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(54) **Method and device for the finishing treatment of a fabric**

(57) Method and device for the finishing treatment of fabrics (11), in which a damp fabric (11), mechanically constrained, is subjected to at least a heating treatment inside a substantially sealed chamber (19) with pressurized steam in order to dry it from an initial value of hu-

midity to a final one. The temperature of the fabric (11) from the beginning to the end of the treatment is regulated in such a manner that, in relation to its initial humidity content, the fabric (11) is always maintained at a temperature above a level corresponding to the permanent fixing temperature (T2).

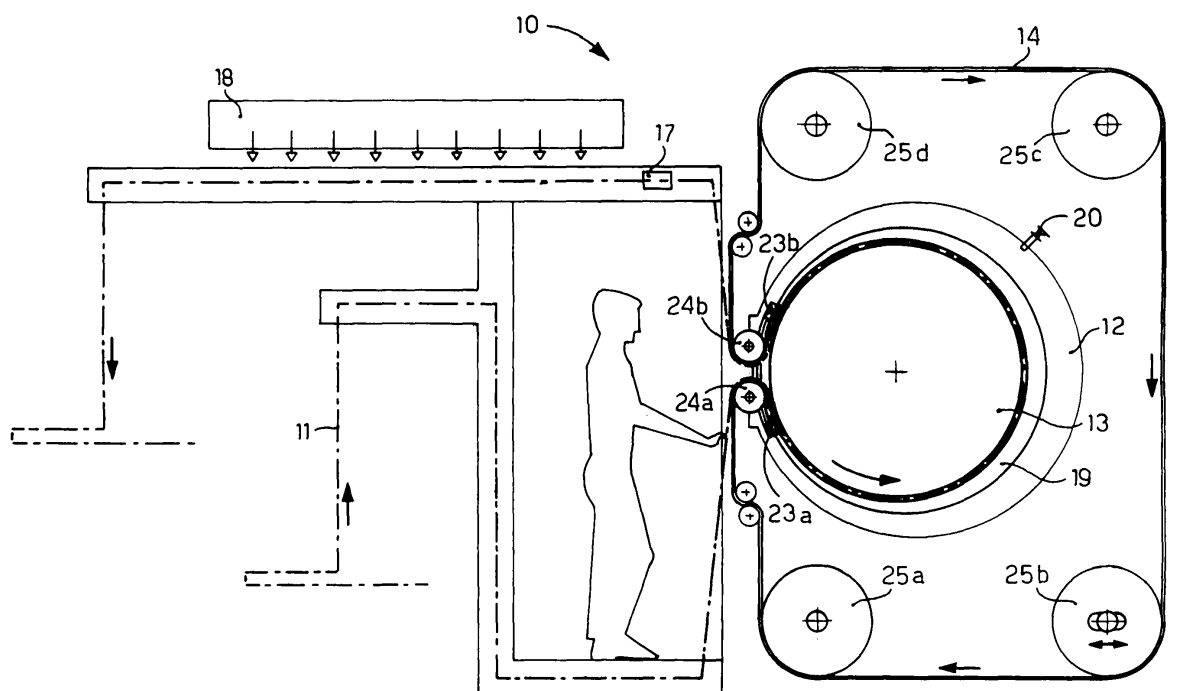


fig. 2

Description

FIELD OF THE INVENTION

[0001] The present invention refers to a method and device for the finishing treatment of a fabric.

[0002] More precisely, it refers to a method and a device where a fabric is subjected to a treatment of at least partial drying, intended to achieve a stable and permanent surface fixing, inside a closed chamber with steam in determinate conditions of temperature and humidity.

[0003] The treatment according to the present invention is advantageously of the continuous type, and is applied mainly, though not exclusively, to wool, wool/mixes, wool/cellulose, wool/synthetics and similar fabrics.

BACKGROUND OF THE INVENTION

[0004] In the field of textile finishing processes before making up, it is known to subject the fabric to a treatment with pressurized steam, known as decatizing, the purpose of which is to confer fullness and softness to the touch and to stabilize the nap and the sizes of the fabric.

[0005] More precisely, pressurized decatizing provides to submit a fabric, maintained mechanically constrained, to a treatment with pressurized steam and at a temperature in the range of 102+130 °C, using suitable sub-pieces the function of which is to produce the desired effects of fixing, finishing and nap on the fabric. The fabric exiting the decatizing treatments has a regular surface, with sizes and glossiness unaffected by the pressing of the iron and water drops.

[0006] The devices used to carry out decatizing are divided substantially into two categories: continuous devices and discontinuous devices.

[0007] To the first category belong devices comprising at least one chamber with pressurized steam, delimited at the entrance and exit by sealing means, inside which a fabric is made to transit compressed between two sub-pieces in a closed ring, normally of a length of about 15+20 meters, which are permeable to steam. Examples of such devices may be seen in documents WO-A-94/10368, EP-B-293.028, EP-A-1.010.797, and FR-A-2.154.244.

