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TEXTILE MATERIALS AND METHOD OF MAKING SAME

Eric E. Weiss, White Plains, N. Y., assignor to United Merchants & Manufacturers Inc., Wilmington, Del., a corporation of Delaware

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This invention relates to textile materials and fabrics in general, and more particularly to fabrics or materials used for apparel, such as, for example, shirts, dresses, pajamas, blouses or the like.

The present application is a continuation in part of co-pending application Serial Number 652,563, filed March 7, 1946, and of U. S. Patent No. 2,433,722, granted December 30, 1947.

The invention relates to synthetic textiles and has for an object the elimination of some of the more common deficiencies found in synthetic fabrics under the conditions and requirements of ordinary uses. These deficiencies are normal to most fields of wearing apparel, and are particularly notable in men's shirts, pajamas, blouses, sportswear, children's wear and other articles of apparel.

It has long been recognized that a fabric used for the purposes mentioned should be made of so-called "spun yarn." These spun yarns are composed of short fibers of a predetermined length, uniform or not uniform—such as cotton, wool, etc., in the case of natural fibers, or such as spun rayon, spun acetate, etc., in the case of synthetic fibers.

Moreover, many of the cotton yarn fabrics ordinarily employed in such apparel have left much to be desired from the standpoint of appearance and hand as compared with fabrics made from spun yarn of synthetic fibers. The synthetic yarn fabrics possess a most desirable subdued and rich lustre and are more luxurious and soft in hand.

Many worsted yarn fabrics composed in whole or in major part of wool are also used for apparel. While these fabrics possess desirable hand, lustre and softness, they have the disadvantage of high cost. Furthermore, they cannot readily be laundered. By their very nature, they must be subjected to special finishing processes, at least initially, to obtain the desired appearance and hand. In the hands of the wearer or consumer, almost inevitably this type of fabric must be dry cleaned and cannot be laundered.

Synthetic yarns are produced in two different physical forms. In the fiber state they are commonly spun into yarn by the varied processes of carding, combing, drafting and spinning. These are therefore known as spun yarns. The other form normally is known as continuous filament

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yarn. These are produced by means of chemicals and by a continuous extrusion process of combining fine filaments into a unitary continuous thread or yarn. Spun yarns, due to their nature, i. e., being composed of short fibers, are considerably inferior in strength to yarns of the continuous filament type. Conversely, yarns made of continuous filament fibers are inherently stronger. Heretofore, many attempts have been made to make fabric exclusively from continuous filament yarns; and not withstanding the fact that large sums have been expended to design, develop and promote the same, they remain for the most part undesirable from the standpoint of appearance and for other reasons. Usually such fabrics have a definitely objectionable high and cheap looking sheen. They do not show the roundness of thread or the depth of fabric made from yarns composed of spun fibers.

Generally it is recognized that in the field of apparel, fabrics should be washable and should, at the same time, retain stability. However, synthetic fabrics, when subjected to laundering, very often do not retain the original dimensions of the garments as manufactured. This condition or requirement for dimensional stability is of considerable importance, especially where, as is usually the case, any extended or repeated use of the garment is intended. Therefore, for many years those skilled in the art have attempted to produce synthetic materials possessing this very desirable and, in fact, essential quality of dimensional stability.

Fabrics made from yarns of synthetic fibers lose a considerable portion of their original tensile strength when subjected to moisture, in comparison to cotton fabrics of substantially similar weight and construction. They begin by having a lower tensile strength in the dry state, and ordinarily will be about 50% of their normal dry strength in the wet state. When subjected to normal body moisture, especially during the summer months, such fabrics may rip or tear under the strain of ordinary wear; thus rendering the garments unfit for further use. Furthermore, it is common knowledge that synthetic fabrics intended to replace high cost worsted fabrics normally utilized in the apparel field have the deficiencies commonly associated with such worsted fabrics, i. e., the necessity for dry cleaning and

the lack of dimensional stability, especially when fabrics of this type are subjected to laundering.

