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A request for correction by deletion of part of the description has been filed pursuant to Rule 88 EPC. A decision on the request will be taken during the proceedings before the Examining Division (Guidelines for Examination in the EPO, A-V, 3.).

(54) Apparatus for humidifying continuous textile materials and associated method

(57) An apparatus and a method for humidifying a continuous textile material (2) are described. The apparatus comprises: a rotatable drum (3) having an internal cavity (32), the side wall (4) of which is formed externally by a side surface (40); a tank (5) facing the side surface (40); conveying means (9,21,22) for conveying the textile material through the tank (5); and means (7) for supplying into the tank substantially saturated steam at a pressure Pv and at a temperature Tv and for supplying into the internal cavity (32) substantially saturated steam at a pressure Pc and at a temperature Tc, wherein the conveying means (9,21,22) comprise a permeable belt (9) for pushing the textile material into direct contact with the side surface (4) at least in the zone of said tank (5), the steam supplied into the internal cavity (32) being kept at a pressure Pc less than said steam pressure Pv inside the tank (5) by a certain value so as to cause partial and controlled condensation of the steam supplied into the tank (5) onto the side surface (40) and onto the textile material (2).

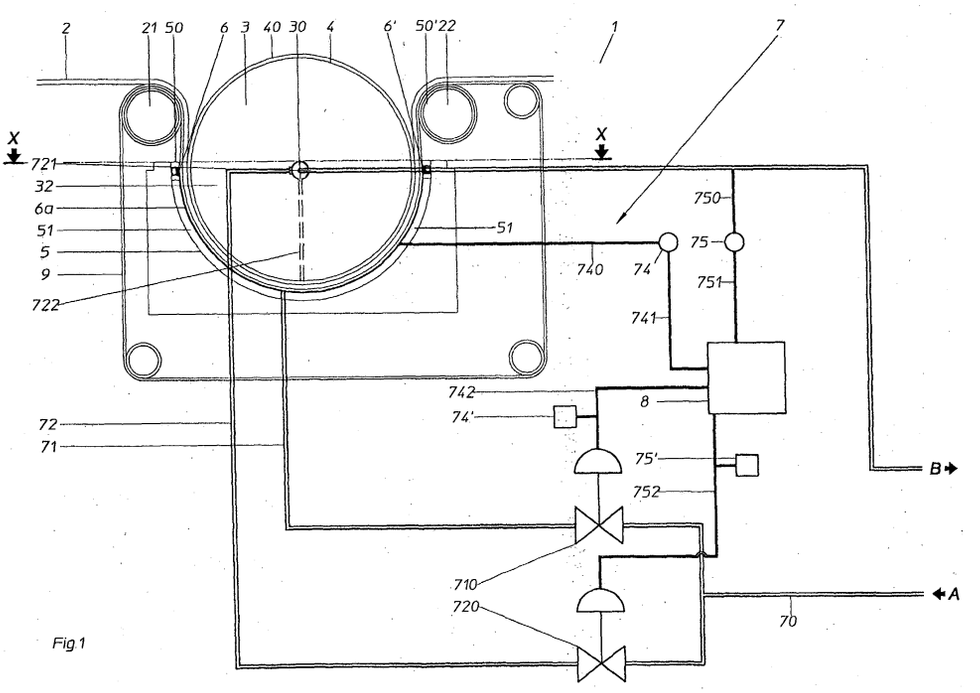


Fig.1

EP 1 428 923 A1

Description

[0001] The present invention relates to the field of the treatment of textile materials or the like and in particular relates to an apparatus and a method for humidifying continuous textile materials.

[0002] The European patent application EP 1,245,710 in the name of the present Applicant describes a device for humidifying a continuous textile material. The device according to EP 1,245,710 is based on a technique involving application of a liquid using essentially mechanical means.

[0003] This known technique is characterized in that the moisture is distributed on the outside of the textile material so as to perform, in practice, surface wetting thereof and cause said moisture to penetrate partially inside the textile structure. The main drawback of this known art is that the wetting does not involve, except to a small degree, interaction of a physical nature between the moisture and the textile fibre.

[0004] However, the physical phenomena relating to the diffusion of the surface moisture inside the textile substrate and, subsequently, the absorption of the internal moisture by the macro-molecular structure of the fibre may produce, under suitable physicochemical conditions, morphological modifications of the fibrous component which are useful and, in certain cases, decisive for the finishing processes applied to the textile materials.

[0005] The lack of said interaction between moisture and textile fibre; therefore, constitutes a constraining limitation as regards use of the humidifying technique by means of application of a liquid using purely mechanical methods.

[0006] Another known technique for humidifying a continuous textile material is based on the principle of the physical absorption of gaseous state moisture by a textile fibre, according to a method which uses the relative humidity content of the air and which is known as "conditioning".

[0007] A known apparatus suitable for the conditioning of continuous textile materials is described in EP 0,723,609 and uses, as treatment means, moisture in the gaseous state conveyed by an air flow. This apparatus uses essentially a physical principle which performs in succession the following steps: transfer of the moisture from the air to the surface of the textile material; diffusion of the moisture inside the textile structure (humidifying); and absorption of the moisture by the fibre (conditioning).

[0008] This conditioning humidifying apparatus has certain drawbacks. Firstly it is required to develop and use fairly sophisticated software. Moreover, the apparatus is complex and bulky. Another not insignificant drawback is the somewhat high cost. Owing to these and other drawbacks the application of said apparatus to current practices in the textile industry is problematic.