[0008] These continuous decatizing treatments work wool and wool/mix fabric that enters the treatment chamber with a humidity of about 17-18%, and is therefore already in a substantially dry state, and is removed from the chamber substantially with no variation to its humidity content. The finishing result of the surface characteristics of the fabric is extremely insufficient, therefore a further specific treatment is required downstream of decatizing. The unsatisfactory fixing derives from the fact that, as the humidity content does not change, the breaking and reforming of the bonds of the fibers consequent to drying only partly occurs, and therefore a transition from one state to the other of the fiber does not take place, as explained in more detail hereafter.

[0009] Documents US-B-6.381.833 and EP-A-1.277.871 describe decatizing devices which provide to treat a damp fabric with steam at high temperature; upon exiting the treatment chamber, the fabric still has a high humidity level, and therefore in this case too no variation in the humidity content of the fabric occurs. In this case, the fabric exiting the treatment chamber is subjected to a drying process that determines the loss of the surface fixing characteristics obtained with the high temperature steam treatment.

[0010] Other solutions, for example described in GB-A-1.467.119, EP-A-532.795 and EP-A-395.861, provide that a dampened fabric, introduced into a treatment chamber, is pressed, for example by means of a strip or cloth, against one or more heated cylinders, bringing the water contained in said fabric to a high temperature. These solutions also provide either that the fabric exiting the treatment chamber still has a high level of humidity, or that it exits dry but with a low fixing level, this also being due to the fact that the treatment temperature has to be kept below 100 °C.

[0011] In continuous pressurized decatizing treatments, taking into account the reduced steaming time (contact between fabric/pressurized steam) and the limited pressure of the steam, the final decatizing effect is not comparable with the effect achieved with discontinuous machines, which normally work under pressure.

[0012] Discontinuous decatizing devices in an autoclave usually comprise at least:

- a rolling and unrolling station, in which the fabric to be treated (treated) and at least one sub-piece are respectively wound onto (and unwound from) a perforated metal cylinder;
- a closed pressurized chamber, where the fabric wound with the sub-piece around the metal cylinder is subjected to a treatment with saturated steam at a temperature that varies between about 105 and 130 °C, for a time that varies between about 1 and about 5 minutes, and is then removed in order to be sent for unrolling.

[0013] These discontinuous devices in autoclave, however, have the considerable disadvantage that the fabric is not treated in a homogeneous manner, since the flux of steam that goes through the layers of fabric varies its physical conditions due to losses in load distributed in an uneven manner in the phase of transition between fibers.

[0014] Furthermore, there is a lack of physical uniformity due to the irregular conditions of compression to which the fibers between the periphery and the centre of the roller are subjected, which generate un-homogeneous tensions in the wound fabric.

[0015] Normally, the fabric to be treated in the autoclave has an initial humidity content of about 17-18%; this value substantially corresponds to the official recovery rate of wool products. On exiting the autoclave de-

catizing treatment, it keeps about the same value, and in normal operating conditions this determines an unsatisfactory fixing rate of the fabric.

[0016] As a general consideration, it must be said that, in the case of treatments of wool fabrics or suchlike, pure or mixed, the resulting effect of the hot water treatment is that the wool softens in proportion to the percentage of water and to the temperature. The effect of this treatment, according to the heat, is to increase the plasticity of the fiber to the point that it can assume, under the action of an external force, a different structure from its natural one, and this structure can be preserved after drying. When the fiber is maintained mechanically constrained in the presence of high humidity and heat, the bonds sensitive to water (H bridges) break and reform in equilibrium in the new state of the fiber, as the drying proceeds. These phenomena enable to define the concept of vitreous transition temperature for wool, which is directly influenced by the humidity content of the fiber and shows the existence of two characteristic temperatures (fig. 1): the first temperature T1 corresponds to the redistribution temperature of the hydrogen bonds, the second temperature T2 corresponds to the redistribution temperature of the cystinic bonds. With a humidity rate of the wool higher than 40%, the temperature T2 is about 65°C, a critical temperature above which permanent stabilization begins.

[0017] When a certain structure is given to a wool fabric or suchlike at a temperature higher than T1 but lower than T2, the structure is stabilized in a cohesive manner, until T1 is once again exceeded. When, instead, the transition temperature T2 is exceeded, the effect obtained is permanent, that is, it remains stable in the usual make-up conditions, where the temperature of 100 °C can only slightly be exceeded.

[0018] On the basis of these considerations, the Applicants have faced the problem of obtaining a finishing treatment, in particular for wool-type fabrics or suchlike, that will guarantee effective, uniform and constant results, without entailing the disadvantages of the devices used in the state of the art, and in particular allowing to obtain a better stability of the width and of the sizes of the fabric than known decatizing treatments.

[0019] The purpose of the present invention is therefore to achieve a method and a device to fix, preferably in a continuous manner, wool fabrics or suchlike (alpaca, lama, vicuna, guanaco, cashmere, animal fibers), wool/mixes, wool/cellulose and wool/synthetics, which can replace the current pressurized decatizing machines and current wool fixing machines.