The present invention, therefore, contemplates the production of synthetic yarns, fabrics and materials having the features normally associated with fabrics made exclusively or nearly so from spun yarn; such as a rich, subdued lustre and a luxurious soft hand and touch, although made in part from continuous filament yarns. Another object is to produce synthetic yarns, fabrics and textile materials having the desirable properties of fabrics made of spun yarn, but characterized by high wet and dry tensile strength and dimensional stability.

The invention further proposes a synthetic fabric of substantially equal or greater strength than a fabric of comparable weight made of cotton. A further object is the manufacture of synthetic fabrics or articles of apparel which the consumer or wearer may satisfactorily launder without the necessity of dry cleaning. Another object is the manufacture of synthetic piece goods such as, for example, a material of unusual wearability and high screening power, having the soft hand characteristic of high grade mousseline fabrics. In the finished product or article, such material has the appearance of a fabric made wholly from spun yarns, even though comprised at least in part of continuous filament yarns. It is, however, dimensionally stable, stronger and altogether more serviceable than spun yarn material.

With the above and other objects in view, as will be apparent, the present invention contemplates the manufacture or production of yarns, fabrics and textile materials characterized by high wet and dry strength and dimensional stability. For the yarns, it proposes the composite association of a continuous filament core with a drafted wrapping of fibers. The material forming the core may be a polyamide continuous filament such as, for example, nylon, or "vinyon" or a copolymer of vinyl chloride and vinyl acetate. Prior to associating or combining the core with the wrapper, such core is preferably thread sized with polyvinyl alcohol, gelatin, or other suitable sizing material to impart flexibility and strength thereto.

The wrapper element of the composite yarn may be one or more rovings of textile fibers such as spun rayon, spun acetate, or cotton, wool or natural fibers or blends thereof. Following the sizing of the core, the wrapper and the core components may then be made up into a composite yarn by means of conventional drafting and spinning apparatus. Thereafter a second sizing may be applied to at least some of such composite yarns by means of slashing. If it is desired to fabricate woven piece goods as the finished product, ordinarily no sizing is applied to those composite yarns intended for the weft in the weaving operations. The composite yarns intended for the warp, however, are normally sized prior to weaving. To that end, the several composite yarns required for the warp are run through a slashing machine. Thus, in a preferred form of the present invention, two separate and distinct sizings may be applied to the core elements of the composite yarns intended for the warp, while only one sizing is applied to the wrapper components. On the other hand, with respect to those composite yarns intended for the weft, the core elements thereof receive only one sizing, and the wrapper components may remain unsized. The several yarns may then be fabricated into textile material.

Among others, one feature of the invention resides in the coaction between the core and wrapping components, upon setting or stabilizing the products composed of such special composite yarns. This setting or stabilizing of the product may be done by means of steam or boiling water. The setting can be effected by different processes that subject the textile product to varying degrees of moisture, heat, pressure and time. These factors will vary, of course, with the type of textile fabric which is to be processed and will depend further upon the desired finished quality. In some cases the simple and inexpensive method of subjecting the textile material to the action of water at boiling temperatures for periods of from about ½ an hour to an hour will give the desired results. In other cases saturated steam is used, as described and claimed in U. S. Patent No. 2,433,722 granted Dec. 30, 1947 and heretofore mentioned herein. As the result of such setting treatments, the spun fibers lock themselves around and conform themselves to the contours of the core of nylon or Vinyon thus inhibiting any tendency of the composite yarn to unravel—or slippage of the spun fibers relative to the continuous filament core component, thereby enhancing and improving the wearing qualities of such fabrics or materials.

