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METHOD OF MAKING COTTON FABRICS WITH
DIFFERENTIAL ELASTIC PROPERTIES
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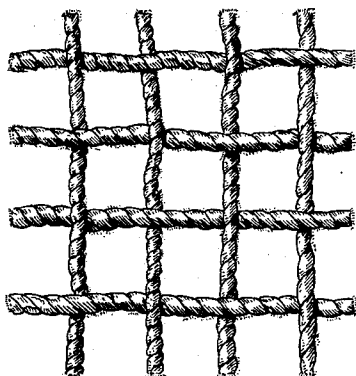


Fig. 1.

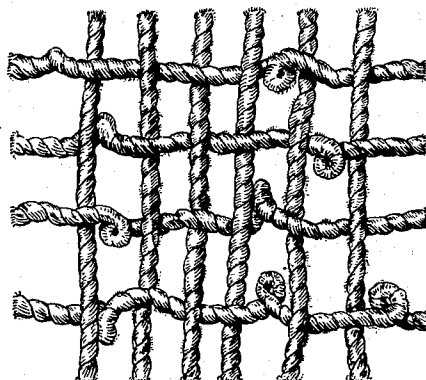


Fig. 2.

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METHOD OF MAKING COTTON FABRICS
WITH DIFFERENTIAL ELASTIC PROPERTIESCharles F. Goldthwait, New Orleans, La., assignor
to the United States of America, as represented
by the Secretary of Agriculture

Application November 5, 1943, Serial No. 509,133

6 Claims. (Cl. 8—117)

(Granted under the act of March 3, 1883, as
amended April 30, 1928; 370 O. G. 757)

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This application is made under the act of March 3, 1883, as amended by the act of April 30, 1928, and the invention herein described, if patented, may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment to me of any royalty thereon.

This invention relates to the production of a cotton fabric with a high degree of stretchability and of elasticity in one direction in the piece, at the same time with approximately normal elastic properties in the other direction. Such different elastic behavior in the two directions in one piece of goods is herein referred to as differential.

The extra stretchability and elasticity may be in the warp (lengthwise) direction in the piece, or in the filling (width) direction. In either case the stretchability and possible elastic recovery in the other direction will be approximately normal, by which is meant that they are of such low values as commonly found in plain cotton cloth of ordinary constructions; or not significantly greater than in the original fabrics from which the new types of fabric are prepared.

This invention is akin to that of my co-pending application Serial No. 509,134, filed November 5, 1943, now Patent No. 2,379,574 entitled Surgical bandages with improved elastic properties, but differs from it in that the improved elastic properties are present in fabrics in only one direction at a time in the piece instead of in both directions at once. New surface properties that cause layers of the fabric to resist forces tending to make them slip on other layers are developed here to a somewhat lesser degree than in the fabrics of the application mentioned above, because the yarns in the cloth are greatly modified in only one direction in the piece instead of in both directions. The new fabrics with improved elastic properties in only one direction are prepared by a somewhat similar method.

They are prepared by either of two modifications of the general method of shrinking suitable fabrics by means of swelling agents for cellulose, removing the swelling agent and then drying the goods with a minimum of tension.

The two modifications are (1) allowing the shrinkage to take place in only one direction while restraint is exerted to prevent shrinking in the other direction, and (2) allowing the shrinkage to take place in both directions, and then pulling the fabric back by tension in one direction to as nearly as possible its original length or width, according as the elastic properties are to be developed in width or length respectively.

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A large proportion of the shrinkage in one direction or the other of the piece, as desired, is retained in the form of added crimp and kinkiness in the yarn in the shrunken direction in the fabric. Hereafter, the combined crimp and kinkiness will be generally called crimp. The yarns thus crimped in the piece goods have elastic properties which they impart to the fabric making it, in effect, elastic in one direction while remaining relatively inelastic in the other direction.

These new fabrics are intended for uses where a cloth is desired to stretch in one direction and to remain relatively tight and firm in the other direction. They are particularly adapted to various mechanical uses, of which surgical bandages are examples; and are especially useful where a cloth must fit tightly over an irregular surface. They are very useful where more stretch is needed in a fabric than can be obtained with ordinary cloth; where a cloth may be required to stretch occasionally and to return to approximately its original dimensions; and where used as a wrapping and the elasticity and self-tightening features allow a close fit without the cloth being put on at high tension. At the present time some of these effects are obtained from knittings but my new fabrics are entirely different in construction from stretchable cloths produced in this way.