[0020] The Applicants have devised, tested and embodied the present invention to obtain the above purpose, overcoming all the disadvantages described above, and to obtain other advantages as will be described hereafter.

SUMMARY OF THE INVENTION

[0021] The present invention is set forth and charac-

terized in the respective main claims, while the dependent claims describe other innovative characteristics of the invention.

[0022] The invention provides to impregnate the textile material that is to undergo the finishing treatment with a determinate percentage of water, water and oxidizing and reducing chemical products (for example sodium bisulphite), or other suitable liquid substances, in order to take it to a desired level of humidity, considerably higher than its official recovery rate.

[0023] Said suitable liquid substances can be chosen, for example but not only, from among aromatic alcohols, urea, sodium hydrate, ammonium hydrate, softeners, etc.

[0024] The fabric is then made to transit in a chamber, closed in a sealed manner, where a heating means is present able to bring the water present in the textile material to boiling point, in this way taking the fibers of the fabric to a substantially plastic state of softness, and then to progressively dry it under pressure at least partly between the entrance and the exit of the device, with the fabric maintained mechanically constrained.

[0025] In particular, the humidity value of the fabric on exiting the machine can be regulated so that it is around its recovery rate, that is, around 17-18%.

[0026] According to the invention, the treatment temperature from the entrance to the exit of the device is maintained constantly above 100°C, and in particular it is regulated so that, in relation to its initial humidity content, for example in the range of 30-50%, the textile material is always at a temperature higher than the permanent fixing temperature. In other words, the invention uses a working area in the temperature and humidity diagram which guarantees that the temperature of the textile material, during the entire treatment, will never go below the level determined by the curve T2 - figure 1 - which represents the limit between a situation of permanent fixing and a situation of cohesive fixing, or even below the cohesive fixing temperature itself.

[0027] In this way, the finishing and the permanent fixing can be obtained in a continuous manner in the same machine, therefore without needing subsequent and/or auxiliary treatments, even in conditions of atmospheric pressure or near atmospheric pressure, and therefore without the problems and disadvantages of known decatizing and fixing devices.

[0028] The fabric exiting from the treatment according to the present invention will in this way have a stable thickness, a high stability of size, a regular surface and with a very soft nap, a finishing resistant to water and regular along the entire treated piece.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029] These and other characteristics of the present invention will become apparent from the following description of some preferential forms of embodiment, given as a non-restrictive example with reference to the at-

tached drawings wherein:

- fig. 1 shows a temperature/humidity graph relating to a fabric to be treated in the finishing device according to the present invention;
- fig. 2 shows a first form of embodiment of a finishing device according to the invention;
- fig. 3 shows, on an enlarged scale, a variant of a detail of fig. 2;
- fig. 4 shows another form of embodiment of a finishing device according to the invention.

DETAILED DESCRIPTION OF A PREFERENTIAL FORM OF EMBODIMENT

[0030] In fig. 2, a continuous finishing device for a fabric 11, in which the teaching of the present invention can be used, is denoted in its entirety by the reference number 10. It comprises an autoclave 12, of a substantially cylindrical shape, inside which a heated cylinder 13 is housed on which the fabric 11 is made to transit, using a felt 14, or a sub-piece, to compress the fabric 11 against the surface of the cylinder 13.

[0031] The surface of the cylinder 13 can advantageously be smooth metal, in order to obtain a shiny effect in the fabric after treatment. According to a variant, the cylinder 13 has a sanded metal surface, causing the surface of the fabric 11 to be opaque after treatment. According to other possible forms of embodiment, the surface of the cylinder 13 can also be rubber, synthetic, for example polyamide, Teflon, covered with felt or other material, or other.

[0032] The felt 14, for example made of cotton, polyester, nomex, satin, fiberglass, or other suitable material, permeable to steam, unwinds continuously in a closed ring around four cylinders, respectively 25a, 25d, 25c and 25b disposed around the autoclave 12.

[0033] The surface of the felt 14 is smooth and is highly permeable in order to let the evaporation steam pass and give the fabric 11 a very regular surface.

[0034] At least some of the cylinders 25a, 25b, 25c and 25d are motorized and at least one or some of them, advantageously cylinders 25a and 25d disposed respectively at the entrance and the exit of the autoclave 12, is heated so that the entrance one 25a achieves a heating of the felt 14, and the exit one 25d achieves a drying of the felt 14 after its passage through the treatment chamber.

[0035] The position of at least one of the cylinders 25a, 25b, 25c and 25d can also be regulated in order to vary the force of compression on the fabric 11 with the purpose of regulating the final thickness of the fabric 11 at exit from the treatment.

[0036] At exit from the autoclave 12 there is a humidity measuring device 17, followed by a cooling device 18 the function of which is to bring the fabric 11 to ambient temperature.

[0037] Between the cylinder 13 and the autoclave 12

a steam chamber 19 is defined, sealed by a pair of sliding seals, respectively at the entrance 23a and the exit 23b, while the entrance and the exit to/from the autoclave 12 are defined by entrance roller 24a and exit roller 24b, which also cooperate in the sealed closure of the chamber 19.