[0009] Finally a known apparatus - designed by the present Applicant - for the finishing of a continuous textile material or the like comprises a rotatable drum having an internal cavity, the side wall of which is formed externally by a felt-lined side surface; a tank facing said side surface; a felt belt for conveying the textile material through the tank; and means for supplying steam into said tank and into said internal cavity. In this apparatus, the textile material is not in direct contact with the side surface of the drum which is lined with a felt-like material. The textile material is thus compressed in sandwich fashion between the drum lining and the belt. Moreover, means for regulating both the pressure of the steam supplied into said tank and into said cavity in order to regulate the respective temperatures inside the tank and drum are not envisaged. This, in other words, prevents the controlled regulation of the difference in temperature inside the tank and the temperature of the side surface of the drum. The result is that it is extremely difficult, if not impossible, to cause controlled condensation of the steam inside said tank onto the textile material.

[0010] The main object of the present invention is that of providing an apparatus and a method for humidifying continuous textile materials or the like, which is very efficient and causes controlled interaction of a physical nature between moisture and textile fibre.

[0011] A further object of the present invention is that of providing an apparatus and a method for humidifying continuous textile materials or the like, which does not involve the development and use of sophisticated software.

[0012] A further object of the present invention is that of providing an apparatus for humidifying continuous textile materials or the like which is relatively compact and less complex than the known apparatus.

[0013] A further object of the present invention is that of providing an apparatus for humidifying continuous textile materials or the like which is relatively inexpensive.

[0014] A further object of the present invention is that of providing an apparatus and a method for humidifying continuous textile materials or the like, which is also applicable as a system integrated in a textile finishing machine.

[0015] These and other objects are achieved by means of an apparatus according to the independent Claim 1 and by means of a method according to the independent Claim 15. Further advantageous features of the invention are indicated in the respective dependent claims. All the claims are regarded as forming an integral part of the present description.

[0016] According to the present invention, moisture supplied in the semi-gaseous state is used to achieve controlled saturation of the textile material or the like.

[0017] The principle of humidification is based on causing a controlled condensation of part of the steam supplied from a chamber (or tank), onto the surface of the side wall of a drum on which the textile material to

be humidified is wound.

[0018] According to a first aspect, the invention provides an apparatus for humidifying a continuous textile material or the like, the apparatus comprising: a rotatable drum having an internal cavity, the side wall of which is formed externally by a side surface; a tank facing said side surface; conveying means for conveying the textile material through the tank; and means for supplying into said tank substantially saturated steam at a pressure Pv and at a temperature Tv and for supplying into said internal cavity substantially saturated steam at a pressure Pc and at a temperature Tc, wherein said conveying means comprise a permeable belt for pushing the textile material into direct contact with the side surface at least in the zone of said tank, the steam supplied into said internal cavity being kept at a pressure Pc less than said steam pressure Pv inside the tank by a certain value so as to cause partial and controlled condensation of the steam supplied into the tank onto said side surface and onto said textile material.

[0019] According to a second aspect, the invention provides a method for humidifying a continuous textile material or the like, the method comprising the steps of: i) providing a rotatable drum having an internal cavity, the side wall of which is formed externally by a side surface around which said textile material is wound; ii) conveying the textile material through a first peripheral zone of said drum, outside and close to said side surface; iii) supplying into said first peripheral zone substantially saturated steam at a pressure Pv and at a temperature Tv; iv) supplying into said internal cavity substantially saturated steam at a pressure Pc and at a temperature Tc; v) causing partial condensation of said saturated steam in said first peripheral zone onto said surface of the drum and said textile material, wherein the steam pressure in the first peripheral zone and the steam pressure inside the internal cavity of the drum are controlled and regulated so that said pressure is at least less than the pressure by a certain value which is variable and can be predetermined. wherein the steam pressure Pv in the first peripheral zone and the steam pressure Pc inside the internal cavity of the drum are controlled and regulated so that said pressure Pc is at least less than the pressure Pv by a certain value which is variable and can be predetermined. wherein the steam pressure Pv in the first peripheral zone and the steam pressure Pc inside the internal cavity of the drum are controlled and regulated so that said pressure Pc is at least less than the pressure Pv by a certain value which is variable and can be predetermined.

[0020] The invention will undoubtedly become clear from the detailed description which follows, provided purely by way of a non-limiting example, to be read with reference to the accompanying sheets of illustrative drawings in which:

- Fig. 1 shows a schematic and substantially cross-sectional view of an apparatus for humidifying continuous textile materials or the like according to a first embodiment of the invention;
- Fig. 2 shows a cross-sectional view, along the plane X-X indicated in Fig. 1;
- Fig. 3 shows a schematic and substantially cross-sectional view of an apparatus for humidifying continuous textile materials or the like according to a second embodiment of the invention; and
- Fig. 4 shows a schematic and partially cross-sectional view of a further embodiment of the present invention with a cooling device.

[0021] With reference initially to Figs. 1 and 2, the apparatus 1 for humidifying continuous textile materials 2 (or the like) being fed in a prechosen direction comprises: a drum 3; motor means 31 for rotating the drum 3; a chamber (or tank) 5 for supplying steam; elements for sealing the pressure of the steam 6, 6', 6a, 6'a; an endless belt 9; an idle entry roller 21 and idle exit roller 22 for said fabric and said belt; a circuit 7 for the supply A of the steam into said chamber and into said drum and for discharging B of the condensate from the drum; and a system 8 for managing the steam pressure inside said chamber and said drum.

