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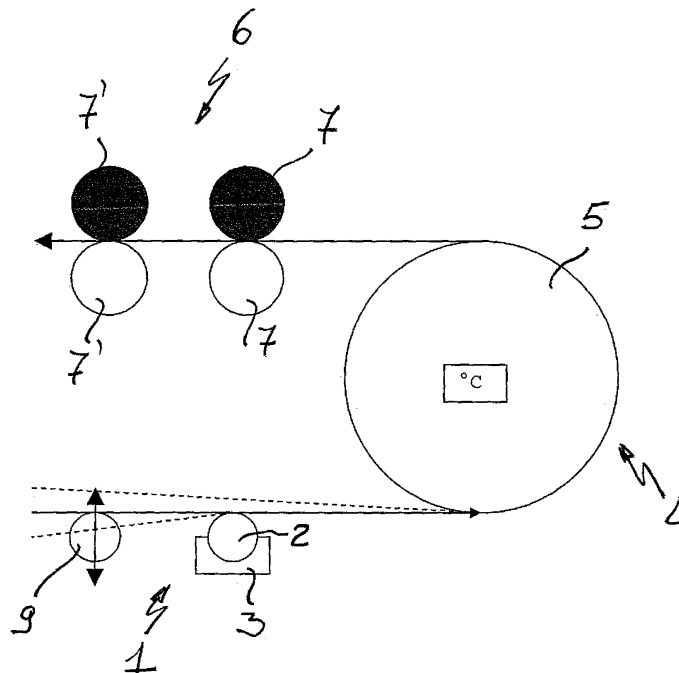
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(54) **Process and apparatus for the treatment of fabrics with the use of tangentially applied chemical products**

(57) A process and apparatus for the treatment of fabrics with the application of chemical products, wherein the chemical products in liquid phase are applied only

on the surface of the fabric (T), tangentially thereto, and then solidified by means of only partial and controlled evaporation of the liquid phase contained therein prior to final finishing of the fabric.

*Fig 1*



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## Description

### Field of the invention

**[0001]** The present invention relates to a process and to an apparatus for the treatment of fabrics, and more in particular for bestowing upon a fabric a tendentially permanent effect of finish via the application of chemical products on their surface, basically by means of an initial step of application of the chemical products, an intermediate step of drying and solidification of the applied chemical products, and a final step of surface action on the fabric.

**[0002]** In the variegated and potentially boundless sector of textile finishing many physical (mechanical, thermal, etc.) processes and chemical processes (soda treatment, carbonization, mercerization, etc.) are used to bestow upon the fabrics an ideal appearance for their final use.

**[0003]** The present invention adds to the methods so far known a new methodology that enables modification of the physical and/or visual and/or tactile features of the fabric processed by applying, thanks to an innovative process, chemical products, which, interacting with a succession of physical effects conferred by the apparatus that implements the process, modify the surface and/or the feel of the fabric itself in a more or less permanent way.

### State of the prior art

**[0004]** The currently known and most widespread systems for application of chemical products on fabrics are summed up hereinafter.

**[0005]** Impregnation. This is a complete immersion of the fabric in a bath, where the chemical agents are dispersed, said chemical agents penetrating throughout the thickness of the fabric, followed by squeezing between rollers and by a subsequent reaction in drying systems, such as air dryers or batteries of rollers. The limits of the impregnation system are the excessive and useless consumption of the bath, the presence of product even where it would serve no purpose, the difficulty of double application carried out in succession (referred to as "wet-on-wet") of different materials, where the second agent is sometimes "refused" on account of the invasive presence of the first agent, and for which reason the first and second agents must at times necessarily be kept separate. Added to this is the high consumption of energy for drying.

**[0006]** Spreading. This consists in a surface application of material (generally with high viscosity) via a levelling blade (doctor blade) and subsequent drying with known systems, typically applied only on a front surface (i.e., on just one face of the fabric) especially for large-scale production for technical products. Limits of the system are the long times for setting-up and the waste of material, together with problems also for regulating min-

imum applications of product.

**[0007]** Transfer. This consists in a surface application made using perforated tipping rolls (such as impression cylinders), which deposit the product on the surface via pumping through the holes. The limits of this methodology are the need to provide various rolls with different perforations and the long times for setting up the equipment. The treatment is applied only on one face of the fabric at a time.

