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PROCESS FOR MAKING ELASTIC TEXTILE MATERIALS

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8 Claims. (Cl. 28—72)

The present invention concerns improvements in and relating to elastic textile materials.

It is known that fabrics made from synthetic thermoplastic fibres such as polyamides and polyesters may be set, so as to be dimensionally stable and resistant to area deformation and extensions, by heating the fabrics at tempartures approaching their softening points and subsequently cooling. During this setting treatment, such fabrics shrink both in length and width, unless they are held at their original dimensions on a stenter or similar apparatus. The amount of such shrinkage depends on the chemical constitution of the fibres, the temperature of heat treatment, and its duration. Unset thermoplastic fabric, also fabric set while dimensionally controlled, and fabric allowed to shrink freely during setting all behave similarly when tension is subsequently applied, in that relatively large tensions produce only relatively small extensions.

However, all textile materials possess, to a greater or lesser extent, the property of stretching under applied tension and, provided that a critical value is not exceeded, will revert to their original length on removal of the tension; but the amount of such recoverable stretch is comparatively small, in all normal fabrics.

Fabrics which possess high recoverable stretch or elasticity, as distinct from normal fabrics in which this effect is small, have various uses. They may be used for example as elastic bandages or medical dressings, with or without a medicated surface. Another large field in which they are used is the electrical trade where such fabrics may be used for winding around coils of wire or other electrical components, where their property of conforming to the shape of any particular component enables tight and compact insulation windings to be made. Other uses are for certain parts of clothing which require to fit the body closely such as waistbands and cuffs, and for swimming costumes, all of which require high recoverable stretch.

We have now discovered that synthetic thermoplastic textile materials such as, for example, polyamides, polyaminolactams, polyesters, polyacrylonitrile, polyvinyl or polyvinylidine esters, or co-polymers thereof, after being mechanically shrunk to a length shorter than their normal length, heat-set (by passage through a compressive shrinking machine adapted for use in carrying out the process according to this invention) and allowed to cool, are then elastic, that is they extend relatively easily under relatively low tensions, such as are desirable for the uses mentioned above, and recover to their shrunk length on release of the tension.

According to the present invention, therefore, a process is provided for the manufacture of elastic textile material which comprises mechanically shrinking synthetic thermoplastic textile material in a compressive shrinking machine to a predetermined length shorter than its normal length

and setting the thermoplastic fibres of the material in their altered form by heating and cooling.

When we refer in this specification to the "normal length" of textile material we mean the length it was when in a substantially relaxed state, that is when it is substantially stable to wetting.

The preferred temperatures at which the fibres are set in their altered form are from 250° F. to 400° F. These temperatures compare with the 200° F. used in the normal shrinking process.

The thermoplastic textile material may be in the form of a woven or knitted fabric which consists of or contains thermoplastic fibres or it may be, for example, in the form of yarn.

The material, after being compressively shrunk and heat-set may also, if desired be treated with a varnish and finally baked.

For thus purpose the material after the compressive shrinkage stage, may be given a coat of one of the varnishes customarily employed in the fabric-varnishing trade, which are known as varnishes with linseed oil base, and then subjected to a drying or baking operation at an elevated temperature appropriate to the type of material treated after the application of each coat. If desired or necessary the fabric may be given more than one treatment with the varnish and be subjected to the elevated temperature after each treatment. The customary method of treating textile materials with varnish is to dip the material into the varnish at the bottom of a tower or flue which may be about 45 feet high and heated by circulating air at the appropriate temperature. After being dipped the fabric travels slowly up and down the tower in a single run.

The preferred machine for producing materials requiring maximum elastic properties such as clothing fabrics is that described in U.S. patent specification No. 2,263,712 which incorporates an adjustable "Confining Passage" in the shrinking zone, although the machine described in U.S. patent specification No. 2,021,975 employing a contracting surface is particularly effective on materials requiring greater resistance to extension, such as materials used for insulation fabrics. Other known compressive shrinking machines employing a contracting surface, such as those described in British patent specifications Nos. 359,759, 371,976, 372,803 and 400,950 may also be used. The subject matter of the last three British patents appears to be combined in U.S. Patent No. 2,021,975.

