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(12) # EUROPEAN PATENT SPECIFICATION

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(54) **Process and apparatus for finishing cotton knits.**

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Description

This invention relates to a process and apparatus for finishing of knitted fabrics of cotton or other natural or regenerated cellulosic fibres, or blends thereof with other fibres.

Canadian Patent No. 765735 is concerned with an ammonia treatment of such fabrics, and also—and more particularly—of woven fabrics of the same materials, to impart thereto varying degrees of elasticity (stretchiness) and/or crease resistance. The process involves swelling the fibres of the fabric by impregnating it with liquid ammonia and, after a time interval, evaporating the ammonia from the still swelled fibres.

As a matter of fact, however, the processes of the aforementioned patent have only ever been used significantly in connection with the treatment of woven fabrics. We have now, however, after revising certain established ideas about the end uses to which fabrics of different constructions can be put, devised finished fabric of cotton or other cellulosic fibre which, it turns out, can be made by modified techniques according to the said patent.

The finished knitted fabrics which can be produced according to the invention of cotton or of other natural or regenerated cellulosic material are lustrous, flat and dense and they lack spirality and edge curling, and are crease resistant, all being characteristics of mercerized fabrics, and they have in addition good dimensional stability uncharacteristic of mercerized fabric.

Particularly useful are fabrics in which the linear shrinkage in the coursewise direction is less than 5%. It is preferred that the linear shrinkage in either direction is less than 10%.

A single jersey fabric produced according to the present invention preferably has a Kr value in excess of 1.0, and more preferably in the range from about 1.1 to about 1.3. (The Kr value is the number of courses per unit length divided by the number of wales per unit length.)

The processes described in Canadian Patent 765735 aforesaid cannot produce such knitted fabrics. It is stated in said Canadian patent that if the ammonia process therein described is effected entirely without tension, one will theoretically obtain a fabric which shows no washing shrinkage. However the Canadian patent, while teaching that different effects can be achieved by processing under different tensions, discloses only processing arrangements in which tension is required in the fabric even if only that which is sufficient to haul the fabric through the processing apparatus. In practice the application of even the minimum tension one can achieve with the apparatus described in the Canadian patent will not produce any useful result with knitted fabrics.

The invention is based on the problem of ammonia finishing knitted fabrics under substantially zero tension so as to produce improved finishing knitted fabrics having an attractive appearance and useful textile properties.

The problem is solved according to the invention by processing the fabric in substantially tension-free condition while held substantially flat on a carrier from supply means before impregnation means to a take-up device after evaporation means.

A machine for carrying out the process of the aforementioned patent has a support for a supply of fabric to be treated, an impregnation bath in which the fabric is impregnated with liquid ammonia, an evaporating unit comprising a rotary heated drum against which the swollen fabric is held by a blanket, and further processing zones in which the fabric may be subjected to heat or steam, prior to being wound up or otherwise collected after the processing.

Such a machine is suitable for making the fabric according to the present invention, but it must be arranged that the knitted fabric is supported as it passes through the machine so that it is not under any tension. The knitted fabric may thus be passed through the machine while supported by a woven fabric.

A suitable woven fabric support is not affected by the ammonia and may comprise a polyester or polypropylene fabric—which should itself be dimensionally stable, of course, and may comprise a plain woven fabric which may be of relatively open or even mesh-like structure. A roll of knitted fabric can be sent through together with a roll of woven support fabric, or a continuous "belt" of support fabric may be arranged to carry the knitted fabric through the apparatus. A really enterprising finisher might elect to finish a knitted fabric and a suitable woven fabric together, using the woven fabric as a support for the knitted fabric.

It is helpful if the support fabric is smooth so that the knitted fabric can pull in with respect thereto without catching or snagging or undue frictional resistance.

A particularly effective arrangement seems to be if a tubular knit fabric is placed as a sleeve on a woven carrier, but this, of course, would present difficulties in practice.

If, incidentally, a tubular fabric is processed, no problems seem to be encountered in marking at the creases.

The other properties of the finished fabrics processed according to the invention are produced or altered as descrbed in our earlier patent aforementioned.

Embodiments of novel cotton and other natural and regenerated cellulosic material knitted fabrics and finishing processes and apparatus for producing the same are hereinafter described with reference to the accompanying drawings in which:—

Figure 1 is a diagrammatic illustration of one embodiment of finishing apparatus,

Figure 2 is a diagrammatic illustration of another embodiment of finishing apparatus.