[0038] In the variant shown in fig. 3, in cooperation with the entrance roller 24a and the exit roller 24b a further sealing roller 15 is present, which cooperates by rolling contact with said rollers 24a, 24b, creating, together with stoppers disposed in contact with the head of the respective rollers, a sealed safety chamber 16 that further contributes in avoiding losses and leakages of steam from the treatment chamber 19.

[0039] Advantageously, the roller 15 has a rubber surface and its position can be regulated according to the direction 21 in order to change the compression level between roller 15 and rollers 24a, 24b.

[0040] According to a variant not shown, the sub-piece 14, advantageously of suitable length, is unwound from an unwinding roller, disposed on one side of the autoclave 12, and wound onto a mating winding roller, disposed on the opposite side of the autoclave 12. Return and drawing rollers are also normally present in order to facilitate the unrolling of the sub-piece 14 and to constantly maintain the tension thereof under control.

[0041] When the sub-piece 14 has been completely wound onto the winding roller, the reciprocal position of the two rollers can be inverted and the decatizing cycle can start again.

[0042] According to a variant, the two winding and unwinding rollers can simply invert their function, so that the unwinding roller becomes winding, and vice versa.

[0043] According to the invention, the fabric 11, upon entering the autoclave 12, has a humidity rate preferably in the order of 30-50% and the temperature of the heated cylinder 13 is regulated, for example to a value between 100 and 200 °C, so that the heating of the fabric 11 occurs at a temperature in the order of 110-130°C, and in any case always higher than T2 in relation to its humidity content.

[0044] For example, in the case of an initial humidity rate of 40% and a working temperature equal to about 120 °C, the initial working point is point A' in the graph in figure 1. In its travel around the heated cylinder 13, the fabric 11 progressively dries, being always maintained mechanically constrained, until, on exiting the autoclave 12, the humidity rate has come down to around 17-18% (working point A'' in the graph in figure 1). This value substantially corresponds to the official recovery rate of the fabric 11.

[0045] Thanks to the control of the parameters regulated so that the drying of the fabric occurs in this manner, during the entire pressurized steam treatment the working area on the fabric is always above the limit defined by the curve T2 of permanent fixing. Thanks to this a definitive effect is achieved on the fabric 11.

[0046] In the event that the humidity measuring device

17 detects a humidity rate at the exit of the autoclave 12 lower than 17%, which causes the working point in the graph in figure 2 to move to the left with respect to the curve T2, the temperature of the heated cylinder 13, or the transit time of the fabric 11 in the chamber, can be regulated in order to bring the working parameters back to the desired levels, that is, always above the curve corresponding to the permanent fixing temperature T2.

[0047] The autoclave 12 is equipped, for example in its lower part, with a vent 20, consisting for example of an adjustable valve, to allow the controlled discharge of the steam from the pressurized chamber 19 and therefore guarantee that the pressure conditions be maintained constant to assure the desired finishing effect of the fabric 11 in transit.

[0048] By increasing the working temperature, for example to 140 °C or 160 °C, the time necessary for the treatment can be reduced, even though it is still necessary for the humidity of the fabric 11 upon exit to be maintained at values of around 17-18% so that the nap of the fabric does not turn yellow and roughen.

[0049] Figure 4 shows another form of embodiment of a continuous type decatizing device where the teaching of the present invention is applied, in which parts equal or equivalent to those in figure 2 have the same reference number, and therefore will not be described again.

[0050] In this solution, the damp fabric 11 to be treated is introduced into an oval shaped autoclave inside which two heated cylinders are disposed, a lower cylinder 113a with an adjustable temperature and an upper cylinder 113b with a pre-determined temperature. The inside of the autoclave 12 defines a pressurized steam chamber 19 with a pressure higher than 1 atmosphere. Seals with three rollers, respectively 15, 24a, 24b, are present at the entrance and exit of the autoclave 12, as already described with reference to fig. 3.

[0051] The fabric 11 is accompanied around the respective cylinders 113a and 113b by means of respective felts, or permeable sub-pieces 14, which wind onto respective rollers 25a, 25b, 25c of which at least one (25c) is adjustable in order to regulate the level of compression of the fabric 11 against the surface of the respective cylinders 113a, 113b. In this case too, the fabric 11 to be treated is advantageously introduced into the autoclave 12 with a humidity rate of around 30-50% and the temperature of the heated cylinders 113a and 113b is regulated so that, at exit from the autoclave 12, the humidity rate is in the order of 17-18%. In this manner, the fabric 11, during the entire pressurized heat treatment, is always maintained in a condition of permanent fixing.

[0052] Here too, a humidity measuring device 17 located at the exit of the autoclave 12 can control in feedback the regulation of the device 10, particularly of its working temperature, if a humidity rate is detected at exit which does not correspond to the set levels.

[0053] Modifications and/or additions of parts may be made to the foregoing description, without departing from the field and scope of the present invention as defined

by the attached claims.

