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⑤④ **Novel finished cotton knits.**

⑤⑦ A finished knitted fabric of cotton or other natural or re-generated cellulosic material which is lustrous, flat and dense and lacks spirality and edge curling, is crease resistant and has in addition good dimensional stability uncharacteristic of mercerized fabrics. An apparatus for finishing knitted cotton or other natural or regenerated cellulosic fabric is described, and also a process for finishing such knitted fabric.

EP 0 068 748 A1

NOVEL FINISHED COTTON KNITS

This invention relates to knitted fabrics of cotton
5 or other natural or regenerated cellulosic fibres, or blends
thereof with other fibres.

Our 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
10 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.

15 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
20 be put, devised novel, finished fabric of cotton or other
cellulosic fibre which, it turns out, can be made by
modified techniques according to the said patent.

According to the invention, the novel, finished
knitted fabric of cotton or other natural or regenerated
25 cellulosic material is characterised by being lustrous, flat
and dense and in that it lacks spirality and edge curling,
and is crease resistant, all being characteristics of
mercerized fabrics, and in that it has 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%, and fabrics in which the linear shrinkage in either direction is less than 10%.

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

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
5 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
10 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
15 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
20 as described 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:-

25 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 cellulose 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 apparatus 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/m²). 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/m²) 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 - 33.4⁰ 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

$$k_c = \frac{cpi}{e} \quad k_w = \frac{wpi}{e} \quad k_s = \frac{cpi \times wpi}{e^2}$$

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 $(60 \times 60) \text{ cm}^2$. In the middle of the sample, a square of $(10 \times 10) \text{ cm}^2$ 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. ($\frac{cpi}{wpi} = k_r$)

The results are given in Tables 1 + 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.

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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 II

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 finished knitted fabric of cotton or other natural or regenerated cellulosic material, characterised by being lustrous, flat and dense and in that it lacks spirality and edge curling, and is crease resistant, all being characteristics of mercerized fabrics, and in that it has in addition good dimensional stability uncharacteristic of mercerized fabrics.
2. A fabric according to claim 1, characterised in that it has a linear shrinkage in the coursewise direction of less than 5%.
3. A fabric according to claim 1 or claim 2, characterised in that it has a linear shrinkage in either direction of less than 10%.
4. A fabric according to any one of claims 1 to 3, characterised in that it is a single jersey fabric having a Kr value greater than 1.0.
5. A fabric according to claim 4, characterised in that it has a Kr value between about 1.1 and about 1.3.
6. A process for finishing knitted fabric of cotton or other natural 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 is processed in substantially tension-free condition while held substantially flat.

5 7. A process according to claim 6, characterised in that the process is continuous and the fabric passes through the process on a carrier fabric.

8. Apparatus for finishing knitted cotton or other
10 natural or regenerated cellulosic fabric 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
15 carrier means are provided for carrying the said fabric substantially free from tension through the apparatus.

9. Apparatus according to claim 8, characterised in that said carrier means comprise a woven fabric of a
20 material that is not deleteriously affected by the ammonia.