As will be understood, since the core of the composite yarn of the present invention is formed of thermoplastic material, after setting the yarn will be dimensionally stable and not subject to shrinkage or sag as is so characteristic of fabrics made from only spun yarns. Furthermore, textile material made from such composite yarns will have a much higher wet and dry strength than textiles made solely from spun yarns. Manifestly, in the setting operation the continuous filament core may be shrunk or preshrunk by means of such setting treatments, thereby to set the continuous filament element in a fixed position. As a result, despite the spun fiber element, which would normally tend to produce a fabric of inferior stability, the composite yarns, fabrics and materials made therefrom are dimensionally stable and are not subject to any substantial sagging or stretch. They are washable and can be dry cleaned. By means of the setting operation, the thermoplastic core coacts with the wrapping of roving to form an interlocking engagement therebetween; thus resulting in the formation of a product of unusual strength and dimensional stability.

Furthermore, the amount or degree of setting employed for the composite yarn of the present invention may vary extensively, especially in proportion to the relative percentage content of the core element. Depending upon the percentage content of the core with relation to the total weight of the fabric, the amount of setting may be varied, in direct proportion to the percentage weight of nylon or Vinyon in the composite yarn. Heat setting is the preferred method. However, other methods of stabilizing or setting the core or the wrapper or both may be employed, as will be hereinafter described.

It is to be understood, however, that whatever method of setting is employed—a soft, flexible yarn and fabric are desired. To that end, the invention, as stated, contemplates and proposes an interlocking engagement between the core and wrapper elements of the composite yarn, or a mechanical conformation therebetween. It does not contemplate any bonding, fusing or permanent adhesion of these several components relative to

each other; nor a bonding, fusing or permanent adhesion of the individual yarns to each other in the finished fabric or article.

Where water is employed to set, as previously mentioned, the temperature thereof may be about 212° F. However, the range of temperatures is not considered critical except that the temperature should not be so high as to render the thermoplastic core of nylon or a copolymer of vinyl chloride and vinyl acetate such as "vinyon" tacky or cementitious or adhesive—so as to adhere or adhesively unite the core to the wrapper component. The use of higher ranges would tend to result in a fabric characterized by stiffness or brittleness and a corresponding lack of flexibility, together with a lack of porosity, by reason of the cement-like bond or permanent adhesion thereby effected between the several elements in the composite yarn and between the several yarns fabricated into the finished article.

The present invention, however, avoids the disadvantages enumerated by employing in the setting operation a temperature control such as will prevent tackiness of the core element and any permanent bond, fusion or adhesive union thereof with the wrapper component of the composite yarn, and any such fusing, bonding or adhesive uniting of the several composite yarns in the fabric. The temperatures used and applied in the instant invention are such that there is produced no more than an interlocking relationship between core and wrapper—as distinguished from a fusion, bonding or permanent adhesion: so that these two elements mechanically conform in complementary contour. As a result, the present yarn, fabric and material are flexible, porous and have a soft wool-like hand, as heretofore described and hereinafter claimed.

After heating setting the material as described, the goods may be scoured and dyed. Then the material is preferably subjected to a second and successive setting operation, wherein the individual yarns thereof and especially the wrapper components are further stabilized or set. For example, after the dyeing step is completed, the goods may be run through a bath containing from about 30% to about 50% caustic soda concentration at about 100° F., followed by neutralization The material is then given a boil-off, which is followed by drying. It is to be noted that the second and successive setting or stabilization just described may also be effected prior to the dyeing step. However, as stated, it is preferred to so treat the goods after dyeing: and it has been found that better results ensue if this second or later setting is done subsequent to dyeing.

In a preferred embodiment, the present invention utilizes a continuous nylon filament core yarn of the order of from 20 to 75 denier, preferably within the range from 30 to 70 denier and most desirably about 30 denier. The number of turns per inch of core may vary from 7 to 25. In practice, however, it has been found that a range of the order from 7 to 10 turns per inch is preferred. 7 turns per inch may be considered most satisfactory. The covering or wrapper component of the present invention, as distinguished from the continuous filament core thereof, may be one or more rovings of rayon, acetate or other suitable fiber material having an average length of from about 1⅛" to about 3". In practice it has been found that the preferred range would run from 1½" to 2½". The thickness of this spun wrapper component, explained in terms of

hanks, should be within a range of from about 4 to 8 hanks, a preferred construction being of the order of from 6 to 6½ hanks.