[0022] The drum 3 is rotatable about hubs 30, 30' by means of motor means 31. The drum 3 is provided with an internal cavity 32, the side wall 4 of which is formed externally by a metallic heated surface 40. The steam supply chamber or tank 5 is outside the drum 3, but close to the side wall 4 of the drum 3 and facing the heated metallic surface 40 at a first peripheral zone. The steam supply tank 5 has longitudinal lateral edges 51, 51' where the elements 6, 6' and 6a, 6'a for sealing the steam pressure are housed. The endless belt 9 is preferably made of permeable felt and is associated with said textile material.

[0023] The circuit 7 comprises a pipe 70 for supplying the steam A and two associated branches, 71 and 72 respectively. Respective means 710 and 720 for regulating the steam pressure are arranged on said branches 71, 72. The delivery side of the branch 71 is connected to the steam supply tank 5 and the delivery side of the branch 72 is connected to a rotating coupling 721 - shown in Fig. 2 - associated with the hub 30 of the drum 3.

[0024] The rotating coupling 721 has a first end facing the drum 3 and a second end facing the opposite direction. The rotating coupling 721, at one of its ends, is connected to a small pipe 722 for collecting the condensate liquid of the steam from the internal cavity 32 of the drum 3. The rotating coupling 721, at its second end, is connected to a pipe 73 for discharging the condensate liquid of the steam from the internal cavity 32 of the drum 3.

[0025] The circuit 7 also comprises a first pressure-sensing means 74 and a second pressure-sensing means 75. The first pressure-sensing means 74 is connected to the tank 5 by means of a first probe 740 and to the means 710 by means of a first and a second cable

741, 742. The second pressure-sensing means 75 is connected to the pipe 73 for discharging the condensate liquid of the steam, via a second probe 750, and to the steam pressure-regulating means 720 by means of cables 751, 752.

[0026] A system 8 for managing the pressure of the steam is arranged between the first and the second pressure-sensing means (74, 75) and said pressure-regulating means 710, 720: the cables 741 and 751 convey input signals from the respective pressure-sensing means 74 and 75 to said system 8 and, similarly, the cables 742 and 752 convey output signals from said system 8 to the respective pressure-regulating means 710 and 720. Moreover, a first means 74' for converting the signal output from the system 8 to the regulating means 710 is arranged between the pressure management system 8 and the first pressure-regulating means 710. Similarly a second means 75' for converting the signal output from the system 8 to the regulating means 720 is arranged between the pressure management system 8 and the second pressure-regulating means 720. Therefore, the conversion means 74' and 75' are connected respectively to the cables 742 and 752.

[0027] The continuous textile material 2 to be humidified - equipped with its own known driving means not shown for the sake of clarity - is associated with the endless belt 9 (preferably made of permeable felt) and travels on an idle entry roller 21 and idle output roller 22, being wound around the side wall 4 of the drum 3. As mentioned above, the side wall 4 of the drum 3 is formed on the outside by a metallic heated surface 40. In turn the drum 3 is driven rotationally around the hubs 30 and 30' by the motor means 31. The continuous textile material 2 and the belt 9 are treated with steam in the zone which is delimited by the side wall 4 and by the steam supply tank 5 facing it and is situated in a first peripheral zone of the drum 3.

[0028] The belt 9 is of the known type. Advantageously, by way of example, it may be of the type described in the European patent applications EP 0,293,028 and EP 1,010,797 A1 in the name of the present Applicant. Advantageously it comprises a needle-punched felt made of polyester and aramide fibres.

[0029] Saturated steam at a predetermined pressure is supplied into the tank 5 by means of the branch 71 and the regulating means 710. Saturated steam at a predetermined pressure is also supplied into the hollow drum 3, by means of the hub 30 and the rotating coupling 721. Supplying occurs via the branch 72, the regulating means 720 and the rotating coupling 721, by means of which the condensate liquid of the steam is also collected from the internal cavity 32 of the drum via the small pipe 722. The condensate liquid of the steam is then discharged outside the drum 3 by means of the discharge pipe 73.

[0030] The predefined value of the pressure of the steam supplied into the tank 5 is maintained substantially by means of the actuation of the longitudinal sealing elements 6, 6' and lateral sealing elements 6a, 6'a arranged along the longitudinal edges 50, 50' and lateral edges 51, 51' of the tank 5.

[0031] The relative pressure of the steam is varied and regulated by the means 710 and 720 depending on said predefined value within the range of between 0 bar (atmospheric pressure) and 2.5 bar and, preferably, between 0.5 bar and 2.0 bar.

[0032] Said steam pressure sealing elements (6, 6' and 6a, 6'a) are of any known type. Preferably, they are substantially of the type described in EP 0,293,028 and EP 1,010,797 A1 in the name of the present Applicant. The sealing elements advantageously comprise slider elements associated with inflatable elements.

[0033] Supplying of the steam inside the drum 3 produces heating of the side wall 4 and its surface 40 to a temperature substantially corresponding to that of the steam and, similarly, in the zone delimited by the side wall 4 and by the tank 5 a temperature substantially corresponding to that of the steam is established.

[0034] The principle of humidification is based on causing a controlled condensation of part of the steam supplied by the tank 5 onto the surface of the side wall of the drum on which the textile material to be humidified is wound.

[0035] In order for this condensation of the steam to take place it is necessary to provide on the surface 40 of the drum 3 a temperature value which is less than that of the temperature of the steam present in the tank 5. In order to control condensation of the steam, the surface temperature of the drum, or the temperature of the steam supplied inside it, must be suitably regulated with respect to that of the steam supplied into the tank 5.

