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PROCESS FOR PRODUCING AN ELASTIC FABRIC

Michael Herbert Mainz, Wilmington, Del., assignor to E. I. du Pont de Nemours and Company, Wilmington, Del., a corporation of Delaware

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ABSTRACT OF THE DISCLOSURE

An elastic fabric is made by weaving a fabric using a core-spun spandex/wool yarn and thereafter, in either order, (a) wet-finishing the fabric in the extended state, and (b) stretching and heat-setting the fabric.

This invention relates to the preparation of woven elastic fabrics. More particularly, it relates to the provision of woven elastic fabrics which contain core-spun spandex/wool yarns in at least one fabric direction.

The present invention utilizes, in part, certain general procedures of the prior art for producing wool fabrics. It provides a distinct product improvement, however, by additionally employing a combination of selected processing features. These involve (1) proper fabric construction for good tensile strength, (2) low temperature in wet-finishing in order to preserve fabric strength, (3) heat-setting of the fabric to anneal the spandex component, and (4) an optional resin treatment to improve stretch recovery. The use of these features in conjunction with conventional processing techniques leads to the production of stretch fabrics having a good balance of strength, stretch recovery, and aesthetics. Other advantages of this invention will become apparent hereinafter.

The advantages of this invention are attained by providing in the process of producing an elastic fabric containing core-spun spandex/wool yarn prepared from a tensioned spandex filament and a roving of dyed wool fibers, the improvement which comprises

(1) using a core-spun yarn having a twist multiplier of at least 3 and containing at most about 20% spandex by weight,

(2) weaving said core-spun yarn to form a fabric which is capable of being stretched from about 10% to about 50% in at least one direction, and

(3) thereafter, in either order, (a) wet-finishing said fabric in the extended state at a temperature of at most 71° C. and at a pH of between 1 and 8, and (b) stretching and heatsetting said fabric at a temperature of at least 160° C.

The stretchable fabric of the present invention is one in which the stretch is provided in at least one direction by the suitable interweaving of normally non-stretchable yarns or continuous filaments and stretchable yarns formed of wool fibers spun around a tensioned spandex continuous filament. If the fabric is stretchable in only one direction, the core-spun spandex/wool yarns described hereinafter are woven in the stretch direction (preferably the weft or filling direction), and ordinary wool yarns or nylon yarns or continuous filaments are incorporated in the non-stretch direction (preferably the warp direction). Other synthetic yarns, such as rayon, polyacrylonitrile, and polyethylene terephthalate, may be substituted for or used in addition to the wool or nylon components in the non-stretch direction.

The stretchable fabrics of this invention also include fabrics having two-way stretch. In such fabrics the core-spun spandex/wool yarns are incorporated in one direction, while stretch in the other direction is provided either by the same or similar core-spun spandex/wool yarns or

by other stretch yarns, such as the well-known textured nylon.

Regardless of the choice of fibers, the fabrics of this invention are constructed so that in the unstretched state at least 2.7 oz./yd.^{2} (91.4 g./m.^{2}) of core-spun stretch yarn is contained in the stretch direction and so that the sum of warp yarns per inch and filling yarns per inch of the fabric is in the range from 90 to 170. The fabric is so constructed that it may be stretched from 10% to 50% in at least one direction. Fabrics having a stretch of about 25% are preferred.

The core-spun spandex/wool yarns used in the present invention may be prepared by the general method taught in Humphreys patent U.S. 3,038,295. However, not all of the yarns disclosed in that patent are useful in the present invention. For the present process, the suitable core-spun yarns are those which have a twist multiplier of at least 3.0, as measured in the cotton system. Expressed in units of denier,

$$\text{twist multiplier} = \frac{\text{t.p.i.} \times \sqrt{\text{denier}}}{73}$$

wherein t.p.i. is the twist in turns per inch of the core-spun spandex/wool yarn, and the term "denier" refers to the core-spun yarn in its fully stretched condition. Preferably, the core-spun yarn has a twist multiplier of 3.5 for this invention. The core-spun yarn should contain no more than about 20% of spandex by weight. Moreover for this invention, the wool component of the core-spun yarn must be dyed before the core-spinning operation, that is, the wool is either top dyed or stock dyed.