Figures 1 and 2 illustrate machinery for carrying out an ammonia treatment of knitted cotton or other natural or regenerated cellulosic fabric, comprising a support 11 for a supply of fabric 12 to be treated, an impregnation bath 13 in which the fabric is impregnated with liquid ammonia 14, a hot calender 15 on which the fabric 12 swollen by the ammonia is pressed by a blanket 16, a further processing zone 17 in which the fabric is subjected to heat or steam, and fabric collection means 18 which, as shown, comprise a trolley 19 into which the fabric drops from a folding apparatus 21, but which could equally be a take-up roll arrangement.

In the embodiment illustrated in Figure 1, there is an additional supply arrangement 22 for a support fabric 23 of woven polyester or polypropylene which is fed through the entire appararatus together with the fabric 12 under treatment so as to support the latter and guide it through the apparatus without any significant lengthwise tension being applied to it. The support fabric is rolled up on a take up arrangement 24 for subsequent re-use.

In the embodiment illustrated in Figure 2, a support fabric 23, again of woven polypropylene or polyester, is run as an endless belt through the machine from an input roller 25 to a return roller 26 with a return run 27 under the machine.

The machinery illustrated will, of course, also have the usual ancillary equipment for recovering evaporated ammonia, and heating and/or cooling means and so on.

By means of the machinery, processes can be applied to cotton and other cellulosic fabrics as more particularly described in the following Examples:

Example

Treatment in a padding machine

Four single jersey fabrics, from an ordinary mill production were treated in tubular form in the grey state (fabric weights 105, 110, 170 and 185 g/m^2). Each experimental fabric sample was approx. 100 m long. The samples were before treatment sewn together and onto a machine runner (woven cotton fabric). To ensure tensionless treatment, a woven polyester fabric (fabric weight 65 g/m^2) was also sewn onto the machine runner and fed into the machine parallel with the single jersey fabric samples.

The speed of the padding machine was 12 m/min. (The padding machine running speed ranges from 7—16 m/min.)

Treatment procedure

In the treatment, the fabric passes through three zones:

1. The impregnation zone. (Foulard technique, temperature of ammonia—33.4°C.)
2. The reaction zone.
3. The ammonia removal zone.

Assessment of dimensional stability of the treated fabric

Fabric shrinkage or dimensional stability may be defined as :

(i) Relaxation shrinkage,
which is measured shrinkage when the fabric is statically immersed in water for the first time and it is considered to be due to the release of strains built up and imposed on the fibres, yarn and fabric systems during manufacture.

(ii) Consolidation shrinkage.
This is observed particularly on fabrics other than wool and shows itself as a continued shrinkage in washing treatments after the first immersion. Scientifically this shrinkage can be considered as a delayed relaxation of some processing strains that require agitation to assist in their full release.

Commercially, the dimensional stability of a knitted fabric is commonly expressed as a shrinkage measurement based on either the original dimensions of a fabric or on the dimensions after a soaking treatment. However, it has been shown that it is more informative, in terms of assessing the loop configuration to express the fabric dimensions in terms of the k_c, k_w and k_s values, where these constants are given by

$$k_c = \frac{cpi}{l} \qquad k_w = \frac{wpi}{l} \qquad k_s = \frac{cpi \times wpi}{l^2}$$

The stitchlength l was found by measuring unravelled yarn lengths from a known number of courses from the knitted dry-relaxed fabrics, using a Shirley Crimp Tester.

Relaxation and washing treatments

The fabric sample size was (60×60) cm^2. In the middle of the sample, a square of (10×10) cm^2 was measured by means of a smaller template and marked by three points in length and width direction respectively. The average of the three measurements was used in the subsequent calculations.

The samples were machine washed according to Swedish Standard SIS 25 12 39 (V4), i.e. washed at 60°C and rinsed. They were hydroextracted for 6 mins, and samples were dried lying flat. The samples were given 13 washing treatments.

The dimensional changes were measured after conditioning for at least 4 hours in an atmosphere of 20°C, 65% R.H.