**[0008]** Foaming. The chemical product is mixed in special machines that create foam of different cell size, which is then distributed and levelled out over the fabric using different mechanical methodologies. The limits are the rather small number of types of products that can be used with this method, and the difficulty in controlling the applications. Also in this case, the treatment is applied only on one face at a time.

**[0009]** Transfer using kiss roll. These are rotating rolls that are partially immersed in a liquid chemical product, with which they are charged, and then the product is transferred onto the fabric that is travelling in the underlying area so that effects similar to those obtained by spreading with a roll are achieved. The process is not very widespread, and control thereof is somewhat precarious.

**[0010]** For the intermediate step of drying and solidification of the chemical products applied on the fabric, the following currently known and most widespread drying systems may be mentioned:

**30** Air dryers ("rameuses"). These are large chambers with a forced flow of air. The source of energy can be various (diesel oil, gas, superheated water).

**35** Hot rolls. These are rolls kept at a constant temperature via injection of steam, hot water, or diathermic oil.

For the final step of surface action on the fabric the following systems are traditionally used:

**40** Cotton calendering. Two or more heated high-pressure rolls, between which the fabric is inserted, are made to roll on one another in order to obtain a very marked and shiny "ironing" effect. Said effect is, however, far from permanent, with negative lengthening of the fabric and a frequently excessive flattening of the thickness of the fabric itself, the consistency of which becomes similar to that of paper.

**45** Chintz treatment of wool. Following upon the application of chemical products (disulphites) via deep "foulard" impregnation, the fabric is subjected to a subsequent calendering reaction with silicone belt, to bestow thereupon a glossy appearance. The effect is in this case permanent, but leads to weakening of the fibres of the fabric and early wear of the components of the apparatus.

**50** The patent No. US-4,086,387 describes a proc-

ess for the treatment of fabrics with the use of tangentially applied chemical products, corresponding to the preamble of Claim 1. Said known process expressly envisages a deep impregnation of the fabric, treated with chemical conditioning products, obtained by means of a rotary applicator roller, partially immersed in a tank containing the chemical products, and a rotary counter-roller, which compresses the fabric against the applicator roller to impregnate it fully throughout its thickness.

The impregnated fabric then proceeds, for the step of solidification or drying at ambient temperature of the impregnating chemical products, on a series of rollers, resting against the latter with the face that had been impregnated by the roller.

Then, for the finishing step, the fabric is again compressed between a single pair of further rollers, both of which heated to a very high temperature, equal to or higher than the melting point of the impregnating chemical substances, and with a precise degree of application of compression (70% or less) of the fabric with respect to its initial thickness. In practice, there is entrusted to said rollers, and in effect to the entire known system, a purely mechanical function of "crashing" of the hardened textile structure to obtain softening of the feel thereof.

#### Summary of the invention

**[0011]** The object of the present invention is to provide a process and an apparatus suitable for enabling production, in an industrially advantageous form, of a series of effects, always exploiting the same plant, without any waste of chemical treatment products in order to enable production of both fabric samples and amounts of fabric on a large scale.

**[0012]** The above object is achieved thanks to the process defined principally in Claim 1, as well as to an apparatus set forth principally in Claim 15.

**[0013]** The present invention involves the use of some of the known, but improved, processes set in line according to an original sequence in order to obtain, in just one passage, a variety of desired results working on one and the same plant.

**[0014]** The final effects obtainable on the fabrics treated according to the invention are at least three, which are described hereinafter but do not rule out other possible future applications:

- bubble effect;
- glossy effect;
- skin-dye effect.

**[0015]** The bubble effect bestows a "casual" appearance upon fabrics with a classic structure so as to render

them more "spongy" and "full-bodied" to the touch. Said effect is permanent on all the fabrics.

**[0016]** The glossy effect bestows a shiny appearance resistant to washing upon many fabrics, especially cellulose-based ones, that up to now had never been achieved or in any case obtained with different results in terms of effect/appearance.

**[0017]** The skin-dye effect envisages the use of dyes (of various sorts) that can be applied as overdyes in a uniform way or as a "melange" to obtain interesting effects of iridescent colour.

#### Brief description of the drawings

**[0018]** The invention will now be described by way of non-limiting example in the annexed drawings, wherein:

- Figure 1 is a diagram exemplifying a first embodiment of the apparatus for implementation of the process according to the invention; and
- Figure 2 shows a variant of Figure 1.

