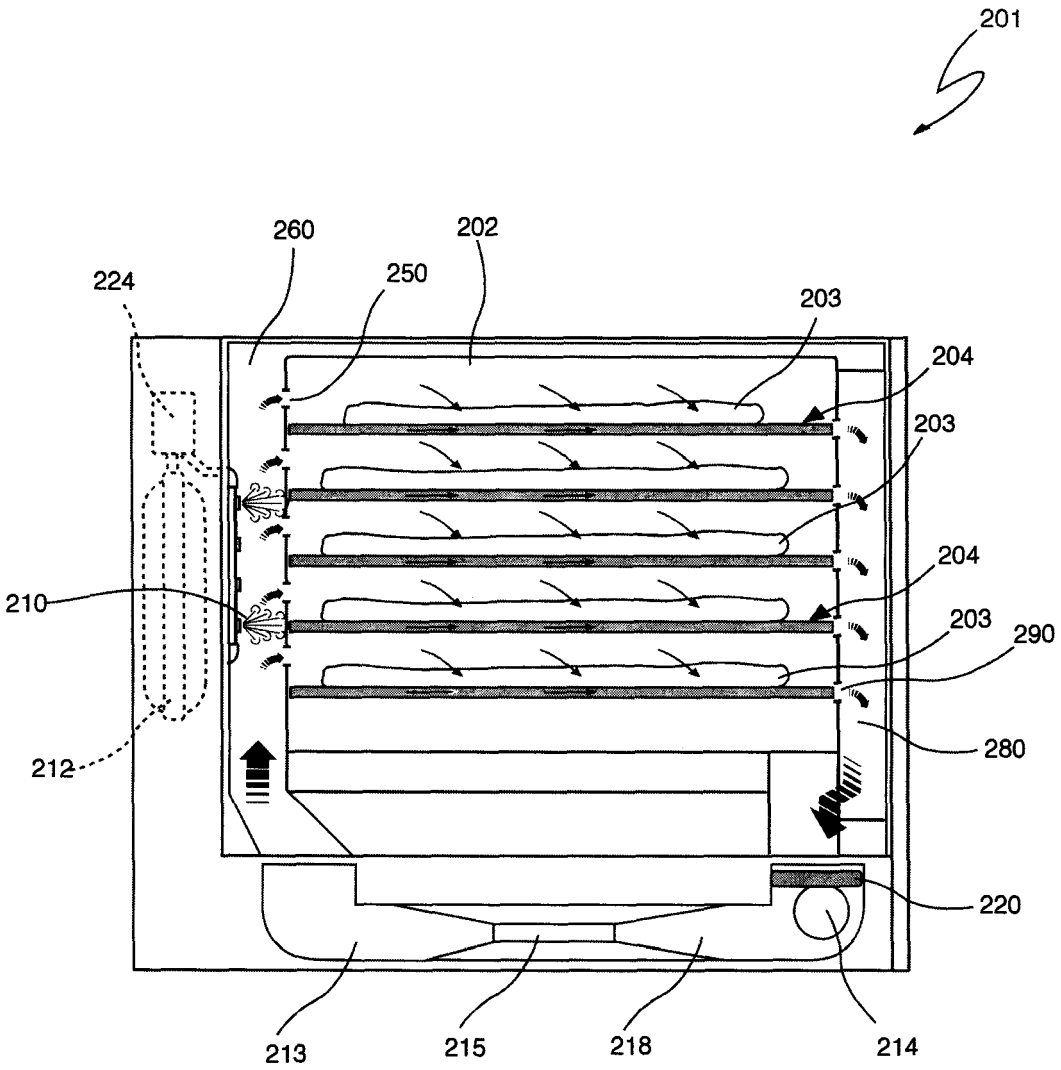


fig. 5


201
260
202
224
250
203
204
203
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204
203
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212
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213