The dimensional changes are expressed in k_c, k_w and k_s values and changes in stitch configuration in k_r values

$$\left(\frac{\text{cpi}}{\text{wpi}} = k_r\right).$$

The results are given in Tables 1+2.

TABLE 1

Single jersey fabric, NH_3, treated with a runner. Code Am.
Code SIS[II], i.e. machine washed at 60°C, hydroextracted, dried lying flat.

Number of treatments	Factory: Code I				Factory: Code II			
	k_c	k_w	k_s	k_r	k_c	k_w	k_s	k_r
Untreated	5.78	3.42	19.7	1.69	4.37	3.82	16.7	1.15
NH_3	5.65	4.56	25.6	1.24	4.63	4.66	21.5	0.99
1	*6.22	4.50	27.8	1.38	*5.52	4.53	25.0	1.22
2	*6.22	4.50	27.8	1.38	*5.50	4.51	24.8	1.22
3	6.13	4.44	27.1	1.38	5.07	4.43	22.4	1.15
4	6.09	4.44	26.9	1.37	5.28	4.45	23.5	1.19
5	6.05	4.44	26.7	1.36	5.32	4.45	23.6	1.20
6	6.02	4.52	27.1	1.33	5.43	4.23	23.0	1.28
7	5.98	4.46	26.5	1.34	5.15	4.41	22.7	1.17
8	6.00	4.56	27.2	1.32	5.41	4.31	23.3	1.26
9	6.05	4.50	27.1	1.34	5.20	4.43	23.0	1.17
10	6.05	4.48	26.9	1.35	5.32	4.41	23.4	1.21
11	5.94	4.50	26.6	1.32	5.07	4.47	22.6	1.14
12	5.98	4.44	26.4	1.35	5.11	4.31	22.0	1.19
13	6.05	4.41	26.5	1.37	5.16	4.42	22.8	1.17

*Accidentally tumble dried.

TABLE 2
Single jersey fabric, NH_3, treated with a runner. Code Am.
Code SIS[II], i.e. machine washed at 60°C, hydroextracted, dried lying flat.

Number of treatments	Factory: Code III				Factory: Code IV			
	k_c	k_w	k_s	k_r	k_c	k_w	k_s	k_r
Untreated	4.66	3.27	15.3	1.43	4.36	3.30	14.4	1.32
NH_3	5.04	4.17	21.0	1.21	4.51	4.62	20.9	0.98
1	*5.70	4.06	23.2	1.40	*5.30	4.53	24.1	1.17
2	*5.74	4.06	23.3	1.41	*5.34	4.51	24.1	1.18
3	5.53	3.91	21.7	1.41	4.99	4.47	22.4	1.12
4	5.49	4.05	22.2	1.36	5.03	4.45	22.4	1.13
5	5.47	3.97	21.7	1.38	4.98	4.35	21.7	1.14
6	5.49	4.05	22.2	1.36	5.03	4.51	22.7	1.12
7	5.56	3.87	21.5	1.44	5.03	4.33	22.4	1.19
8	5.39	4.05	21.8	1.33	5.09	4.47	22.8	1.14
9	5.47	4.00	21.9	1.37	5.03	4.37	22.0	1.15
10	5.51	3.95	21.8	1.40	5.16	4.43	22.9	1.16
11	5.39	3.97	21.4	1.36	4.99	4.33	21.6	1.16
12	5.45	3.90	21.3	1.40	5.01	4.36	21.9	1.15
13	5.56	3.95	22.0	1.40	5.06	4.34	22.0	1.17

*Accidentally tumble dried.

Claims

1. A process for finishing knitted fabric of cotton or other natural fibre or regenerated cellulosic material comprising swelling the fibres thereof by impregnation with liquid ammonia and evaporating the ammonia from the still-swelled fibres, characterised in that the fabric (12) is processed continuously in substantially tension-free condition while held substantially flat on a carrier (23) from supply means (11) before impregnation means (13) to a take-up device (18) after evaporation means (15, 17).

2. Apparatus for finishing knitted fabric of cotton or other natural fibre or regenerated cellulosic material comprising means for passing said fabric continuously through an impregnation zone for impregnating the fabric with liquid ammonia to swell the fibres thereof and means for evaporating the ammonia from the still-swelled fibres, characterised in that carrier means (23) are provided which are forwarded together with the fabric (12) to be treated from supply means (11) before the impregnation zone (13) to a take-up device (18) after the ammonia evaporation means (15, 17), for carrying said fabric (12) substantially free from tension.