#### Detailed description of the invention

**[0019]** The apparatus for implementation of the process according to the invention envisages, in extreme synthesis, a series of stations that carry out in succession and in a continuous way on the moving fabric the following operations:

#### APPLICATION OF THE CHEMICAL PRODUCT SOLIDIFICATION FINISHING.

**[0020]** In the embodiment represented schematically in Figure 1, the fabric T, after passing through a series of possible accessories designed to guide and prepare the fabric for the treatment, enters the application station designated as a whole by 1.

**[0021]** The application of the product must take place in just a superficial form, i.e., without impregnation of the fabric T throughout its thickness. Typically, the application is consequently implemented by means of an adjustable spray system or more preferably by at least one kiss roll 2 that turns at a speed synchronized with respect to the rate of advance of the fabric T.

**[0022]** The kiss roll 2 picks up the product to be applied, in a liquid phase or in any case a fluid phase, from a tank 3 and transfers it onto the fabric T by applying it tangentially on the surface thereof resting on the roll 2.

**[0023]** Even though in the case of Figure 1 there is envisaged a single roll 2 for application of the chemical product on just one face of the fabric T, the invention envisages the same technical solution also in the case of multiple applicators on the same face of the fabric T, as likewise single applicators on both faces and/or multiple applicators on both faces of the fabric T.

**[0024]** The fabric, soaked superficially on at least one

face with the chemical product, advances towards the solidification station, designated as a whole by 4.

[0025] The chemical product, specifically developed in terms of viscosity, is then solidified and fixed on the fabric via partial evaporation of the water or in general of the liquid phase present as dispersing agent of the chemical product. The action of solidification must be controlled and sufficiently fast in order to block migration of the product towards the inside of the fabric T at the desired depth (which could even reach the opposite face).

[0026] In the example of Figure 1, the solidification station 4 includes a heated roll 5, which rotates in synchronism with advance of the fabric T.

[0027] The fabric T is run over the roll 5, resting thereon with its face opposite to the one on which the chemical product has been applied.

[0028] The solidification step can take place on a number of heated rolls, or else with the aid of an oven (either an air oven or infrared oven), without contact with the fabric.

[0029] Preferentially, the source of drying energy will be set on the side opposite to the face of the fabric T treated with the chemical products, obviously in the case where said products are - as in the case of the example of Figure 1 - applied on just one of its faces.

[0030] In case the step of chemicals application is carried out on one single face of the fabric, then the solidification step is preferably performed on the opposite face of the fabric, also at adjustable temperature and with or without contact. In case the step of chemicals application is carried out on both faces of the fabric, the solidification step is conveniently performed on both faces of the fabric, at adjustable and possibly differentiated temperatures and with or without contact.

[0031] After solidification, the fabric T and the chemical product have reached a sufficient cohesion, which, however, still enables structural modifications.

[0032] In detail, these two layers, which cohere but are still in part distinct and set on top of one another, can optionally remain as such or else penetrate each other to a greater extent by means of mechanical and/or thermal energy, applied in an innovative and advantageous way when the chemical product is still in a semisolid state and hence modifiable and malleable, towards the underlying fabric T, the fibres of which still contain humidity and are hence more readily deformable.

[0033] The fabric T then reaches the finishing (modelling) station, designated as a whole by 6, where - with the chemical product applied on its surface - passes through a series of opposed rolls 7 that bestow thereupon the desired finish with a more or less marked reduction of the thickness and/or smoothing of the surface and/or modification of the surface roughness.

[0034] The fabric T advances through at least two pairs of rotating heated and opposed rolls 7, 7', set in adjustable pressure in such a way as to bestow upon the fabric and the chemical product applied thereon the final desired appearance.

[0035] The rolls 7, 7' may also have surfaces with different finishes: in a preferential form, a roll 7, 7' of each pair will have a very rigid metal surface, and the other opposed roll 7, 7' will present its surface coated with elastically deformable material.

[0036] The fabric T is finally gathered in laps or rolls.

[0037] The use of the kiss rolls in the step of application of the chemical product on the fabric T enables controlled application of the chemical product on the surface in an innovative and peculiar way, which is fundamental for applying the product only in the area concerned. The subsequent and adjustable solidification of the chemical product applied, followed immediately by definitive drying during its final finishing, define an original, innovative sequence, with results that had never been obtained up to now.

[0038] Surface application means reduced use of chemical products, application only in the required area, simplified preparation of the baths, possible instantaneous variation of the final effect thanks to the independent regulation of the rate of running between the material and the kiss roll or rolls.

