

June 20, 1967

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3,325,871

PROCESS FOR COMPACTING FABRIC

Filed March 8, 1965

2 Sheets-Sheet 1

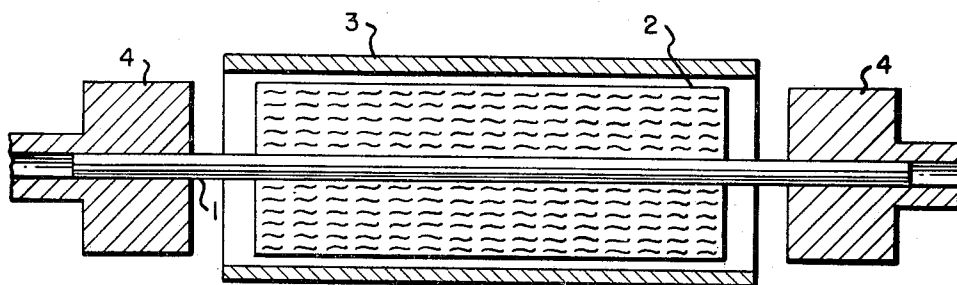


FIG. -1-

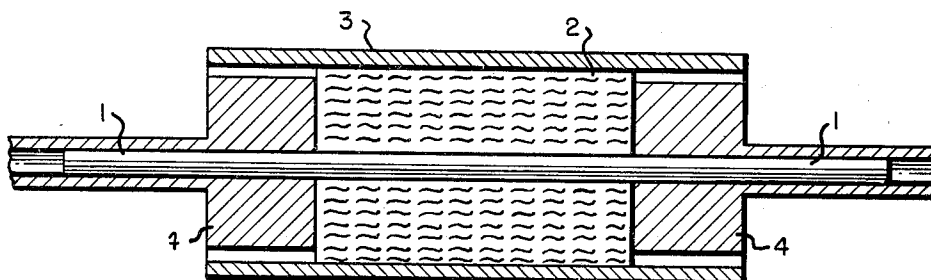


FIG. -2-

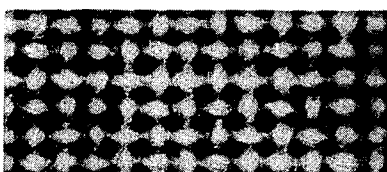


FIG. -3-

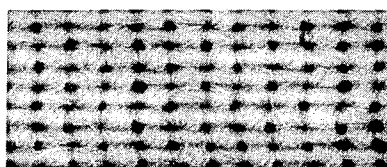


FIG. -4-

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2 Sheets-Sheet 2

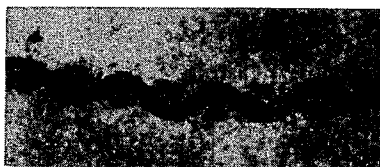


FIG.-5-

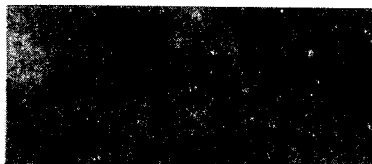


FIG.-6-



FIG.-7-

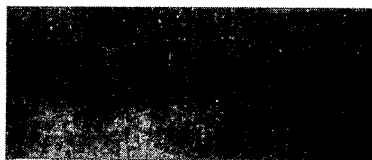


FIG.-8-



FIG.-9-



FIG.-10-



FIG.-11-

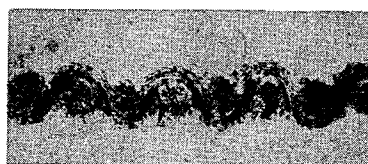


FIG.-12-

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PROCESS FOR COMPACTING FABRIC

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4 Claims. (Cl. 26—18.6)

This invention relates to apparatus for the preparation of stretch fabric and more specifically to apparatus for the preparation of stretch fabric having elastic characteristics in the direction of the fill yarns.

In general, elastic effects are produced in a fabric either by preparing fabrics from elastic yarns or by compacting preformed fabrics prepared from yarns having no prior stretched characteristics. Stretch yarns are commonly prepared by employing an elastomeric component as a core about which non-elastic fibers are spun. A second means for producing stretch yarn is by compacting or crimping the yarns or the filament fibers employed in the preparation of the yarns. Methods which are commonly employed for the preparation of such non-core spun stretch yarns are gear crimping, knit-unknit methods, edge-crimping, belt crimping, blowing methods and twist-set-untwist methods.