3. Apparatus according to claim 2, characterised in that said carrier means (23) comprise a woven fabric of a material that is not deleteriously affected by the ammonia.

4. Apparatus according to claim 3, characterised in that said woven fabric is of polyester or polypropylene.

5. Apparatus according to any one of claims 2 to 4, characterised that said carrier means (23) comprise a continuous belt.

6. Apparatus according to any one of claims 2 to 5, characterised in that said carrier means (23) comprise a fabric intended to be processed together with the knitted fabric.

Patentansprüche

1. Verfahren zum Ausrüsten von Gestricken aus Baumwolle, anderen Naturfasern oder Zellwolle, bei dem die Fasern durch Imprägnierung mit flüssigem Ammoniak aufgequollen werden und das Ammoniak aus den noch gequollenen Fasern verdampft wird, dadurch gekennzeichnet, daß das Gestrick (12) kontinuierlich in einem im wesentlichen spannungs- und zugfreien Zustand von Zuführungsmitteln (11) über Imprägnierungsmitteln (13) und Verdampfungsmitteln (15, 17) zu einer Ablage- oder Aufwickelvorrichtung (18) geführt wird, wobei es im wesentlichen flach auf einem Träger (23) gehalten wird.

2. Vorrichtung zum Ausrüsten von Gestricken aus Baumwolle, anderen Naturfasern oder Zellwolle mit Mitteln zum Kontinuierlichen Durchführen des Gestrickes durch eine Imprägnierungszone zum Imprägnieren des Gestrickes mit flüssigem Ammoniak, um die Fasern aufquellen zu lassen und mit Verdampfungsmitteln für die Verdampfung des Ammoniaks aus den noch gequollenen Fasern, dadurch gekennzeichnet, daß ein Träger (23) vorgesehen ist, der mit dem von Zuführungsmitteln (11) gelieferten zu behandelnden Gestrick (12) bis zu einer Ablage- oder Aufwickelvorrichtung (18) über die Imprägnierungszone (13) und die Verdampfungsmittel (15, 17) weiterbefördert wird, um das Gestrick (12) im wesentlichen spannungs- und zugfrei zu tragen.

3. Vorrichtung nach Anspruch 2, dadurch gekennzeichnet, daß der Träger (23) ein gewirktes Gewebe aus einem Material aufweist, das nicht in schädlicher Weise durch das Ammoniak beeinträchtigt wird.

4. Vorrichtung nach Anspruch 3, dadurch gekennzeichnet, daß das gewirkte Gewebe aus Polyester oder Polypropylene besteht.

5. Vorrichtung nach einem der Ansprüche 2 bis 4, cadurch gekennzeichnet, daß der Träger (23) ein laufendes Band aufweist.

6. Vorrichtung nach einem der Ansprüche 2 bis 5, dadurch gekennzeichnet, daß der Träger (23) ein Gewebe aufweist, das zusammen mit dem Gestrick behandelt wird.

Revendications

1. Procédé d'apprêt de tricot de coton ou d'une autre matière cellulosique naturelle fibreuse ou régénérée, comprenant le gonflement des fibres par imprégnation avec de l'ammoniac liquide et évaporation de l'ammoniac des fibres encore gonflées, caractérisé en ce que le tricot (12) est traité de façon continue à un état pratiquement sans tension alors qu'il est maintenu sensiblement à plat sur un support (23) d'un dispositif d'alimentation (11) placé avant un dispositif d'imprégnation (13) à un dispositif de prélèvement (18) placé après un dispositif d'évaporation (15, 17).

2. Appareil d'apprêt d'un tricot de coton ou d'une autre matière cellulosique naturelle fibreuse ou régénérée comprenant un dispositif destiné à faire passer le tricot de façon continue dans une zone d'imprégnation afin que le tricot soit imprégné d'ammoniac liquide qui en gonfle les fibres, et un dispositif d'évaporation de l'ammoniac des fibres encore gonflées, caractérisé en ce qu'un dispositif de support (23) est entraîné avec le tricot (12) qui doit être traité d'un dispositif d'alimentation (11) placé avant la zone d'imprégnation (13) à un dispositif de prélèvement (18) placé après le dispositif d'évaporation d'ammoniac (15, 17) afin que le tricot (12) soit transporté en étant pratiquement dépourvu de toute tension.