When a thermoplastic fabric is treated according to the invention, the shrinkage can be controlled so that it may be considerable in the warp direction and may, for instance, be as much as 25% more than the normal potential shrinkage of that fabric. The treated fabrics of synthetic thermoplastic fibres differ from those produced by well-known heat-setting means allowing free shrinkage in that they extend relatively easily in the warp direction under relatively low tensions and recover to their compressively shrunk length on release of the tension. Even in the case of materials treated according to the invention they will only revert to their original compressively shrunk length on removal of the tension if the elastic limit has not been exceeded.

The elastic properties of textile materials treated according to the invention are resistant to normal washing, i.e. domestic or laundry washing.

It is believed that the extensibility and elasticity imparted to the material is produced by allowing the material sufficient freedom to form fine crimps in the fibres. In the case of fabrics these fine crimps are mainly in the warpwise direction. These effects are produced by the use, for instance, of an adjustable confining passage

during warpwise compression in one preferred form of shrinking machine or by the use of a compressive shrinking machine incorporating a contracting rubber base which is soft enough to produce the desired effect, but not so soft that buckling or creasing occurs in the material. The hardness of the rubber base that is preferred is about 35/40 degrees (Shore type durometer), against a hardness of about 60 degrees used for the normal shrinking of ordinary fabric. The desired latitude to allow fine crimping in the shrinking apparatus may also be obtained in some degree by processing the fabric plyed with a backing cloth soft enough to produce the desired fine crimp.

In general, the temperatures required to produce this effect of elasticity and extensibility approximate to those normally accepted as necessary for the heat-setting of the various synthetic fibres mentioned above. The degree of elasticity, that is to say the amount by which the treated material will stretch and recover under comparatively low warp tension, may be controlled by varying the amount of shrinkage imparted to the fabric in the compressive shrinking machine and by adjustment of the confining passage surfaces in the shrinking zone of the preferred form of machine described in U.S. patent specification No. 2,263,712. The degree of elasticity may also be controlled by the adjustment of the temperature used, since heat facilitates softening of the thermoplastic fibres and therefore the crimping so as to obtain the desired elastic effect. Clearly, however, the temperature must not be such that the fibres will fuse. There is an optimum temperature, depending on the material, at which the elasticity imparted by the process is at its maximum. Above this temperature the amount of permanent set increases and thus decreases the elasticity.

While we prefer to apply the compressive shrinking operation and heat treatment simultaneously, the effects obtained according to this invention may be produced by separate application of the compressive shrinking operation and heat treatment but preferably in that order.

The material may be dyed, printed, or submitted to any of the customary textile processes before, during or after treatment by the present invention.

The present invention is mainly concerned with the production of elastic fabrics but it includes the production of elastic yarns or threads. These may be produced, for instance, by treating yarns of thermoplastic fibres from a warp beam. Another method of obtaining such elastic yarns is to weave a fabric having a thermoplastic warp but with weft threads capable of complete removal by a solvent or other chemical agent which does not affect the warp threads. The removable weft thread may be for example an alginate thread. Crimped and elastic yarn is thereby obtained which may then be wound up into a warp beam, and later woven or knitted into fabrics or garments by well-known methods. These fabrics or garments will then have elastic properties both warpwise and weftwise.

As examples of the effect obtained by the process of this invention we may cite firstly a polyester fabric, such as polyethylene terephthalate which is sold under the trade name "Terylene" in Great Britain and "Dacron" in the United States and the following figures in Table I show that whereas the treated fabric shows an extension of 25% with 100% recovery when a load equivalent to 0.8% of its breaking load is applied the untreated fabric shows no extension at all under the same load. Secondly we may cite a fabric such as nylon and the following figures in Table II show that whereas the treated fabric shows an extension of 12½% with 100% recovery when a load equivalent to 0.57% of its breaking load is applied the untreated fabric shows no extension at all under the same load.