While stretch fabrics may be prepared from the stretch yarns produced according to any of the aforementioned processes, great care must be exercised in the preparation of the stretch fabrics to insure that the elastic characteristics of the yarns are not lost in the subsequent knitting or weaving operations.

It is therefore often desirable to produce stretch characteristics in preformed fabrics. Stretch fabrics produced in the piece are now being prepared according to U.S. Patents Nos. 3,077,655; 2,765,513; and 2,765,514. The first of these patented processes involves a combination of factors among which are fabric construction, chemical treatments and mechanical action. In its most general terms the process set forth in U.S. Patent No. 3,077,655 involves the preparation of a loosely constructed fabric from high twist wool yarns, immersion of the fabric in reducing agent followed by agitation of the fabric between vibrating members whereby the fabric is alternately compacted and released thereby permitting the high twist yarns to contract and create a stretch fabric having elastic characteristics in both the warp and fill direction. Another process for the preparation of stretch fabric is embodied in U.S. Patents Nos. 2,765,513 and 2,765,514. The process set forth in these two patents involves the compacting of a fabric in the direction of the warp yarns by the passage of the fabric into a machine consisting of two rolls and a blade. The blade is in close proximity to the upper roll to form a primary feed nip. A fabric entering the apparatus between the blade and a smooth compounded upper roll assumes the speed of that roll. The fabric then passes from this primary nip to a second nip formed by the two rolls themselves. The lower roll possessing a higher coefficient of friction than the top roll and traveling at a slower speed than the top roll takes control of the fabric from the top roll because the fabric is being fed into the apparatus at a faster rate by the first nip and is being taken away at a slower rate. At the second nip the column of fabric supported between the nip is under a state of lateral compression and a fabric having elastic characteristics in the direction of the warp yarn is created.

Stretch fabric developed in the piece according to the methods heretofore known have resulted in a product having a certain degree of stretch. It is found that in general these fabrics are limited to less than 25% extensibility in either the warp direction or the fill direction. The reason for this limited degree of stretch is due to the fact that compacting in the direction of the warp yarns of a pre-

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formed fabric is limited by the fact that the warp yarns in most fabrics are of high twist construction and under tension during weaving operation, both these high twist and high tension characteristics tending to limit the degree to which a fabric may be compacted in the direction of the warp yarns. When a fabric is compacted by relying upon the internal contractions inherent in high twist yarns by subjecting a preformed fabric prepared from high twist yarns to agitation, the yarns themselves will provide a limiting factor to the degree of compaction which may be obtained. A second limiting factor to the degree of stretch obtainable from internal yarn contractions is that the agitated fabric held in an untensioned state will buckle badly if extensive contraction is induced within the yarns.

It is therefore an object of this invention to provide an apparatus which will produce a fabric having stretch characteristics in the fill yarn direction.

It is a further object of this invention to provide an apparatus for the preparation of a fabric having stretch characteristics in the direction of the fill yarns by application of external forces in the direction of the fill yarns.

In accordance with this invention it has now been discovered that it is possible to produce a fabric having stretch characteristics along the direction of the fill yarns by means of a process comprising rolling a fabric, rigidly enclosing the surface of said rolled fabric and then exerting at least one compacting force in a direction parallel to the longitudinal axis of the fabric roll. The compacting force should be sufficient to reduce the fabric width or roll length up to about 50% of its original dimension and preferably a reduction of from about 30% to about 40%. It is preferred that two opposing compacting forces be exerted in directions parallel to the longitudinal axis of the fabric roll. The fabric may be set in a compacted configuration simultaneous to the compacting operation or subsequent to the compacting operation by means of any of the methods well known to the art.

Apparatus suitable for use in conjunction with this invention may be apparatus comprising means for securing a fabric in a rolled configuration, means for enclosing said fabric securing means and at least one pressure exerting member suitable for movement into said fabric enclosing means. It is preferred that two opposing pressure exerting members be employed. Still more preferably the apparatus comprises a shaft for securing a fabric in a rolled configuration, a sleeve member for enclosing said fabric securing shaft and at least one piston member mounted on said shaft in a manner so as to be movable along the longitudinal axis of said shaft.