[0039] There preferably exists a temporal evaluation of the effects that concur to obtain the best results of the process in these terms.

[0040] The distance between application and drying must necessarily be reduced to prevent migration of the product towards the inside of the fibre of the fabric.

[0041] Alternatively, if necessary, it is possible to lengthen the space in the case where it is desired to obtain greater penetration (in addition, of course, to acting on the viscosity of the chemical product).

[0042] The residual humidity, which is controlled and can be adjusted (possibly with the use of automated electronic systems) is a fundamental part of the process. To obtain the "modelling" (finishing) of the fabric it is in fact expedient for the fabric, coming from solidification, to be immediately treated. Otherwise in fact, if it were wound on a roll (or, worse still, if it were folded in layers) prior to the finishing step, a far from optimal non-homogeneous result would be obtained that would be difficult to repeat at an industrial level on account of the natural effect of evaporation and/or of cross-linking of the chemical products applied on the fabric.

[0043] From the environmental/energy standpoint, the surface application is advantageous because it involves a smaller application of liquid and hence a reduced consumption of energy during solidification for evaporating the water in excess.

[0044] The concatenated sequence of the events of application-solidification-finishing enables optimization of the process with reduced use of staff, optimal control of the process parameters, extremely short times for preparation and modification of results.

[0045] Described in what follows are further specific characteristics and variants of the apparatus for implementation of the process according to the invention.

Application station 1

**[0046]**

1) The kiss rolls (or else, the spray applicators) may also number more than one, as designated by 2 and 2' in the case of the variant represented in the diagram of Figure 2, set on one and the same side or on opposite sides of the fabric, even in a different number on one side and on the other side, because:

○ it is possible to apply on one and the same surface chemical products that cannot coexist in the same bath; for example, as in the case of Figure 2, a first product in a first tank 3 and a second product in a second tank 3' that react with one another by contact on the fabric, but that remain separate in the respective application tanks 3, 3'; and

○ it is possible to apply the same product on both surfaces of the fabric, or else two distinct products to obtain a double-face effect. For example, a hydrophilic product on one face of the fabric T and a water-repellent product on the opposite face.

2) The kiss rolls 2, 2' are conveniently provided with a mobile scraper blade, designated by 8 in Figure 2, capable of continuously cleaning the surface of the roll 2, 2' and removing the residue of product to guarantee an optimal uptake at each new rotation.

3) The kiss rolls 2, 2' are preferably driven in rotation with a speed regulator ranging between a lower value at the synchronism speed ("synchronism speed" means that the peripheral speed of the roll is equal to the rate of translation of the fabric T) and a value higher than the synchronism speed. In other words the kiss roll cylinders 2, 2' are driven in rotation at a speed synchronized with the advancement speed of the fabric, even with a variable speed ratio either higher or lower than the fabric advancement speed.

4) The fabric T can approach-recede from the kiss rolls 2, 2' during the steps of arrest of the process, for example via a mobile intake roller designated by 9 in Figure 1. This reduces the defectiveness of the fabric.

5) With the multiple kiss-roll configuration 2, 2', the speed of rotation of the rolls may be differentiated.

6) The kiss rolls, typically with a smooth metal surface, could also be made of different materials, either smooth or engraved, or else be replaced at least in part by brushes or other flexible elements, such as thin plates, spatulas, etc.

7) The chemical product applied may have any physical or chemical characteristics, which are not considered important or critical as regards the final results obtained with the invention.

**[0047]** Tests conducted by the present applicant have experimentally demonstrated that the tangential application of the chemical products on the fabric is noticeably more advantageous and effective as compared to the usual methodologies of impregnation, because:

- it uses smaller amounts of chemical products given that it accumulates and concentrates them exactly and only where necessary;
- the result is more stable; and
- the feel of the fabric at the end of the process is completely different if compared to that of a fabric to which the chemical products have been applied by impregnation.

Solidification station 4

**[0048]**

8) For applications on just one face of the fabric T, to be preferred are processes of drying with contact that use one or more heated rolls 5, with adjustable temperatures.

○ The number of rolls 5 and their diameters may vary and will depend substantially upon the need for solidification of the product and upon the production rate.

○ The rolls 5 may be arranged in various configurations to enable them to be run over by the fabric with more or less wide angles according to the needs of drying and contact. For example, C-shaped paths may be envisaged for the fabric (as in the case of the examples of Figures 1 and 2), or else S-shaped paths.