[0054] It is clear for example that other solutions regarding autoclave systems, sealing systems, heating systems, pressurizing and venting systems, can be used within the field and scope of the present invention.

[0055] It also comes within the field of the present invention to provide that the heating of the fabric be carried out, instead of by direct contact with a heated cylinder, by means of other systems, for example irradiation, radiofrequency, microwaves or with super-heated steam.

Claims

1. Method for the finishing treatment of fabrics (11), in which a damp fabric (11), mechanically constrained, is subjected to at least a heating treatment inside a substantially sealed chamber (19) with pressurized steam in order to determine a drying thereof from an initial humidity value to a final value, **characterized in that** from the beginning to the end of the treatment the temperature of said fabric (11) is regulated so that, in relation to its initial humidity content, said fabric (11) is always kept at a temperature above a level corresponding to the permanent fixing temperature (T2).
2. Method as in claim 1, **characterized in that**, at the beginning of the treatment, said fabric (11) has a humidity content preferably in the range of 30-50%, and at the end of the treatment has a humidity content in the range of 17-18%, substantially corresponding to its official recovery rate, and the temperature is regulated so that the heating of said fabric (11) is carried out at a temperature in the range of 110 to 160°C, advantageously from 120-130°C, and in any case higher than 100°C.
3. Method as in claim 1 or 2, **characterized in that** said fabric (11) is impregnated with one and/or another substance chosen from among water, aqueous solutions of oxidizing or reducing products, softeners, aromatic alcohols, urea, sodium hydrate or ammonium hydrate.
4. Method as in claim 1 or 2, **characterized in that** said fabric (11) is heated by means of its compression with an adjustable pressure against a heated surface by a suitable sub-piece (14).
5. Method as in claim 1 or 2, **characterized in that** said fabric (11) is heated with irradiation, infrared rays, microwaves, super-heated steam, or other.
6. Method as in any claim hereinbefore, **characterized in that** the treatment is carried out continuously by making said fabric (11) transit against the surface of at least one heated cylinder (13) inside a substan-

tially sealed chamber (19).

with an adjustable pressure.

7. Method as in any claim hereinbefore, **characterized in that** the humidity of said fabric (11) is measured at exit from said treatment chamber (19) and, if the detected values do not correspond approximately to the official recovery rate of said fabric (11), at least the heating temperature and/or the transit speed are regulated accordingly.

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8. Device for the finishing treatment of fabrics (11), comprising means for heating a damp fabric (11) inside a substantially sealed chamber (19) with pressurized steam to determine a drying thereof from an initial humidity value to a final one, and means to maintain said fabric (11) mechanically constrained during said drying, **characterized in that** said heating means is configured to always maintain said fabric (11), in relation to its initial humidity content, at a temperature higher than a level corresponding to the permanent fixing temperature (T2).

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9. Device as in claim 8, **characterized in that** said heating means comprises at least a heated cylinder (13) around which said fabric (11) is made to transit between an entrance sealing device (23a) and an exit sealing device (23b).

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10. Device as in claim 9, **characterized in that** said seals are of the sliding type, respectively at the entrance (23a) and the exit (23b) of said chamber (19), while the entrance and the exit to/from the autoclave (12) are defined by entrance (24a) and exit (24b) rollers, which also cooperate with the sealed closing of said chamber (19).

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11. Device as in claim 10, **characterized in that**, in cooperation with said entrance (24a) and exit (24b) rollers, a further sealing roller (15) is provided which cooperates by rolling contact with said rollers (24a, 24b), creating a sealed safety chamber (16).

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12. Device as in claim 8, **characterized in that** said heating means comprises at least a generator of radiofrequencies or microwaves.

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13. Device as in claim 9, **characterized in that** it comprises an element such as a felt or a sub-piece (14), able to be unwound from respective unwinding and guiding rollers (25a, 25b, 25c, 25d) in order to compress said fabric (11) in an adjustable manner against the surface of the heated cylinder (13).

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14. Device as in claim 13, **characterized in that** said felt or sub-piece (14) is made of cotton, polyester, nomex, satin, fiberglass, or other suitable material, permeable to steam, and is unwound from respective unwinding and guiding rollers (25a, 25b, 25c, 25d)