215
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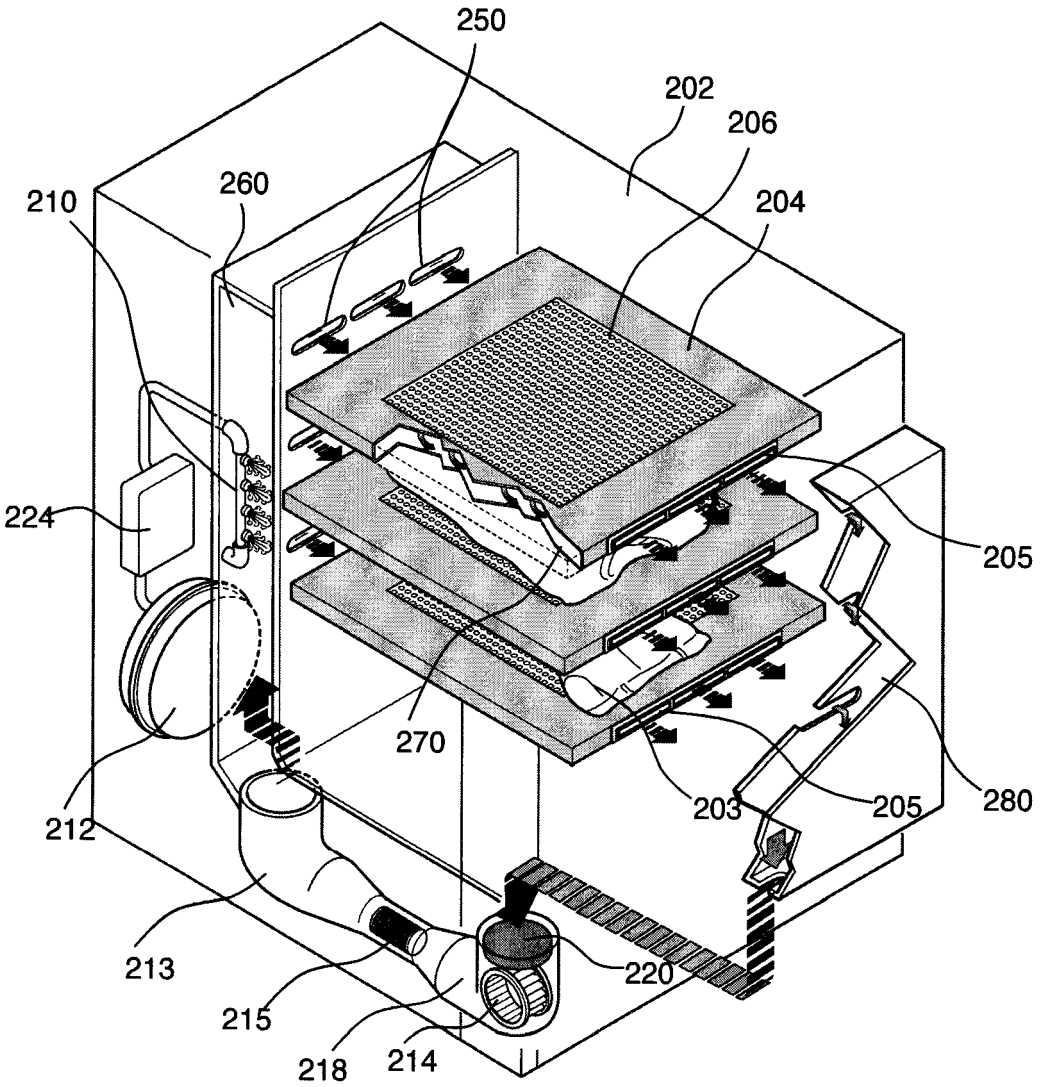
214

fig. 6


250
202
206
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213
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214