[0036] The temperature of the steam depends on the pressure according to the relation expressed by the Mollier diagram for the saturated steam; therefore, by introducing this relation for the prechosen operating pressure range of 0 - 2.5 bar into the steam pressure management system, at each pressure value of the steam "P" the system is able to provide the corresponding temperature value of the steam "T".

[0037] The pressure of the steam "Pv" inside tank 5 is sensed by the pressure-sensing means and transmitted to the management system 8 which compares it with a prechosen pressure value (set-point) "Pvset" inside the tank. If it is not within the tolerance limit, the management system 8 imparts to the first pressure-regulating means 710, by means of the signal conversion means 74', the instruction for restoring inside the tank the pressure value "Pv" corresponding to the set-point value "Pvset". The means 74' converts the electrical signal emitted by the system into a signal which can be understood by the first regulator 710.

[0038] The pressure value of the steam "Pc" inside the drum is measured on its condensate liquid, it being at the same pressure as the steam, by means of the pressure-sensing means 75 connected to the discharge pipe 73 and is transmitted to the management system

8. A comparison is effected with a prechosen pressure value (set-point) "Pcset" inside the drum and the following two options are possible here.

I. No humidification, and therefore no condensation, is required:
the condition whereby "Pc" ≥ "Pv" and therefore "Tc" ≥ "Tv" must be satisfied;

i. if the management system 8 detects a pressure of the steam inside the drum "Pc" which is less than that inside the tank ("Pv") with a difference between the values greater than a fixed tolerance, it imparts to the second regulating means 720, by means of the corresponding signal conversion means 75', the instruction for restoring in the drum the pressure value corresponding to the set-point value "Pcset".

II. Humidification, and hence controlled condensation of the steam onto the surface of the drum, is required: the condition whereby "Pc" < "Pv" and therefore "Tc" < "Tv" must be satisfied;

ii. the system 8 drives the means 720 until the pressure of the steam inside the drum assumes the predefined set-point value less than that of the pressure of the steam inside the tank; consequently a difference between the values of the corresponding temperatures is established.

[0039] However, it may occur that the temperature value of the steam inside the drum "Tc" does not correspond with sufficient approximation to the actual temperature value "Ts" of its side surface 40 on which condensation takes place; in general the condition occurs whereby "Ts" < "Tc" and therefore the amount of steam which condenses exceeds the expected amount.

[0040] In a first variant of the embodiment according to Fig. 1, shown in Fig. 3, a temperature-sensing means 76 is located opposite the surface 40 of the side wall 4 of the drum 3. The temperature sensor 76 is connected to the system 8 by means of a cable 761 and from the latter to the second pressure-regulating means 720 by means of a cable 762 provided with means 76' for conversion of the output signal.

[0041] The means 76 senses the temperature value "Ts" of the surface 40 of the drum 3 which is compared by the system with a prechosen temperature value (set-point) "Tsset" on the surface of the drum. If the condition is encountered whereby "Ts" is less than "Tsset", with a difference between the values greater than a predefined tolerance, the system 8 drives the means 720, via the signal conversion means 76', so as to increase the pressure of the steam inside the drum until the temperature value "Ts" corresponding to the set-point value "Tsset" is restored on the surface of the drum.

[0042] In this way the loss of heat suffered by the side surface 40 of the drum owing to irradiation into the external environment is offset and the difference between the greater temperature of the steam supplied by the tank 5 and the lesser temperature of the side surface of the drum on which the steam condenses is consequently controlled with greater accuracy. It is thus possible to generate the moisture necessary and sufficient for achieving the desired level of humidification of the textile material.

[0043] Preferably, the first and second means for regulating the pressure 710, 720 are respective modulating valves, advantageously of the pneumatically operated type.

[0044] Preferably, the first and second pressure-sensing means 74, 75, as well as the temperature-sensing means 76, are transmitters. Moreover, the conversion means 74', 75' are preferably signal converters. In particular, the temperature transmitter/sensor 76 may be of the contact type or remote type, for example, infrared-ray type. However, any temperature transmitter of another type which is able to sense the surface temperature of the drum and transmit it may be suitable for the purposes of the present invention.

[0045] Advantageously, said management system (8) is a PLC.

[0046] The diffusion of the moisture in the semi-gaseous state (moist saturated steam, i.e. moisture in the vaporous state in equilibrium with moisture in the liquid state), into the textile material and its absorption by the fibre are performed by means of a physical process also influenced by the temperatures of the environment.

[0047] Since the absorption of the moisture by the fibre involves an emission of heat (i.e. it consists of an exothermic phenomenon), for thermodynamic reasons it is greater at a lower temperature.

[0048] On the other hand, the time required for diffusion of the moisture from the outside towards the inside of the textile material diminishes with an increase in the temperature.

[0049] It follows that, while the rapidity of humidification of the textile material is favoured by a relatively high temperature, on the contrary the degree of humidification is increased by a reduction in the temperature, i.e. a cooling of the textile material.

[0050] In a further embodiment of the apparatus according to the invention, shown in Fig. 4, a cooling device 10 is provided. Said cooling device 10, capable of forming an air flow for cooling the textile material 2, is arranged in a second peripheral zone of said drum 3, downstream of said first peripheral zone (in the direction of feeding of the textile material) and substantially facing said side wall 40 of said drum 3.

[0051] Said device 10 is of any known type, for example that described in EP 1,010,797 A1 in the name of the same Applicant.

[0052] The belt 9 associated with the textile material 2 to be humidified, on the one hand distributes uniformly, by means of its permeable felt structure, the steam flow

towards the textile material and the condensation surface 40 and, on the other hand, favours the conservation of the heat generated by the textile material during absorption of moisture.