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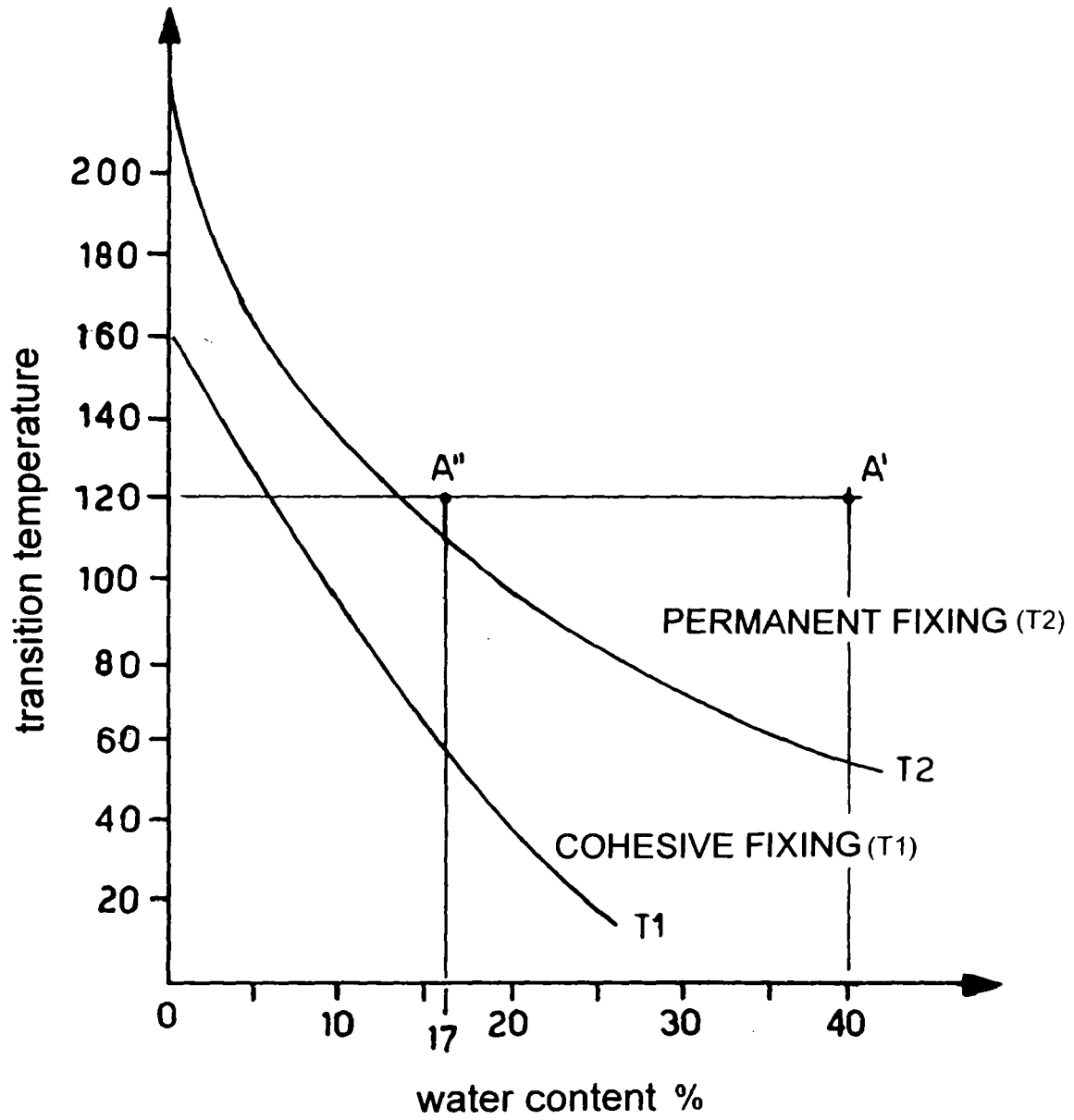