○ The heated roll or rolls 5 may be provided with means designed to divert passage of the fabric so as to increase or reduce the angle of contact with the rolls themselves in order to increase or decrease the drying capacity.

9) For double-face applications, where the contact of hot surfaces with the wet product is to be deemed undesirable as regards its final result, compact systems without contact will be preferred such as of the infrared-oven type, as designated as a whole by 10 in Figure 2 (provided with possible mobile anti-scorch surfaces) or hot-air chambers (with or without height-control chain), as a replacement for or in combination with the heated roll or rolls 5.

10) Solidification of the product could also occur, or rather could be facilitated, as a result of prolonged exposure of the fabric T to free air prior to the finishing step.

11) Solidification could also be facilitated by the application of chemical products at a temperature different from ambient temperature (i.e., typically heated) to facilitate subsequent evaporation thereof.

Finishing station 6

**[0049]**

○ The finishing rolls 7, 7', also with different characteristics, should be in at least two pairs to obtain a sufficiently permanent and appreciable effect. The two cylinders of each pair are conveniently provided with different features, both internal ones and in terms of hardness of the corresponding coatings, of the material of the coatings and/or possible surface engravings. For example, in the case of Figure 2, two rubber-coated rolls are used with a low hardness to enhance the bubble effect, surface effect, and opaque effect, one roll with a mirror-finish metal surface, and one roll coated with material of various hardness to obtain effects of squeezing and gloss.

12) The fabric T may pass through the two or more pairs of rolls 7, 7' with equal contact in all the passes, or else may be turned round to obtain different front-back effects.

13) At least one roll 7, 7' of each pair can conveniently be heated.

14) The fabric T may pass through the rolls 7, 7' either in a direction perpendicular to the axis of the rolls 7, 7' as illustrated in the examples, for a minimum contact with the corresponding surfaces, or by being partially run over the rolls through a fixed or adjustable angle.

**[0050]** As already explained previously, the final effects that can be successfully obtained on the fabrics treated according to the invention are at least three: bubble effect, glossy effect, and skin-dye effect. Additional different effects may, however, also be envisaged.

**[0051]** Of course, without prejudice to the principle of the invention, the details of construction and the embodiments of the apparatus may vary widely with respect to what has been described and illustrated herein purely by way of example, without thereby departing from the scope of the present invention.

**Claims**

1. A process for the treatment of fabrics (T) with the application of chemical products, comprising: a step of application (1) of the chemical products in liquid phase on the fabric (T), tangentially thereto; a step of solidification (4) of the chemical products for fixing them on the fabric (T); and a finishing step (6) of the fabric (T), said process being **characterized in that:**

- in the step of application (1), the chemical products are applied only superficially on the fabric (T); and
- the solidification step (4) is carried out by only

partial and controlled evaporation of the liquid phase of said applied chemical substances.

2. The process according to Claim 1, **characterized in that** the step of application (1) is performed on the advancing fabric via at least one kiss roll (2, 2') driven in rotation at a speed synchronized with the rate of advancement of the fabric (T) and even lower or higher than said rate of advancement.

3. The process according to Claim 1 or 2, **characterized in that** it comprises the step of continuously scraping the surface of said at least one kiss roll (2, 2') prior to application of the chemical products on the fabric (T).

4. The process according to Claim 2, **characterized in that** the step of application (1) is performed with a plurality of kiss-rolls (2, 2') on a single face or on both faces of the fabric (T).

5. The process according to Claim 2 or Claim 4, **characterized in that** the speed of rotation of said kiss-rolls (2, 2') is differentiated.

6. The process according to any one of Claims 2 to 5, **characterized in that**, in the case of interruption of said step of application (1), the fabric (T) is moved away from said at least one kiss roll (2, 2').

7. The process according to Claim 1, **characterized in that** said step of application is performed by means of spraying.

8. The process according to any one of the preceding claims, **characterized in that** it is carried out continuously, the solidification step (4) following immediately the application step (1), and the finishing step (6) following immediately the solidification step (4).

9. The process according to any one of the preceding claims, **characterized in that** the application step (1) is performed only on one face of the fabric (T) and the solidification step (4) is conducted on the opposite face of the fabric (T).

10. The process according to one or more of Claims 1 to 8, **characterized in that** the solidification step (4) is conducted on both faces of the fabric (T).