TABLE I

"Terylene" fabric—4 ozs. per sq. yard suitable for clothing fabric or insulation cloth

Ref.	Machine Temp., ° F.	Compressive Shrinkage Imparted, percent	Load applied on a 2" wide strip, lbs.	Extension under load, percent	Elastic Recovery, percent	Breaking load on a 2" wide strip, lbs.
Fabric treated according to invention	350	38	2	25	100	250
Untreated			2	Nil	Nil	250

TABLE II

Nylon fabric.—4 ozs. per sq. yard suitable for clothing fabric or insulation cloth

Ref.	Machine Temp., ° F.	Compressive Shrinkage Imparted, percent	Load applied on a 2" wide strip, lbs.	Extension under load, percent	Elastic Recovery, percent	Breaking load on a 2" wide strip, lbs.
Fabric treated according to invention	400	20	2	12½	100	350
Untreated			2	Nil	Nil	350

The above Tables I and II show the remarkable difference in extensibility and elasticity between a treated and an untreated "Terylene" or nylon fabric. The following Tables III and IV show the degree of control obtainable on two weights of fabric by varying the temperature. As the temperature is raised so the amount of permanent set is increased with a consequent drop in elasticity. The figures in these tables apply to the fabric before treatment with a varnish having linseed oil base in the manner described above. Naturally before being used as insulation fabric they would be treated with the varnish.

TABLE III

Terylene fabric.—1 oz. per square yard suitable for insulation fabric

Ref.	Machine Temp., ° F.	Compressive Shrinkage imparted, percent	Load applied on 4" wide strip, lbs.	Extension under load, percent		Elastic, Recovery, percent	
				Treated	Untreated	Treated	Untreated
A	250	16	5	6	Nil	100	Nil
B	220	16	3½	6	Nil	100	Nil
C	200	16	2	6	Nil	100	Nil

NOTE.—It will be seen that fabrics "B and C" extend the same amount as fabric "A" but with less load.

TABLE IV

"Terylene" fabric.—2½ ozs. per square yard suitable for insulating fabric

Ref.	Machine Temp., ° F.	Compressive Shrinkage imparted, percent	Load applied on 4" wide strip, lbs.	Extension under load, percent		Elastic, Recovery, percent	
				Treated	Untreated	Treated	Untreated
D	250	18	5	7	Nil	100	Nil
E	220	18	3	7	Nil	100	Nil
F	200	18	2	7	Nil	100	Nil

NOTE.—It will be seen that fabrics "E" and "F" extend the same amount as fabric "D" but with less load.

Each of the fabrics referred to in Tables 1 to 4 were compressively shrunk in the compressive shrinking ma-

chine described in U.S. patent specification No. 2,263,712 which incorporates an adjustable confining passage in the shrinking zone.

This application is a division of Serial No. 454,620, filed September 7, 1954, and now abandoned.

We claim:

1. The process for imparting elastic characteristics to a textile material containing a plurality of synthetic thermoplastic fibres to permit said material to be stretched and to also recover completely, consisting of the steps of (1) mechanically shrinking said material to a length shorter than the normal length of said material, (2) subjecting said material to heat sufficient to set the material in its shrunken condition but insufficient to render said thermoplastic material tacky, and (3) allowing said material to cool, the fibres of said material being crimped and retaining their original freedom of movement relative to each other.

2. Process as claimed in claim 1 in which the temperature to which the material is heated so as to set the fibres in their shrunken form is from 250° F. to 400° F.

3. Process as claimed in claim 1 in which the textile material is fabric containing strands of synthetic thermoplastic fibres.

4. Process as claimed in claim 1 in which the textile material is fabric consisting of thermoplastic fibres.

5. Process as claimed in claim 4 in which the thermoplastic fibres are synthetic linear superpolyamide fibres.

6. Process as claimed in claim 4 in which the thermoplastic fibres are polyethylene terephthalate fibers.

7. Process as claimed in claim 1 in which the textile material, after being shrunk, heat set and cooled, is treated with a varnish and then subjected to an elevated temperature until said varnish is dry.

8. Process as claimed in claim 7 in which the varnish is a varnish with linseed oil base.

References Cited in the file of this patent

UNITED STATES PATENTS

2,319,809	Francis	May 25, 1943
2,400,182	Whitman	May 14, 1946
2,565,152	Wachter et al.	Aug. 21, 1951
2,574,200	Teague	Nov. 6, 1951
2,588,624	Evans	Mar. 11, 1952