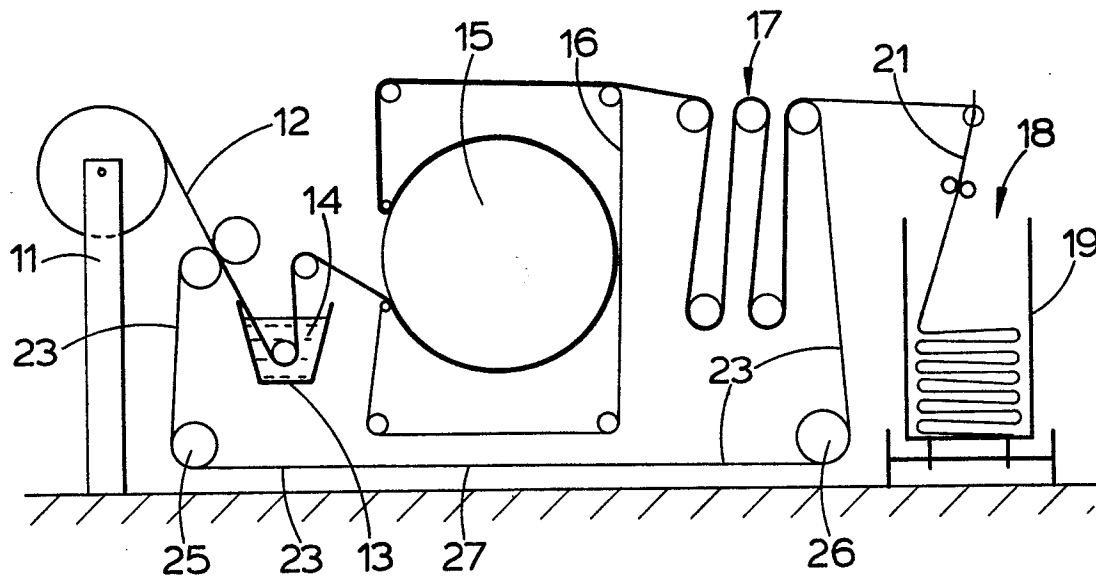
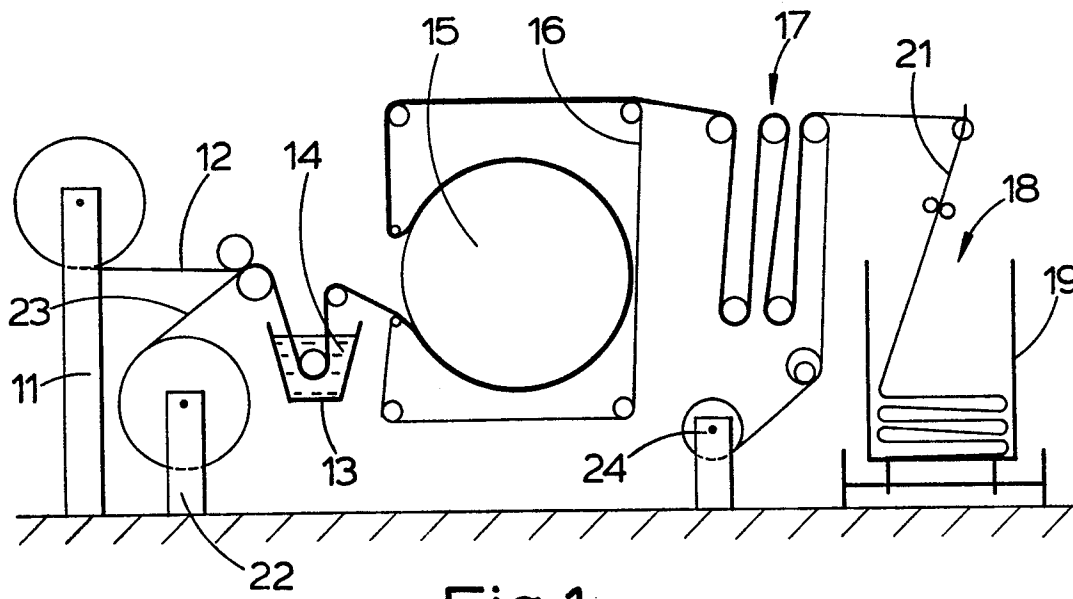
10. Apparatus according to claim 9, characterised in that said woven fabric is of polyester or polypropylene.

25 11. Apparatus according to claim 8 or claim 9, characterised in that said carrier means comprise a fabric which is forwarded, together with the knitted fabric to be treated, from a supply to a take-up.

12. Apparatus according to claim 8 or claim 9, characterised in that said carrier means comprise a continuous belt of fabric.

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13. Apparatus according to claim 11, characterised in that said fabric is itself a fabric intended to be processed together with the knitted fabric.



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EUROPEAN SEARCH REPORT

Application number

EP 82 30 3173

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
X	--- US-A-3 915 632 (CLUETT, PEABODY) * Whole document *	1, 6-8, 12	D 06 B 7/08
A	--- FR-A-2 098 789 (LEFEBVRE et al.)		
A	--- GB-A-1 270 645 (TEDECO)		
A	--- US-A-3 980 429 (CLUETT, PEABODY) -----		
			TECHNICAL FIELDS SEARCHED (Int. Cl. ³)
			D 06 B D 06 C
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 28-09-1982	Examiner PETIT J.P.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			