fig. 7

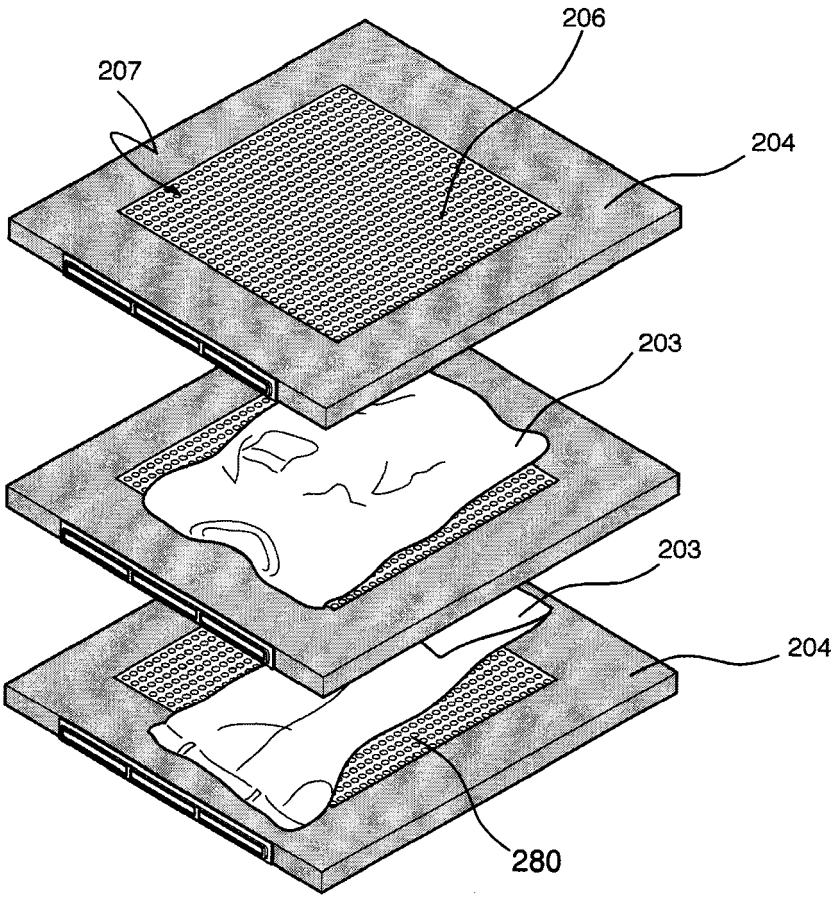


fig. 8