11. The process according to one or more of Claims 1 to 8, **characterized in that** the solidification step (4) is performed at an adjustable temperature, with or without contact.

12. The process according to Claim 9 or 10, **characterized in that** the solidification step (4) is performed by means of exposure of the fabric (T) to free air.

13. The process according to Claim 1, **characterized in that** the finishing step (6) is performed with two or more pairs of counter-rotating rolls (7, 7').
14. The process according to Claim 13, **characterized in that** one roll of the or each pair of counter-rotating rolls (7, 7') is provided with surface features different than those of the other roll. 5
15. An apparatus for the treatment of fabrics (T) with the application of chemical products, comprising: a station (1) for application of the chemical products in liquid phase on the fabric (T), tangentially thereto; a station (4) for solidification of the chemical products for fixing them on the fabric (T); and a station (6) for finishing of the fabric (T); said apparatus being **characterized in that** the application station (1) comprises means (2, 2') for only surface application of the chemical products on the fabric (T) during advancement thereof including at least one kiss roll cylinder (2, 2') and **in that** the solidification station (4) includes means (5) for only partial and controlled evaporation of the liquid phase contained in said chemical substances applied on the fabric (T). 10 15 20 25

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Fig 1

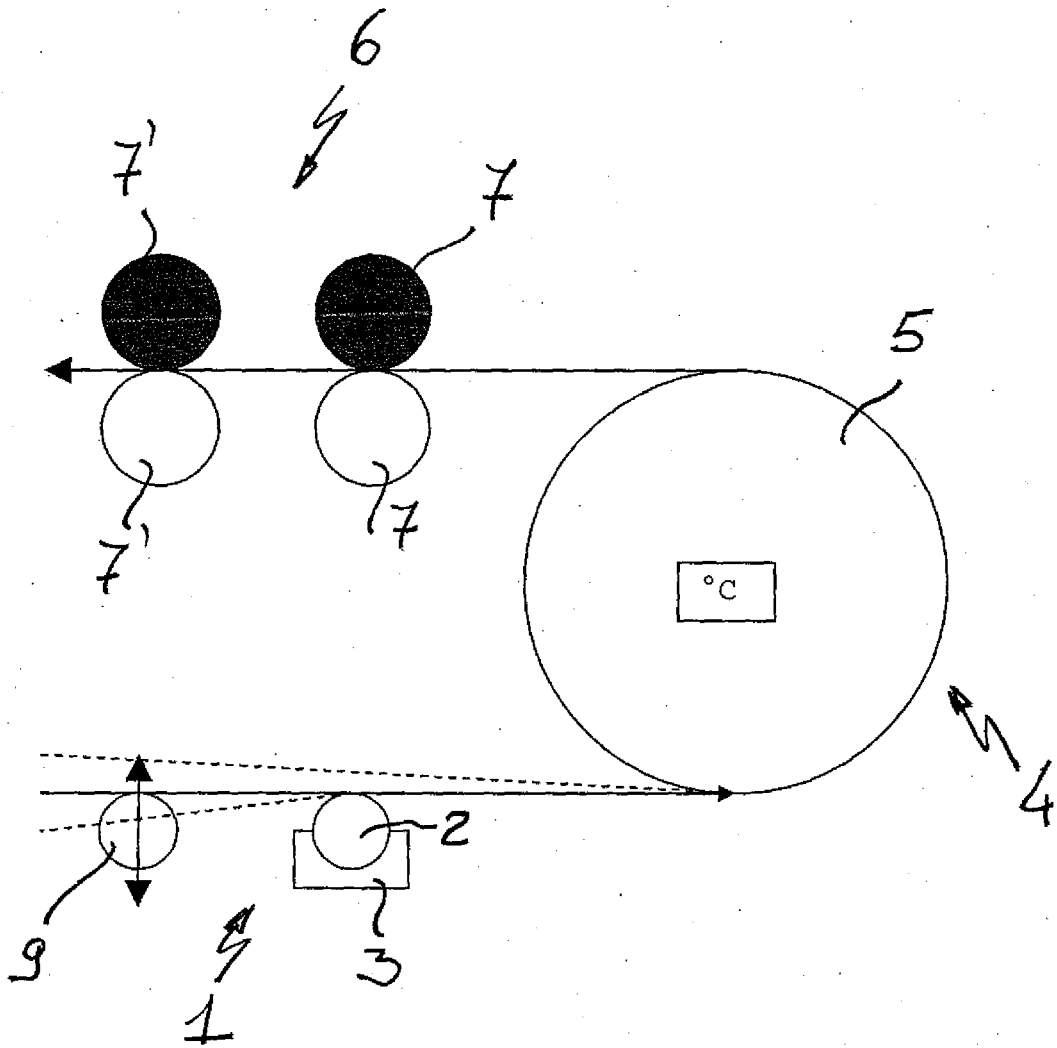
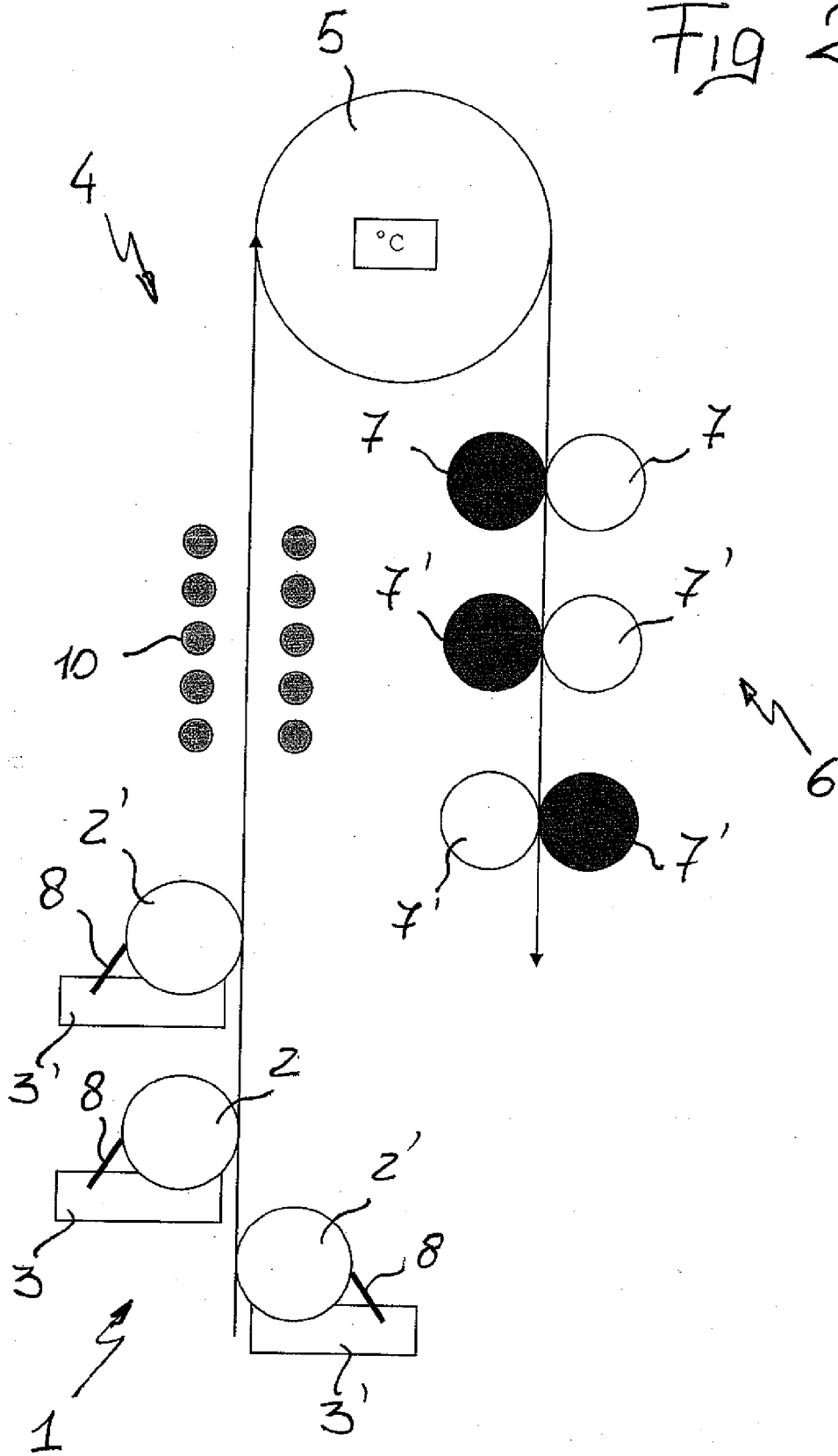


Fig 2





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