A better understanding of the invention may be had from a discussion of the drawings in which:

FIGURE 1 is a cross sectional view of the mandrel and sleeve apparatus prior to actuation.

FIGURE 2 is a cross sectional view of the mandrel and sleeve apparatus as actuated.

FIGURE 3 is an enlarged photograph of a polyester worsted fabric prior to compacting by means of external forces.

FIGURE 4 is an enlarged photograph of a polyester worsted fabric subsequent to compacting by means of external forces.

FIGURE 5 is an enlarged (twenty power) cross sectional photograph of the fabric of FIGURE 3.

FIGURE 6 is an enlarged (twenty power) cross sectional photograph of the fabric of FIGURE 4.

FIGURE 7 is an enlarged (fifty power) cross sectional photograph of a cotton fabric prior to compacting.

FIGURE 8 is an enlarged (fifty power) cross sectional photograph of a cotton fabric subsequent to compacting by means of external forces.

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FIGURE 9 is an enlarged (fifty power) cross sectional photograph of a polyester fabric made from filament yarns prior to compacting.

FIGURE 10 is an enlarged (fifty power) cross sectional photograph of a polyester fabric made from filament yarns subsequent to compacting by means of external forces.

FIGURE 11 is an enlarged (fifty power) cross sectional photograph of a polyester/cotton fabric prior to compacting.

FIGURE 12 is an enlarged (fifty power) cross sectional photograph of a polyester/cotton fabric subsequent to compacting by means of external forces.

Turning to FIGURE 1 of the drawings apparatus suitable for carrying out the objects of this invention is illustrated in cross-section. In FIGURE 1 a mandrel 1 is wound with a roll of fabric 2 having the ability to be compacted in the direction of the fill yarns. The fabric wound mandrel 1 is inserted within sleeve member 3. Portions of mandrel 1 which projects beyond the edges of the roll of wound fabric 2 are fitted with piston members 4. In FIGURE 1 piston members 4 are illustrated in their de-actuated position. In order to compact the fabric roll 2 and thereby produce a fabric having stretch characteristics in the direction of the fill yarns the piston members 4 are, as may be seen in FIGURE 2 of the drawings, permitted to converge upon fabric roll 2 by progressing inwardly along mandrel member 1. It should be understood that one of piston members 4 may be allowed to remain stationary, allowing the other piston member 4 to produce a single compacting force. The fabric in its compacted configuration, as illustrated in FIGURE 2 of the drawings may be permanently set by means of any of those fabric setting treatments which are well known to the art. Specific fabric setting treatments which are suitable for purposes of this invention are the use of a reducing agent setting operation for yarns containing keratinous fibers, the use of cross linking agents in the setting of cellulosic type yarn and the use of heat setting means for thermoplastic yarns, the selection for the particular setting medium being employed, depending, of course, on the type of fiber present to the greatest degree in the yarn or the percentage of fibers of a particular nature coupled with the ability of such fibers to obtain a permanent set. Certain of these setting operations lend themselves to being conducted within the sleeve and mandrel assembly. The heat setting operations carried out on thermoplastic yarn containing fabrics is especially suited to being conducted within the sleeve and mandrel assembly. Where, however, a setting operation such as, for instance, the reducing agent setting operation carried out on fabrics containing keratinous fiber yarns is employed, it is desirable to remove the compacted fabric from the sleeve and mandrel assembly and set the reducing agent containing fabric in its compacted configuration by passage through a full decator.

Fabrics which are suitable for compacting according to the process described herein are any fabrics which are prepared with a reeded out construction, that is to say any fabrics which have a construction such as will admit compacting along the direction of the filling yarns. Specific textile materials which may be employed in the construction of such fabrics are any textile materials which will lend themselves to a setting operation subsequent to or simultaneously with a compacting operation. As previously mentioned the setting operation may be any of the setting operations well known to the art such as, for instance, the use of a reducing agent setting operation for yarns containing keratinous fibers, the use of cross-linking agents in the setting of cellulosic type yarn and the use of heat setting mediums for thermoplastic yarns; the selection of the particular setting medium being employed depending, of course, upon the type of fiber present to the greatest degree in the yarn or the percentage of fibers of a particular nature coupled with ability of such fibers to retain a permanent set.