[0053] The cooling device 10 reduces the temperature of the textile material, dissipating the heat generated by the fibre following absorption of moisture.

[0054] The Applicant has carried out tests with the apparatus of the present invention for humidifying a continuous textile material or the like.

[0055] Tests carried out at fairly low tank pressures Pv (of the order of 0.6 bars) have revealed the importance of controlling and regulating the pressure of the steam pressure Pc, and hence the temperature, inside the drum. In fact, although fairly low tank steam pressure values were selected, not always were satisfactory humidification levels achieved. The Applicant has discovered that this depended on very different pressure and temperature values of the steam inside the drum in the various tests, which in turn resulted in condensation levels of the steam which were equally different.

[0056] Substantially high tank steam pressures produced intermediate humidification levels determined by pressure and temperature values of the steam inside the drum moderately lower than those in the tank.

[0057] The tests carried out have also shown how the value of the temperature on the surface of the drum Ts is generally a few degrees less than the corresponding temperature of the steam or the condensate Tc, whence the convenience of introducing a dedicated control and regulating means into the system.

[0058] In view of the detailed description above and the accompanying figures, the particular characteristic features of the invention and the associated advantages compared to the known art will certainly be clear.

[0059] Compared to the known humidifying devices which act by means of the mechanical application of a liquid onto the textile material, the apparatus according to the present invention performs humidification using a physical notion which is more similar to that of conditioning. Said humidification is more effective and reliable as regards the qualitative aspects associated with the penetration of the moisture into the textile material and its absorption into the fibres.

[0060] As regards, instead, a comparison with the known humidifying apparatus which use the technique of conditioning by means of physical absorption of moisture in the gaseous state, the apparatus according to the present invention is based on a physical notion which is similar but simpler and relatively less costly with regard to both the mechanics and the electronics.

[0061] The apparatus according to the present invention is compact and less bulky. Such an apparatus may be used as an independent self-standing unit or, alternatively, may be applied as a system integrated into textile finishing machinery which are mechanically suitable for this purpose.

[0062] It is obvious that the embodiments described and shown in the accompanying drawings may be subject to numerous modifications, adaptations and replacements of parts by others which are functionally equivalent. However all these modifications, adaptations and replacements of parts are to be regarded as falling within the scope of protection defined only by the accompanying claims.

Claims

1. Apparatus (1) for humidifying a continuous textile material (2) or the like, the apparatus comprising:

   a rotatable drum (3) having an internal cavity (32), the side wall (4) of which is formed externally by a side surface (40);
   a tank (5) facing said side surface (40);
   conveying means (9, 21, 22) for conveying the textile material through the tank (5); and
   means (7) for supplying into said tank (5) substantially saturated steam at a pressure Pv and at a temperature Tv and for supplying into said internal cavity (32) substantially saturated steam at a pressure Pc and at a temperature Tc,

   characterized in that said conveying means (9, 21, 22) comprise a permeable belt (9) for pushing the textile material into direct contact with the side surface (4) at least in the zone of said tank (5), the steam supplied into said internal cavity (32) being kept at a pressure Pc less than said steam pressure Pv inside the tank (5) by a certain value so as to cause partial and controlled condensation of the steam supplied into the tank (5), onto said side surface (40) and onto said textile material (2).

2. Apparatus (1) according to Claim 1, **characterized in that** said means (7) for supplying steam comprise a circuit (7) for the supply (A) of steam, said circuit (7) comprising a pipe (70) with a first and a second branch (71, 72), said first branch (71) being for the supply of steam into said tank (5) and said second branch (72) being for the supply of steam into the internal cavity (32) of the drum (3).

3. Apparatus (1) according to Claim 2, **characterized in that** said circuit (7) also performs discharging (B) of condensate and comprises a pipe (73) for discharging of the condensate from the internal cavity (32) of the said drum (3).

4. Apparatus (1) according to any of Claims 1, 2 or 3, **characterized in that** said circuit (7) also comprises means (710, 720) for regulating the pressure of the steam supplied into said tank (5) and/or into said internal cavity (32).

5. Apparatus (1) according to any one of Claims 1-4, **characterized in that** said supply means (7) also comprise a first means (74) for sensing the pressure of the steam inside said tank (5) and/or a second means (75) for sensing the pressure of the steam inside said internal cavity (32) of said drum (3).

6. Apparatus (1) according to any one of Claims 1-5, **characterized in that** said supply means (7) also comprise a system (8) for managing the pressure of the steam inside said tank (5) and inside said cavity (32).

7. Apparatus (1) according to Claim 6, **characterized in that** said system (8) for managing the pressure of the steam is responsive to said first and second sensing means (74, 75) and/or to said first and second steam pressure-regulating means (710, 720), said system (8) controlling and regulating the supply pressure Pc of the steam into said drum (3) to a value at least less than that of the supply pressure of the steam into said chamber (5).

8. Apparatus according to Claim 6 or 7, **characterized in that** it also comprises conversion means (74', 75') arranged in between said management system (8) and said means (710, 720) for regulating the pressure of the steam.

9. Apparatus (1) according to any one of the preceding claims, **characterized in that** it also comprises a means (76) for sensing the temperature Ts of the side surface (40), arranged opposite the side surface (40) of the drum (3).

10. Apparatus (1) according to Claim 9, when dependent upon any one of Claims 6-9, **characterized in that** said system (8) for managing the pressure of the steam is responsive to said means (76) for sensing the temperature Ts, between said system (8) and said second regulating means (720) there being arranged conversion means (76').