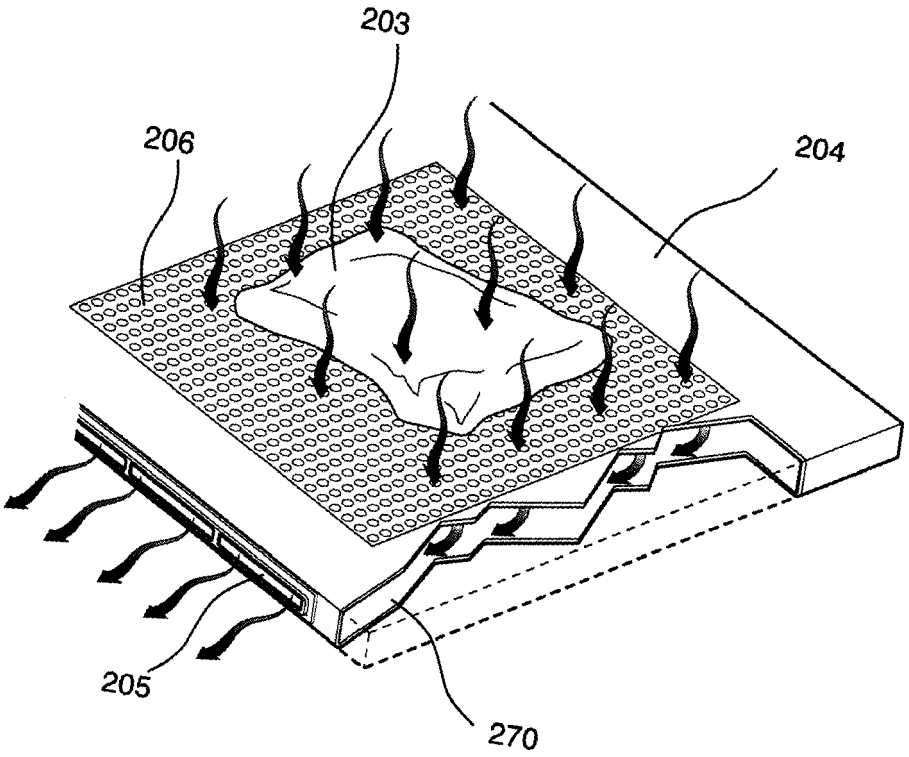
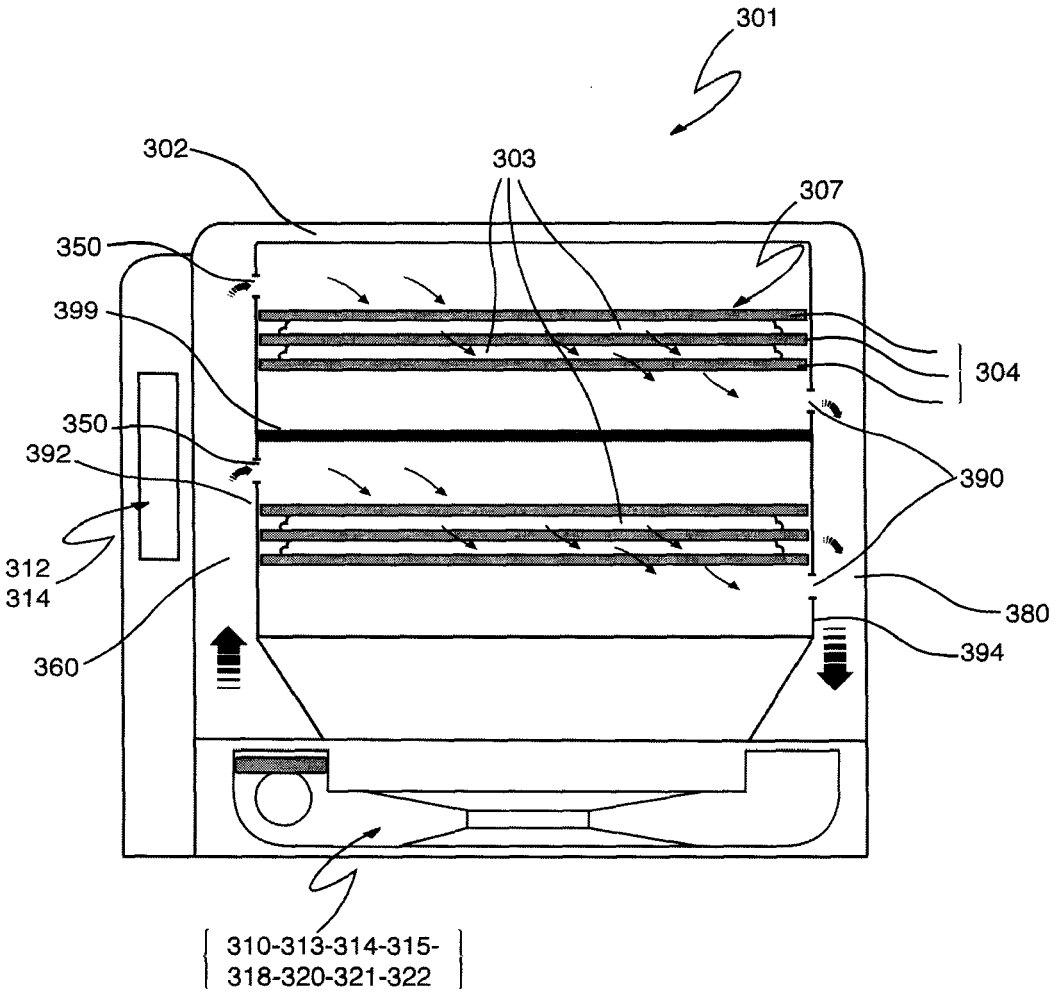