The term "spandex" is used herein in its well known generic sense to mean a manufactured filament in which at least 85% of the fiber-forming substance is a long-chain, synthetic, segmented polyurethane. As is well known, the segmented polyurethanes are prepared by the reaction of hydroxyl-terminated polyethers and polyesters of relatively low molecular weight, organic polyisocyanates, and polyfunctional, active-hydrogen-containing compounds. The segmented polyurethanes of the spandex type are described in several patents, among which are U.S. 2,929,804, 2,953,839, 2,957,852, 2,962,470,3,009,901, 3,071,557, 3,097,192, 3,154,611, and 3,161,706. Although cross-linked spandex filaments may be used in the process of this invention, the preferred spandex filaments are composed of linear, segmented polyurethanes. Preferably, the spandex filament is finer than about 280 denier. Spandex filaments of about 40 to about 100 denier are particularly preferred for the present process.

In the practice of the present invention, all wet-finishing steps must be carried out at temperatures not exceeding 71° C. It has been found that the fabrics containing spandex/wool yarns are best submitted to aqueous treatments at low temperatures. Above 71° C. there is poor recovery of the mechanical properties of the wool fibers, which properties are impaired during formation of the core-spun yarn. Moreover, aqueous baths above 71° C. may cause the core-spun yarn to be set in a bulked state, thereby leading to low strength of the fabric in the stretch direction. Temperatures of 49° to 60° C. are accordingly preferred.

The fabric may be wet-finished either by scouring or by carbonization. Carbonization is carried out at acid pH, but not less than pH 1. For scouring, the pH of the bath must be adjusted to be in the range from 1 to 8, preferably from 6.5 to 7.5. Moreover, the fabric should be scoured in an extended state, i.e., crabbed, to improve the fabric tensile strength. By the term "extended state" is meant that the fabric is at the open width, that is, it is not folded or allowed to ball up in the bath. The scouring may be conducted under relaxing conditions so that the

fabric is permitted to retract in the direction of stretch, but in any event it is restrained from bulking up. The fabric is not necessarily stretched during the scouring operation, although a taut scour has been found to result in increased tensile strength in the finished fabric.

In the heatsetting step, the fabric is deformed by stretching and is heated in the stretched condition at a temperature of at least 160° C. The heating is continued for a sufficient period that on release of the stretching force after cooling, the fabric will retain a substantial amount of the imposed deformation. The maximum temperature for heatsetting is just below that at which the fabric is thermally damaged. Generally the heatsetting temperature should not exceed 200° C., but preferably it is at least 180° C. Ordinarily, a period of heatsetting from about 30 seconds to about 90 seconds is sufficient for the process of this invention. The stretched fabric should be cooled below 70° C. while maintaining the stretching force before releasing same. The amount of stretch used during heatsetting is determined by the residual elongation desired in the finished fabric.

The heatsetting operation may be carried out either before or after the scouring step described hereinbefore. If heatsetting is carried out after the scouring step or after an operation in which the fabric is wetted, the fabric should be thoroughly dried before exposure to the heatsetting temperature. Any suitable means may be used for heating the elastic fabric. Suitable means include hot gas or liquid, infrared radiation, or other known means which is readily controllable and does not damage the fabric.

An additional step which may optionally constitute part of the present invention involves the use of resins to improve the stretch recovery of the fabrics and minimize "bagging" during wear. The type of resins which may be used for this purpose are those taught by Seltzer U.S. 3,145,132 and consist essentially of thermosetting resins which are normally applied to the fabric by impregnation without essentially altering the outward physical appearance of the fabric. Suitable thermosetting resins for this purpose are triazone, urea-formaldehyde, melamine-formaldehyde, etc. Alternatively, thermoplastic resins, such as the nylon type, may be used in combination with cross-linking reactants, such as epoxy resins, as described in U.S. Patent 3,049,445.