11. Apparatus according to any one of the preceding claims, **characterized in that** it also comprises a device (10) for forming an air flow cooling the textile material, said device (10) being arranged substantially facing the side wall (4) of the drum (3) in a second peripheral zone not corresponding to said tank.

12. Apparatus according to any one of the preceding claims, **characterized in that** it also comprises means (6, 6', 6a, 6'a) for sealing the steam pressure, housed along the longitudinal edges (50, 50') and lateral edges (51, 51') of the tank (5) so as to close in a sealed manner said tank (5) in such a way as to create a substantially closed chamber.

13. Apparatus according to any one of the preceding claims, **characterized in that** said conveying means (9, 21, 22) comprise the permeable belt (9) which is wound endlessly and two idle entry and exit rollers (21, 22) for said textile material and said belt.

14. Apparatus according to any one of the preceding claims, **characterized in that** it also comprises a motor means (31) for rotating said drum (3) around hubs (30, 31).

15. Method for humidifying a continuous textile material (2) or the like, the method comprising the steps of:

i) providing a rotatable drum (3) having an internal cavity (32), the side wall (4) of which is formed externally by a side surface (40) around which said textile material is wound;
ii) conveying (9, 21, 22) the textile material through a first peripheral zone (5) of said drum, outside and close to said side surface (40);
iii) supplying (7) into said first peripheral zone (5) substantially saturated steam at a pressure Pv and at a temperature Tv;
iv) supplying into said internal cavity (32) substantially saturated steam at a pressure Pc and at a temperature Tc;
v) causing partial condensation of said saturated steam in said first peripheral zone onto said surface of the drum (40) and said textile material,

wherein the steam pressure Pv at the first peripheral zone and the steam pressure Pc inside the internal cavity of the drum are controlled and regulated so that said pressure Pc is at least less than the pressure Pv by a certain value which is variable and can be predetermined.

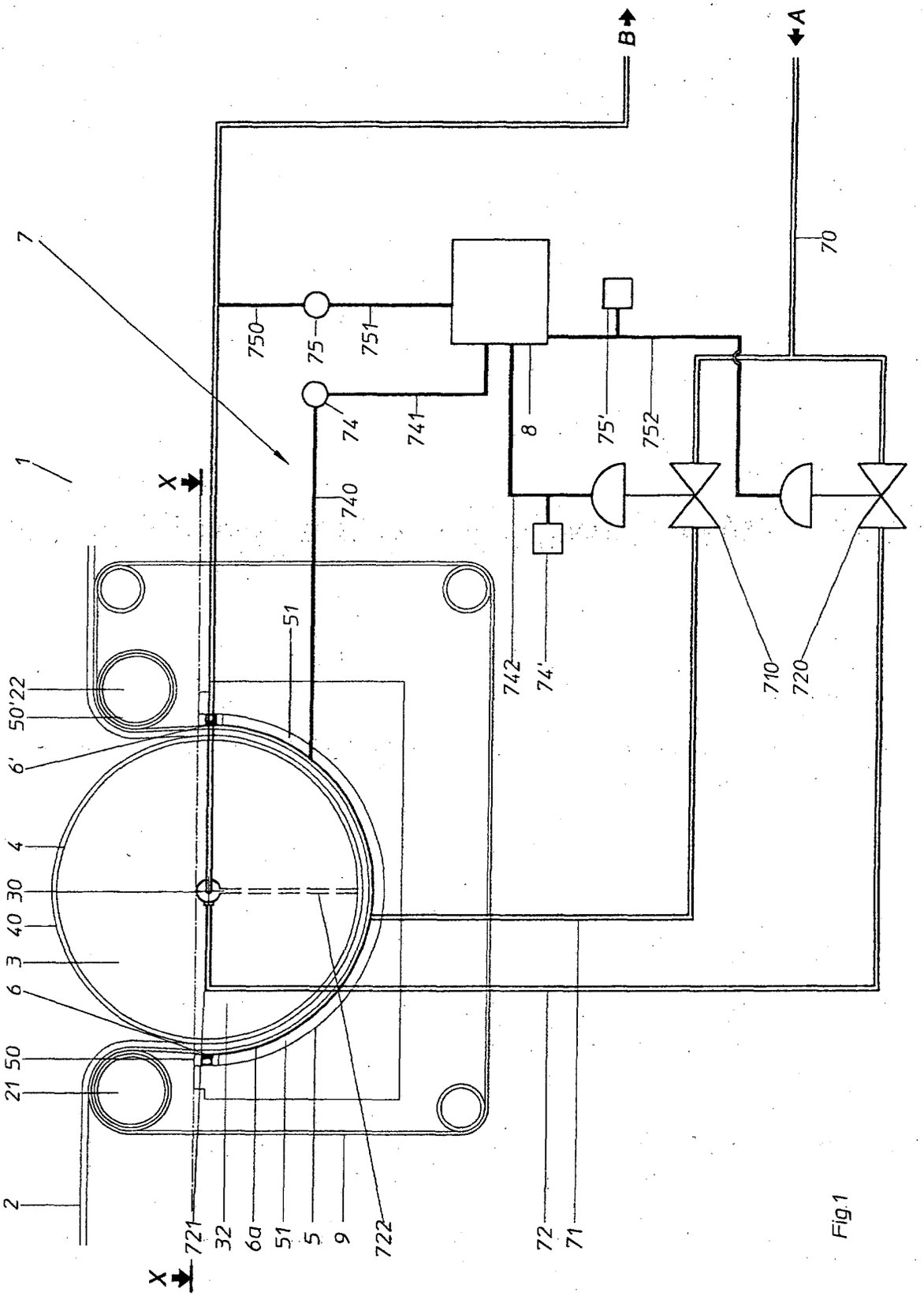
16. Method according to Claim 15, **characterized in that** the step ii) of conveying the textile material comprises the step of associating with said textile material an endless permeable belt (9) for pushing the textile material into direct contact with the side surface (40) at least in said first peripheral zone (5).