fig.1

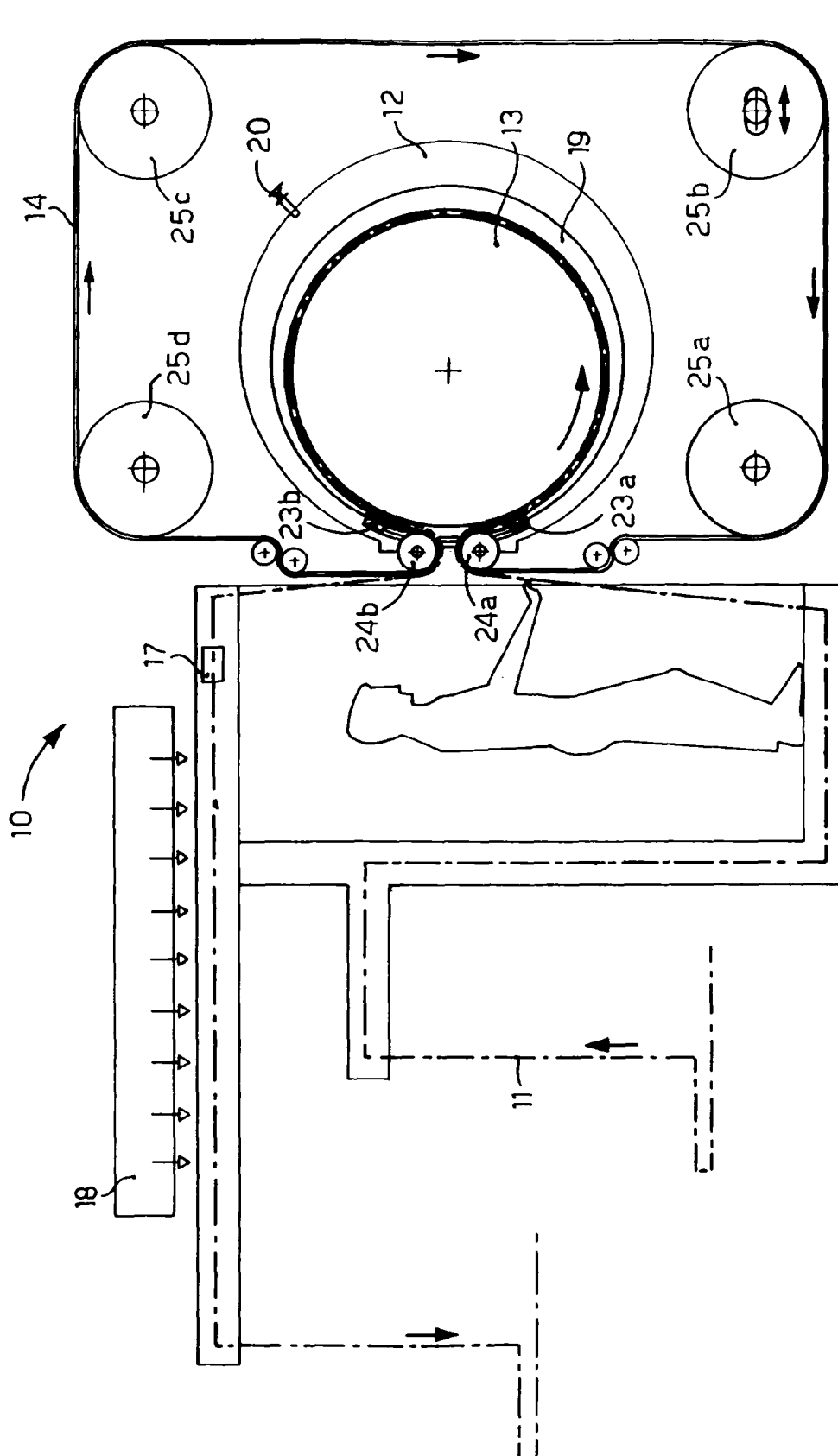


fig. 2

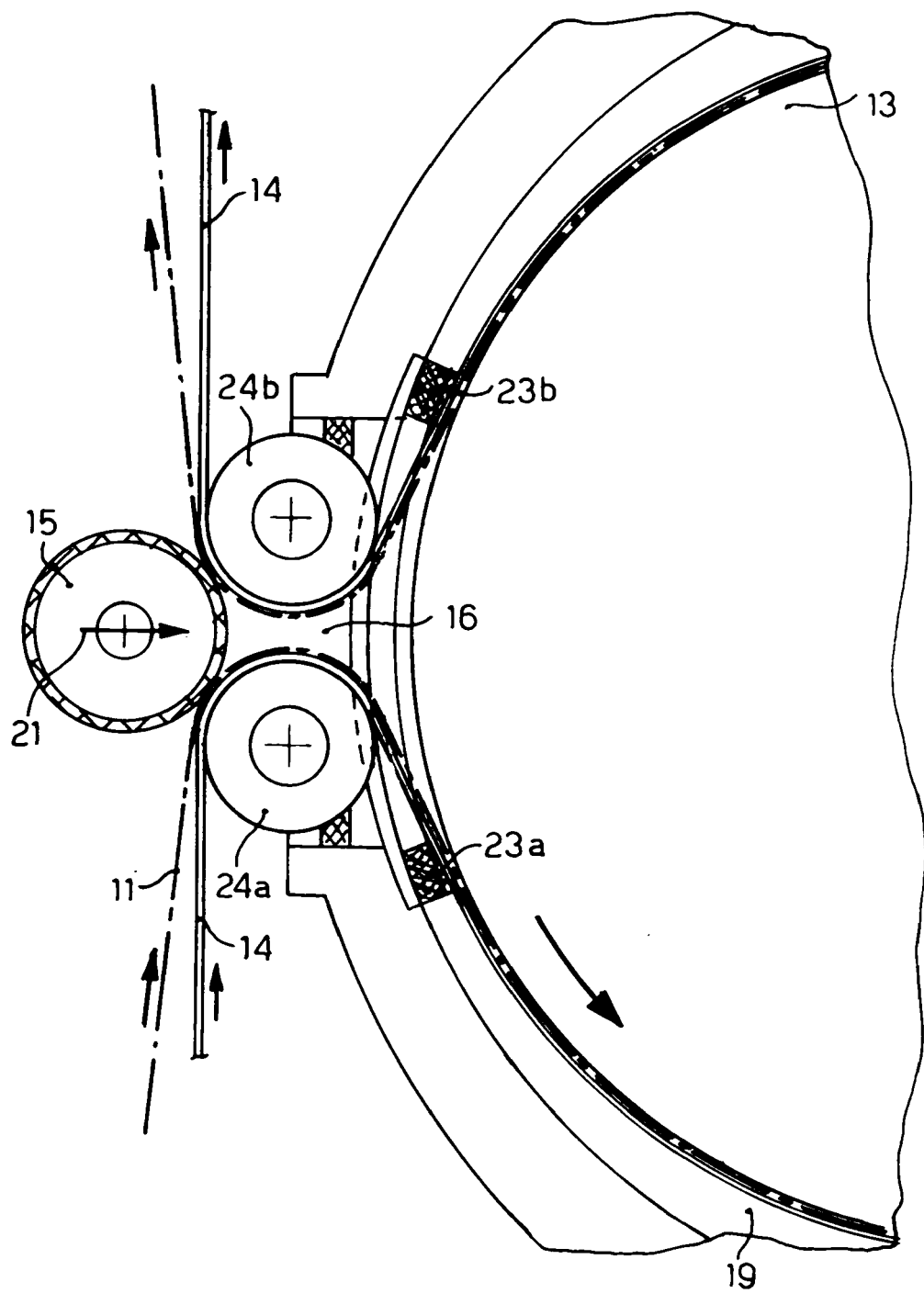


fig. 3