The resins are applied to the elastic fabrics in the present process according to the methods described by Seltzer with the additional proviso that the impregnation is carried out such that the fabric picks up and retains from about 1% to about 5% by weight of the resin based on the fabric weight. Observance of this limitation is necessary in order to obtain an improvement in stretch recovery without sacrificing fabric aesthetics.

The woven elastic fabrics obtained by the process of this invention are useful in making apparel stretch fabrics, particularly slacks and men's suits.

The examples below are given in order to more clearly illustrate the invention. The textiles used in the examples are top-dyed worsted/spandex, 2 x 2 herringbone, suiting fabrics, 5.8 oz./yd.^{2} (196 g./m.^{2}), woven of yarn spun on the worsted system. In weaving the fabrics, 60 warp yarns (2/50 w.c.) per inch (24/cm.) and 68 stretchable filling yarns (1/34 w.c.) per inch (27/cm.) are used at a reeded width of 77.8 inches (197 cm.). The fabrics contain 3.2 oz./yd.^{2} (110 g./m.^{2}) of stretchable yarn in the filling direction. The stretchable filling yarn is a core-spun worsted/spandex yarn containing 5% by weight of spandex core. The core-spun yarn has a twist multiplier of 3.50. The spandex core is a continuous filament of segmented polyurethane prepared according to French Patent 1,388,558 and has a denier of 40.

Example I

An elastic fabric which has a stretch of 20% in the filling direction is given a crabbing scour (pH 8.0) for 11 minutes at about 71° C. The fabric is then dried at 93–121° C. for 30 seconds after which it is heatset on a frame at 78 inches (1.98 m.) for 60 seconds at about 177° C. The heatset fabric is then cooled and given a dry-finishing treatment in the conventional manner.

Example II

An elastic fabric is given a crabbing scour as in Example I. It is then treated with an emulsion of a resin mixture containing 80% nylon (Zytel® 61 polyamide resin) and 20% of the diglycidyl ether of 2,2-bis-(p-hydroxyphenyl)propane ("Epon" 828 polyepoxy resin). The resin mixture is padded on the crabbed fabric at 29° C. from a bath containing 8% resin based on fabric weight. About half of the resin in the bath is picked up by the elastic fabric. The resin-treated fabric is then dried on a frame at 93–121° C. at the wet width and cured at 160–166° C. for 90 seconds. The heatsetting and dry-finishing operations are then carried out as described in Example I. A highly desirable, elastic fabric is obtained.

What is claimed is:

1. In a process for producing an elastic fabric containing core-spun spandex/wool yarn prepared from a tensioned spandex filament and a roving of dyed wool fibers, the improvement which comprises
   (1) using a core-spun yarn having a twist multiplier of at least 3 and containing at most about 20% spandex by weight,
   (2) weaving said core-spun yarn to form a fabric which is capable of being stretched from about 10% to about 50% in at least one direction, and
   (3) thereafter, in either order, (a) wet-finishing said fabric in the extended state at a temperature of at most 71° C. and at a pH of between 1 and 8, and (b) stretching and heatsetting said fabric at a temperature of at least 160° C.

2. Process according to claim 1 wherein the woven fabric in (2) contains at least 2.7 oz./yd.^{2} of core-spun stretch yarn in at least one direction, the sum of warp yarns per inch and filling yarns per inch of the fabric being in the range of 90 to 170.

3. Process according to claim 1 wherein the core-spun yarn in (1) has a twist multiplier of 3.50.

4. Process according to claim 1 wherein the wet-finishing in (3) is accomplished by scouring.

5. Process according to claim 1 wherein (3) additionally includes treatment of the fabric with a thermosetting resin.

References Cited

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3,145,132	8/1964	Seltzer	28—76

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MERVIN STEIN, *Primary Examiner.*

L. RIMRODT, *Assistant Examiner.*