17. Method according to Claim 15, **characterized in that** said prechosen pressures Pc and Pv of said substantially saturated steam are within the range of 0 - 2.5 bar and preferably within the range of 0.5 - 2.0 bar.

18. Method according to any of Claims 15, 16 or 17, **characterized in that** the prechosen temperature Tc of the steam inside said side wall of the drum is at least equal to a temperature Ts of the surface of the drum.

19. Method according to Claim 18, **characterized in that** said temperature Ts of said surface is at least less than said prechosen temperature Tv of said saturated steam outside said side wall of said drum.

20. Method according to any one of Claims 16-19, **characterized in that** it comprises the further step of cooling with an air flow said textile material (2) in a second peripheral zone of said drum, outside and close to said surface, immediately following said first peripheral zone in a direction of movement of the textile material (2).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75
751
74
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740
8
75'
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1
X
51
742
74'
710
720
50'22
6'
4
30
40
3
6
21 50
2
721
32
6a
51
5
9
722
72
71
X

Fig.1

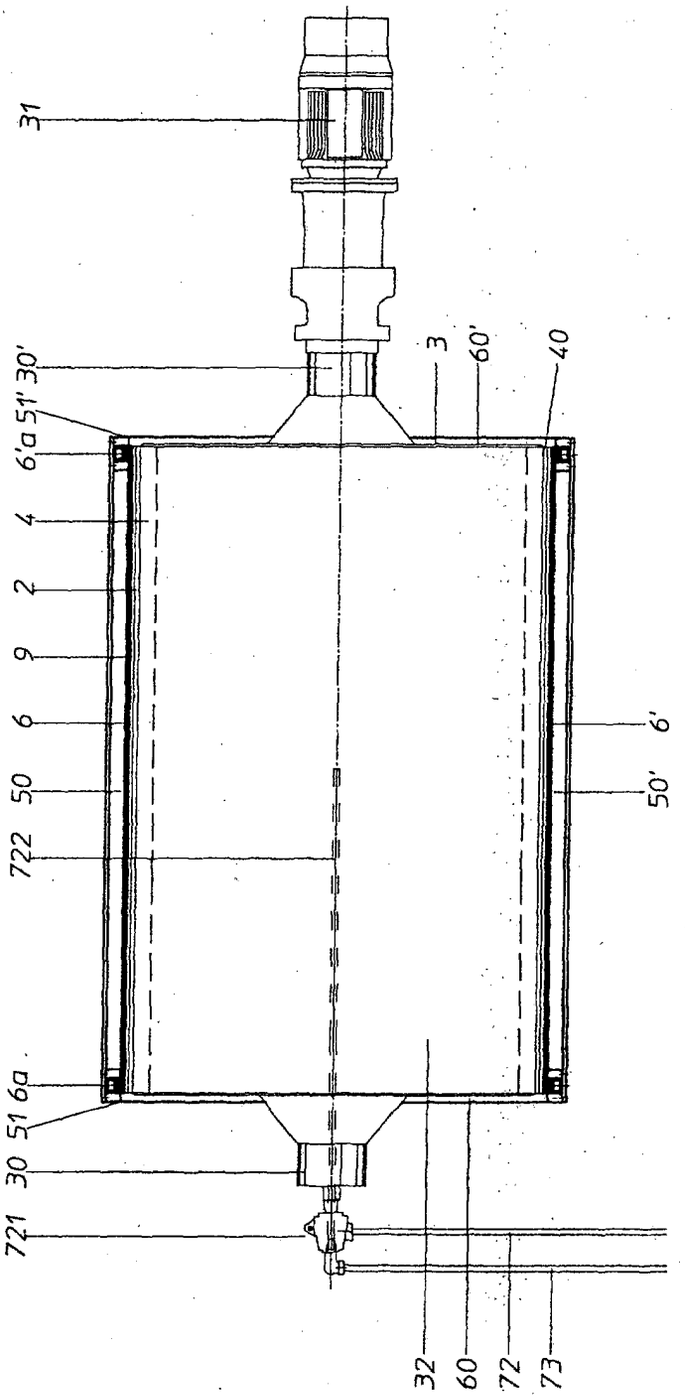

Fig.2

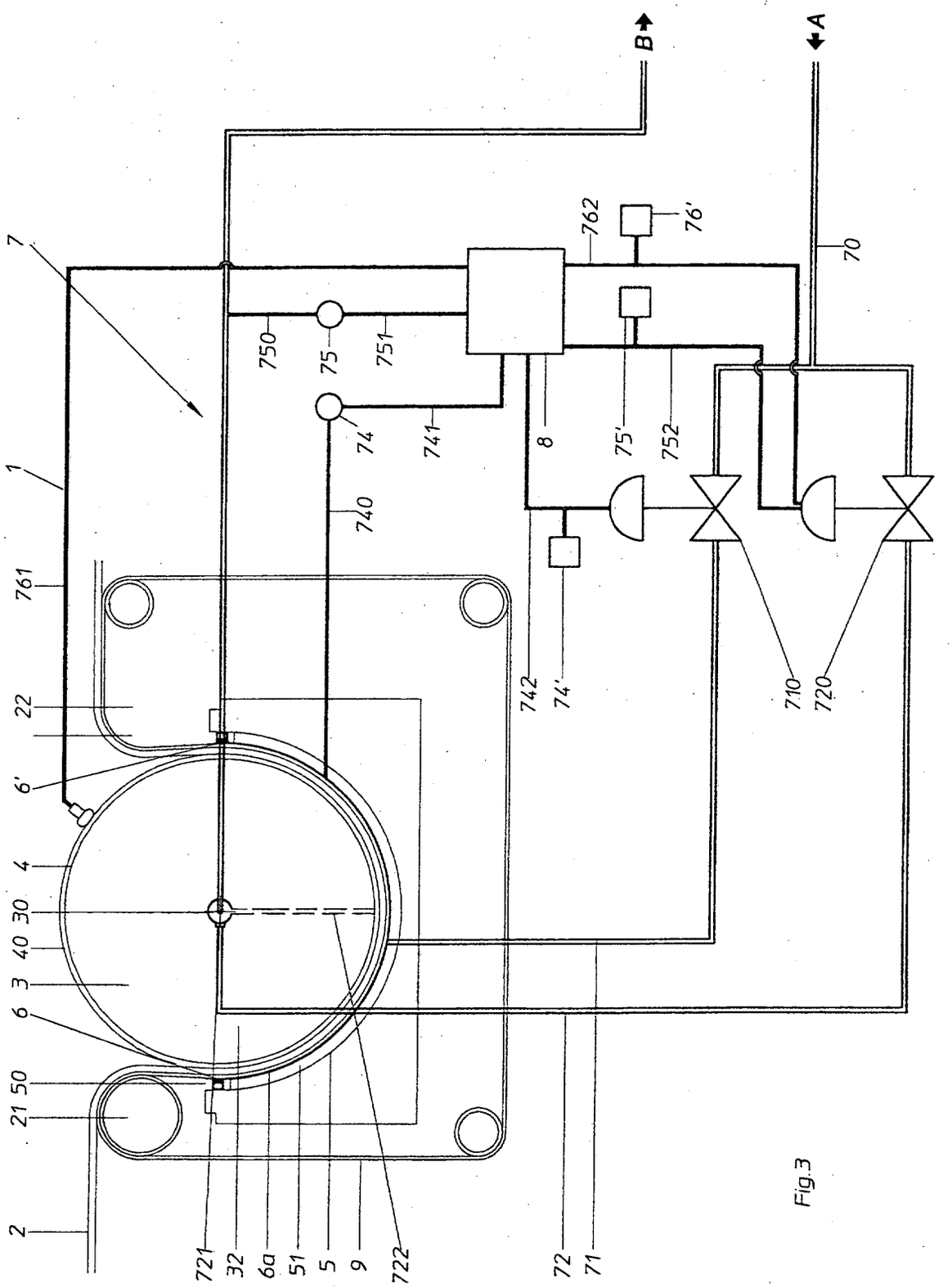
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Fig.3

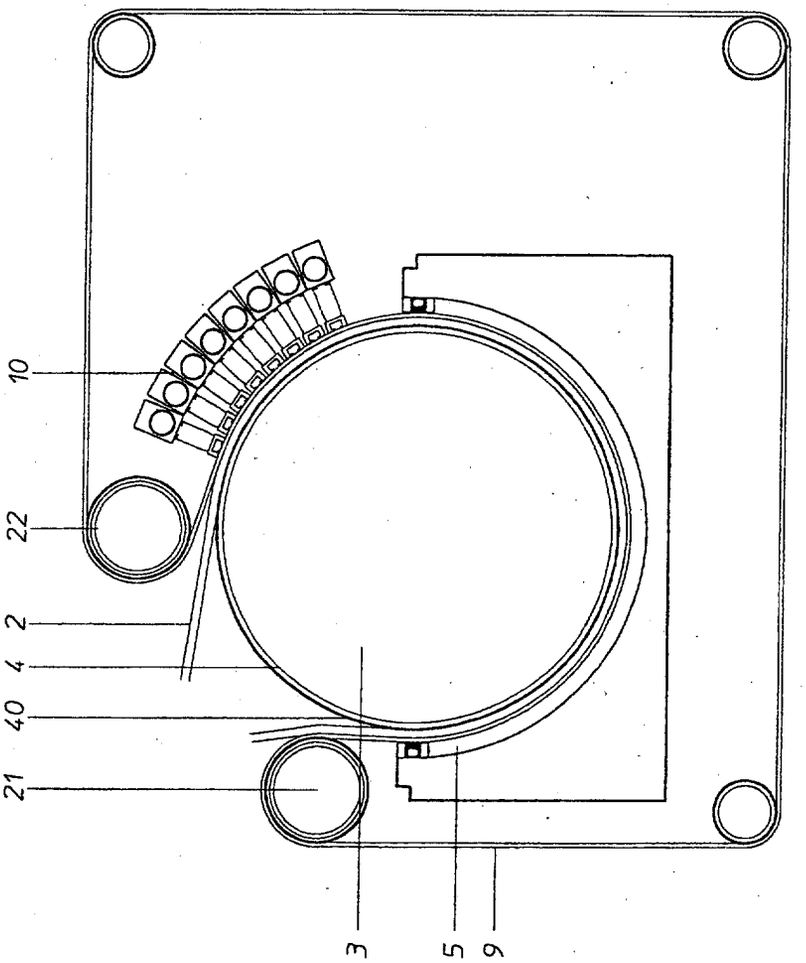

Fig.4

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 02 42 5756

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D06B
D06C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	4 April 2003	Van Gelder, P

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