Other commercial fabrics are made stretchable and elastic by the aid of rubber. My invention has no relation whatever to them.

My new fabrics are similar in effect to present commercial fabrics with elasticity produced by highly twisted yarns such as used in crepe styles, but are entirely different in structure and method of production. A particularly pertinent example is an elastic bandage made highly stretchable lengthwise by means of highly twisted yarns, and unstretchable across the width. My improved fabrics can be made with very similar behavior as illustrated below but, as stated, are entirely different in construction.

The improved fabrics will also find use for household purposes and in clothing. Such stretching effects can be obtained as are now produced by cutting on the bias, with a saving in waste of cloth and the advantage of better elasticity.

Fabrics made stretchable in only one direction by my shrinking process have the advantages over fabrics shrunken in both directions that there is much less loss of area during manufacture and that they are firmer.

Specific examples of these new fabrics are sur-

gical bandages similar to the usual absorbent gauze type with the added properties of easy stretchability in length with a high elastic recovery upon release of the stretching tension, and a non-slip surface, but with no unusual elastic properties in width. Alternatively the bandages may have these special elastic properties in width but not in length.

The result of the treatment of cheese cloth by the methods indicated above to produce a bandage fabric is shown in the accompanying drawing.

Figure 1 illustrates a piece of loosely woven cheese cloth just as it comes from the loom. Figure 2 shows the same cloth after treating, and shows especially the crimp and kinkiness in the yarns in one direction in the piece, and the similarity of the straight yarns in the other direction to those in the original cloth. This drawing is only diagrammatic but it is a faithful reproduction from enlarged photographs of areas of these fabrics. The increased closeness of the vertical threads is a rough measure of the shrinkage and of the new elastic properties of the horizontal threads. The complete crimp does not show because much of it is in the line of sight as one looks at the drawing. That is, it is actually above and below the plane of the fabric. It can be easily seen that the fabric portrayed in Figure 2 can be stretched if enough tension is applied to straighten the crimp. Then, if the bandage has been properly manufactured, there is enough elastic effect in the cotton to cause the crimp to re-enter the yarn upon release of the tension and to return the cloth to very nearly its shrunken size. The crimp also makes the fabric rough and imparts non-slip properties. Thus Figure 2 shows the changes in the cloth which cause the new and useful properties in this new type of fabric.

The process of treatment is not limited to such light weight fabric as used in absorbent bandages but these will serve as very convenient specific examples of the preparation of fabrics stretchable and elastic in one direction and not in the other. Fabrics of this type for bandage purposes can be made from a cotton cheese cloth of 28 warp threads and 24 filling threads per inch.

Example 1.—This is an example of the general method of restraining the fabric in one direction and allowing shrinkage to take place only in the other direction, in this case in width.

A piece of the above cloth is wound in open width on one of the rollers of a dye jig of the type used for dyeing piece goods. The cloth is then passed while under considerable tension through a solution of sodium hydroxide of such concentration, for example 20 or 25%, as will normally cause rapid swelling of the cotton fibers and shrinking of the cloth. The cloth may be previously wet so that the sodium hydroxide will penetrate and act upon it quickly, or the sodium hydroxide solution may contain a wetting agent to help wet the cotton and promote rapid action. In this example the cloth will shrink in width while remaining at its original length and is wound while wet with caustic upon another roller. It may be passed back and forth from roller to roller until it has reached its maximum shrinkage in width.

Then the caustic in the machine can be replaced with water and the cloth is washed in several such waters until free from the sodium hydroxide. The cloth is then dried while under tension in length but with as little tension and stretching as possible in width. If tension is not

applied during drying the cloth may relax a little in length but not enough to affect the differential elastic properties to any material extent.

Example 2.—This is an example of the method of complete shrinkage and approximate recovery of one dimension of the cloth leaving the special elastic properties in the cloth in the other direction only.

The above cloth in rope form or open width is dropped loosely into a solution of sodium hydroxide, such as described in Example 1, so that it can shrink completely.

After the shrinkage is complete the excess sodium hydroxide is removed, usually by careful squeezing, and the residual alkali thoroughly washed out. The cloth is then stretched back in width on a tenter frame as nearly as possible to its original width and dried, with just as little tension as possible in the lengthwise direction of the piece in order not to reduce the shrinkage and stretchiness in that direction.

Alternatively, the width may be recovered while the cloth still contains the caustic, and the washing effected while the cloth is in this stretched state.

The cloth is finally dried with care not to change the dimensions of the goods sufficiently to affect the differential elastic properties.