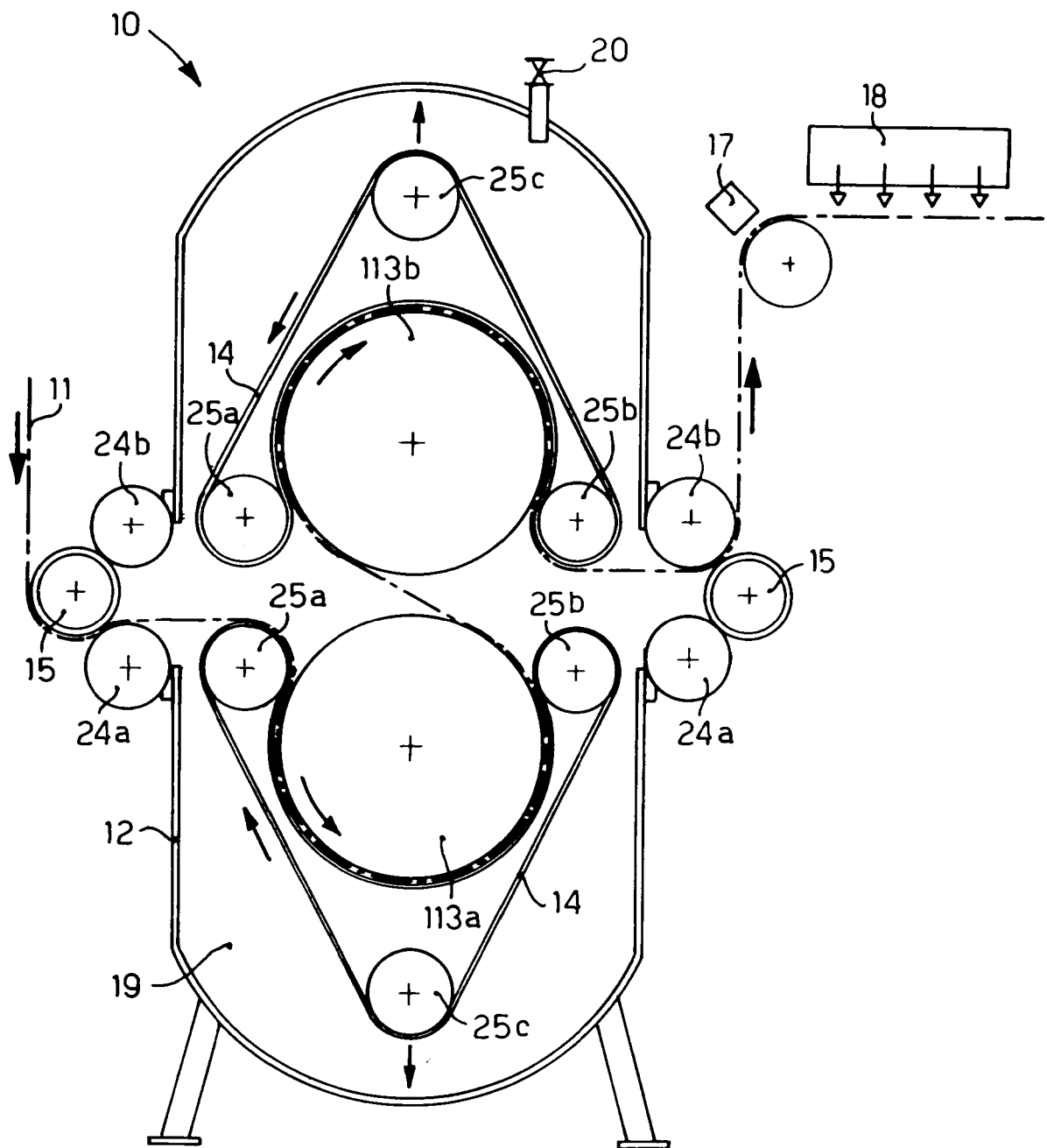


fig. 4

REFERENCES CITED IN THE DESCRIPTION

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