3. Appareil selon la revendication 2, caractérisé en ce que le dispositif de support (23) est un tissu d'une matière qui n'est pas affectée de manière nuisible par l'ammoniac.

4. Appareil selon la revendication 3, caractérisé en ce que le tissu est formé de polyester ou de polypropylène.

5. Appareil selon l'une des revendications 2 à 4, caractérisé en ce que le dispositif de support (23) est une courroie continue.

6. Appareil selon l'une quelconque des revendications 2 à 5, caractérisé en ce que le dispositif de support (23) est un tissu destiné à être traité avec le tricot.

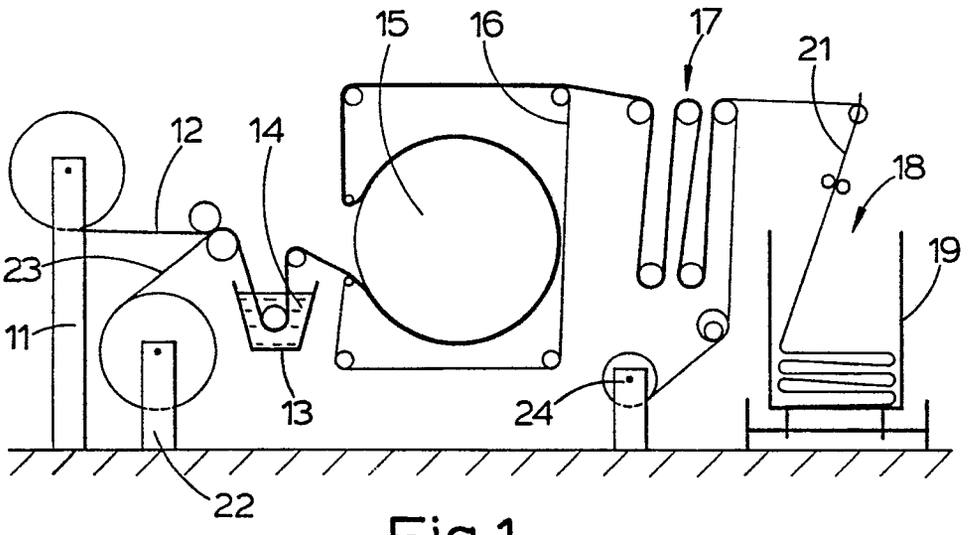
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Fig.1

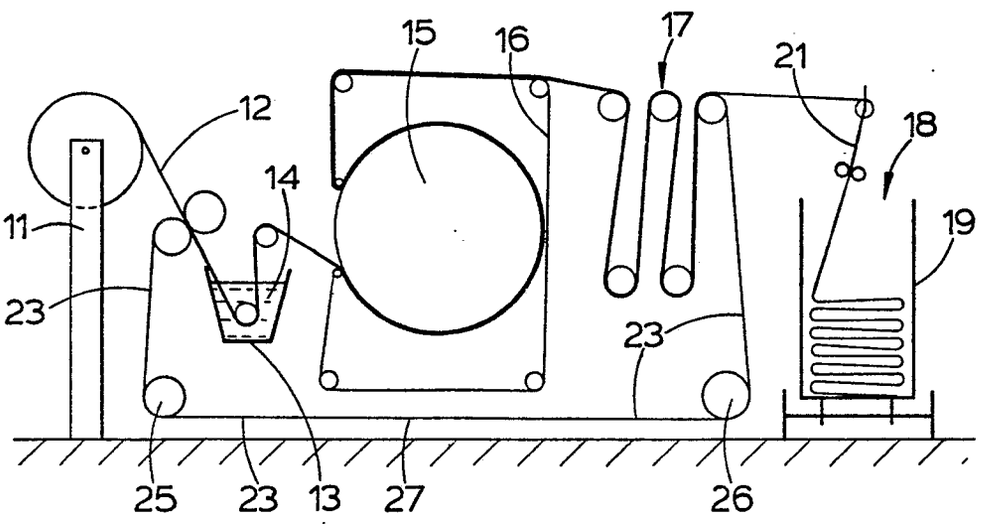
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Fig.2