Fabrics have been prepared by these methods from a cheese cloth of 28 x 24 thread count, containing yarns of numbers 28 and 37 on the cotton system, and of 20 and 26 twists per inch, in warp and filling respectively.

When tested in the directions in which the new elastic effects have been produced, by means of stretching to given percentages and releasing to recover elastically, the results shown in Table 1 were obtained for the fabrics prepared by the methods of Examples 1 and 2 respectively, with the process shrinkages shown in the second column.

Table I

Direction in fabric	Total shrinkage in process	Test data	
		Percentage stretched	Percentage recovered
	Percent		
Example 1: Width.....	33	10	10
	33	20	15
Example 2: Length.....	40	10	9
	40	20	18

In the examples given above only those steps in the manufacture of absorbent type bandage fabrics have been indicated which are necessary to produce fabrics having the described surface and elastic properties. It is to be understood that the cloth can be acidified and washed to remove alkali, or kier boiled and bleached to make it absorbent, at any selected time in the process without substantially changing the nature of my new treatment. It is also to be understood that the shrinking treatment can be varied greatly in detail without departing from the spirit of my invention. It is only necessary that a large amount of shrinkage, not necessarily the maximum that might be attained, shall be put into the goods and retained completely through subsequent processing, or to a sufficient degree to impart the properties which have been described. It is to be understood that the examples given above are not in any sense limitations and it is clear that various modifications and changes in the method of treatment and in the product may

be employed without departing from the spirit and scope of the invention.

It is possible to produce a great range of effects represented by different weights and types of fabric and different degrees of stretchability and elastic recovery. Each fabric can be designed to meet requirements which may be imposed. The twist in the yarns will control to a certain extent the maximum amount of shrinkage that can be reached. The size of the yarns and the number of threads per inch in the goods will affect the shrinkage somewhat but will control particularly the weight and closeness of structure of the resulting fabric. Finally some of the shrinkage can be taken out by suitable tension during finishing if necessary to meet requirements of predetermined dimensions and elastic effects.

The methods of producing these new fabrics do not interfere with their absorbency if they are properly bleached for use as absorbent bandages. In fact the improved cloth texture and the presence of residual swelling in the cotton tend to improve the absorbency.

Other proposals have been made to utilize the shrinking effects of caustic alkalies on cotton fabrics but not with the present object in view. Such have been shrunken more or less completely to obtain closeness of texture, or wool-like characteristics, but the fabric structures resulting from such shrinkage are in no way related to my new fabrics, whether made for bandages or other purposes, where the shrinkage has been utilized to develop new and useful elastic properties in one direction in a piece of cloth without such properties in the other direction.

Having thus described my invention, I claim:

1. A method comprising treating an open weave cotton fabric with an agent which swells the cellulose, thereby tending to shrink the fabric, removing the cellulose-swelling agent, and drying the fabric, the while maintaining it under ten-

sion in one direction and substantially under no tension in the direction normal thereto, whereby the individual yarns of the fabric running in the non-tensioned direction are crimped and the yarns running in the tensioned direction are substantially non-crimped, thus imparting elasticity to the fabric in the non-tensioned direction and substantially no elasticity in the other direction.

2. The method of claim 1, wherein the cellulose-swelling agent is sodium hydroxide.

3. A method comprising treating an open weave cotton fabric with an agent which swells the cellulose, thereby tending to shrink the fabric, the while maintaining the fabric under tension in one direction and allowing it to shrink in a direction normal thereto, removing the cellulose swelling agent and also drying the fabric while the tension is so maintained, whereby the individual yarns of the fabric are crimped in the direction of the shrinking while those in the other direction are not, thus imparting elasticity to the fabric in the direction of crimping and substantially no elasticity in the other direction.

4. The method of claim 3, wherein the cellulose-swelling agent is sodium hydroxide.

5. A method comprising treating an open weave cotton fabric with an agent which swells the cellulose, thereby shrinking the fabric in all directions, removing the cellulose-swelling agent, tensioning the fabric in one direction to remove the shrink in that direction without tensioning it in the direction normal thereto, and drying the fabric while the tension is maintained, whereby the individual yarns of the fabric are crimped in the non-tensioned direction while those in the tensioned direction are not, thus imparting elasticity to the fabric in the direction of crimping and substantially no elasticity in the other direction.

6. The method of claim 5, wherein the cellulose-swelling agent is sodium hydroxide.

CHARLES F. GOLDTHWAIT.