fig.9


301
302
303
307
350
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312
314
380
360
394
310-313-314-315-
318-320-321-322

fig. 10

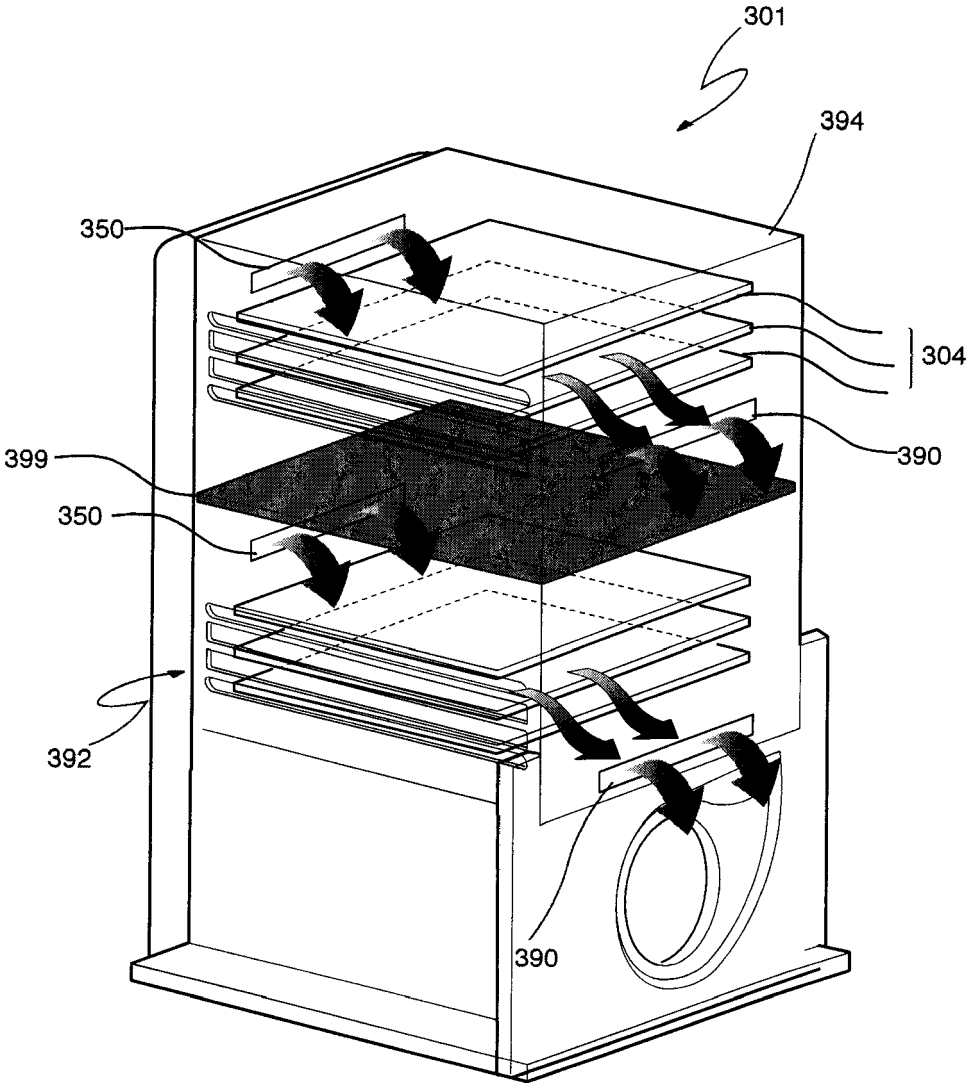

fig. 11

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 08 10 0854

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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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
Munich	5 June 2008	Clivio, Eugenio

CATEGORY OF CITED DOCUMENTS

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05-06-2008

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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