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The yarns employed in the fabrics suitable for compacting according to the process described herein are both high and low twist yarns. It should be understood, however, that the process of this invention lends itself to the preparation of stretch fabrics from fabrics containing yarns of lower twist multiple than may be employed in processes which require internally generated compacting forces. When stretch fabrics are prepared by means of internally generated compacting forces such as in the process described in U.S. Patent No. 3,077,655, worsted wool yarns having at twist multiple in excess of about 2.6 must be employed. When stretch fabrics are prepared according to the process set forth herein, however, worsted wool yarns having a twist multiple of less than about 2.6 may be satisfactorily employed. Correspondingly, low twist woolen system yarns may also be satisfactorily employed, that is to say woolen system yarns having a twist multiple of less than about 8 and preferably from about 5 to about 8 may be employed. Twist multiple is a term common to the textile industry and may be defined as turns per inch divided by the square root of the yarn count.

The following specific examples for the preparation of the stretch fabrics of this invention are given for purposes of illustration and should not be considered as limiting the spirit or scope of this invention:

Example I

An all wool fabric having 35 ends per inch and having a warp and filling yarn count of 4.6 woolen run was passed into a reducing agent bath comprising an aqueous solution of sodium borohydride at a concentration of about 2% by weight. The reducing agent treated fabric is then wound about a mandrel inserted into a sleeve. Piston members riding on said mandrel are then allowed to compact the rolled fabric by pressing on opposite ends of the fabric roll. The fabric is then removed from the sleeve and subjected to a full decating operation while on the same mandrel, the decating operation including a 20 minute aging operation and a temperature of about 280° F. The wool fabric, set in its compacted configuration, is found to have a substantial degree of stretch along the direction of the fill yarns. The stretch fabric is found to have 46 ends per inch.

Example II

A 55% polyester 45% worsted wool fabric having 49 ends per inch and 43 picks per inch and a worsted warp yarn count of 20/1 and a worsted filling yarn count of 20/1 is rolled on a mandrel member and a mandrel member inserted into the sleeve member. The pistons riding on said mandrel member are then caused to exert pressure upon opposite ends of the mandrel wound fabric until the fabric has been compacted to about 60% of the original length of the mandrel wound fabric roll. Simultaneous to the compacting operation the polyester/worsted wool fabric is subjected to a heat setting treatment at temperatures approaching a suitable thermal transition point of the polyester fibers. The compacted and heat set fabric is found to have 40% stretch when subjected to a load of 2 lbs. per inch of the fabric sample with an unrecovered stretch of 3.9% of the unrecovered stretch being reported on the basis of percentage of the original length after being held five minutes at 30% extension and allowed to recover five minutes after unloading.

Example III

A 100% cotton fabric having 76 ends per inch and 70 picks per inch is wound upon a mandrel member, the fabric wound mandrel member then being inserted into a sleeve member. Pistons riding at opposite ends of said mandrel are then allowed to exert a pressure in opposite ends of the fabric rolled about the mandrel. The pressure is such that the fabric roll is compacted to about 65% of its original length. The cotton fabric is then set in a compacted configuration by treatment with a dihydroxy

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dimethylol ethylene urea cross-linking agent. The final product is found to have 35% stretch under a load of two pounds per inch of sample width and to have a 5.6% unrecovered stretch, the unrecovered stretch being reported as percent of original length after being held five minutes at 30% extension and allowed to recover five minutes after unloading.

Example IV

A polyester continuous filament yarn having 144 ends per inch and 100 picks per inch and having a 40 denier yarn count in both the warp and filling directions is subjected to the same processing operation as set forth in Example II. The finished product is found to have 227 ends per inch and 99 picks per inch and to have a 34% stretch at a load of two pounds per inch of sample width with 8.0% unrecovered stretch, the unrecovered stretch being reported as percent of original length after five minutes at 30% extension and allowed to recover five minutes after unloading.

Example V

A 65% polyester 35% cotton fabric having 92 ends per inch and 76 picks per inch and a yarn count (cotton system) of 50/1 in both the warp and filling direction is processed according to the procedure set forth in Example II. The finished product is found to have 121 ends per inch 74 picks per inch and to have a stretch of 35% under a load of two pounds per inch of sample width with an unrecovered stretch of 5.4%. The unrecovered stretch is reported as percent of original length after being held five minutes at 30% extension and allowed to recover five minutes after unloading.

Example VI

A fabric having a fiber content of 65% polyester and 35% cotton and a construction of 87 ends per inch and 67 picks per inch is processed according to the procedure set forth in Example II, the piston induced compaction causing the fabric roll to be compacted to about 60% of its original length. The fabric having a yarn count in the cotton system of 40/1 in both the warp and filling directions is a fabric having 113 ends per inch, 62 picks per inch and a stretch of 42% under a load of two pounds per inch of sample width, the unrecovered stretch being 5.8%. The unrecovered stretch is reported as percent of original length after being held five minutes at 30% extension and allowed to recover five minutes after unloading.

Example VII

A fabric having a fiber content of 65% polyester/35% rayon and having a fabric construction of 64 ends per inch and 60 picks per inch with a yarn count on the cotton system of 20/1 in both the warp and filling direction is processed according to the procedure set forth in Example II. The final product is found to be a fabric having 90 ends per inch, 56 picks per inch and a stretch of 30% a load at two pounds per inch of sample width. The unrecovered stretch is found to be 5.5%, unrecovered stretch being reported as percent of original length after being held five minutes at 30% extension and allowed to recover five minutes after unloading.

The determination of elasticity in the finished product as reported in the foregoing examples was determined by cutting test specimens 2 inches by 24 inches with the longer length being parallel to the stretch direction. The upper end of the test specimen is then secured to a clamp member while the lower end of the test specimen is subjected to a load of four pounds (two pounds per inch). The specimen is then exercised by cycling three

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times between a zero load and a two pound load at approximately five seconds per cycle. The increase in length is then recorded within 30 seconds after the completion of the fourth loading cycle. The increase in length over the initial length multiplied by 100 is then recorded as the percent stretch.

The extent to which a fabric has been compacted and correspondingly given stretch characteristics is readily discernable from a review of FIGURES 3 through 12 which are enlarged photographs of fabrics and fabric cross sections prior to compacting subsequent to compacting operations. The cross sections in each of FIGURES 3 through 12 are cross sections made by cutting through the warp yarns. The increase in both frequency and amplitude of the filling yarns may be seen in each set of fabric cross sections subsequent to compacting. It is important to note that the finished stretch fabric prepared according to the process of this invention may be a fabric having low twist yarns, the low twist yarns, of course, having greater bulk and resulting in a fabric having a superior hand than fabrics prepared from the high twist yarns which are necessary in the preparation of fabrics compacted by internal forces. While the stretch fabrics of this invention may be prepared from either high or low twist yarns, it is an important feature of the present invention that stretch fabrics may be prepared from yarns having insufficient twist to produce internal compacting force.

Having thus disclosed the invention, what is claimed is:

1. A process for the preparation of stretch fabric having elastic characteristics in the direction of the fill yarns comprising the steps of: rolling a fabric having a reeded out construction, rigidly enclosing the surfaces of said rolled fabric, exerting at least one compacting force in a direction parallel to the longitudinal axis of said fabric roll, releasing the compacted fabric from the rigid enclosure and setting the fabric in the compacted configuration.

2. The process of claim 1 wherein two opposing compacting forces are exerted in directions parallel to the longitudinal axis of said fabric roll.

3. The process of claim 2 wherein said compacting force is sufficient to reduce the original length of said rolled fabric by up to about 50%.

4. A process for imparting stretch characteristics to a woven fabric having an open weave adapted to provide clearance between adjacent yarns to accommodate a shrinkage in fabric dimensions along the filling yarns in excess of 25%, said process comprising rolling a fabric having a reeded out construction, rigidly enclosing the surfaces of said rolled fabric, exerting at least one compacting force in a direction parallel to the longitudinal axis of said fabric roll, releasing the compacted fabric from the rigid enclosure and setting said fabric in the compacted configuration.

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ROBERT R. MACKEY, Primary Examiner.