As will be understood, one or more of such spun rovings are introduced into a spinning frame and submitted to the usual drafting operations. The continuous filament component, which should be finer than the roving and which ultimately will form the core, thereby substantially reinforcing the inherently weak spun yarn, is introduced at the same time in such a manner that it escapes the attenuating action of the drafting rolls and coacts with the roving to form the composite yarn of the present invention.

Any suitable number of turns per inch may be employed when the spun rovings are combined with the coacting continuous filament core. For example, a range of from 14 to 25 turns has been found practical and successful; and from 16 to 17 turns per inch is considered especially suitable.

Furthermore, the relative percentage of spun fiber wrapper content with respect to the total percentage of the composite yarn may be varied, as may be found desirable, from about 60% to 85%, thus leaving the continuous filament core element of the yarn a relatively minor portion of the composite yarn considered as a whole.

As will hereinafter appear, a series of tests or experiments has been made for the purpose of determining the relative merits and effectiveness of various yarns of specific and definite construction. All of these yarns embody the principles of the present invention. The relative strength or effectiveness of each yarn is indicated by its resistance to abrasion expressed in terms of the number of strokes or rubs of a reed device that the yarn can resist before breaking down or unraveling. In the tests so conducted, it was found that a very satisfactory specific composite yarn construction was, for the core component, a 30 denier 7 turn continuous filament nylon yarn, comprising 21.6% of the whole. For the spun fiber component, 2 ends of 6.5 hank spun rayon roving were used, constituting the balance of 79.4% of the composite yarn. The size of this composite yarn expressed in terms of hanks per pound was 36.5. When tested for resistance to abrasion, this particular construction showed a figure of 58 as the number of strokes or rubs with a reed device such a yarn can resist before breaking down. Based on present experience, an abrasive resistance of about 50 or more strokes gives the composite yarns very satisfactory performance strength.

It would appear from the experiments that any yarn made according to the present invention having a composite yarn size no finer than 40 hanks per pound and with a percentage of spun fiber of at least 50% would be satisfactory. The denier size of the continuous filament core yarn will depend, of course, upon the composite yarn size desired, with the heavier denier being used for the coarser composite yarn. From 70 denier down to 20 denier is considered a satisfactory range for the continuous filament core. However, it is possible to use a much heavier continuous filament yarn if a coarse, very strong composite yarn is desired and if the end use of such composite yarn would warrant the high cost involved.

The following table illustrates the results obtained in making composite yarns embodying the principles of the present invention, as heretofore indicated and described:

Table of examples

Experiment No.	Core Yarn Den./Fil. t.p.i.	Hank Roving	Composite Size Cotton Count	Per Cent of Spun Fiber	Abrasion No. of Strokes
1	70/23/7	2 ends of 4 hk	20.8	72.8	106
2	60/20/1	do	21.8	74.4	84
3	60/20/10	do	22.5	74.8	101
4	40/13/7	do	25.4	80.7	61
5	60/20/10	1 end of 3 hk	28.5	67.8	61
6	20/7/12	2 ends of 4 hk	20.5	88.8	53
7	40/13/7	1 end of 3 hk	30.1	77.4	56
8	30/10/7	2 ends of 6.5 hk	36.5	79.4	58
9	60/20/10	1 end of 4 hk	36.8	48.4	30
10	40/13/7	do	41.3	68.7	29
11	30/10/7	1 end of 6.5 hk	59.5	66.7	16

Although continuous filament nylon and "vinyon" have been cited herein as examples of thermoplastic materials particularly adaptable for use as the core of a composite yarn of the present invention, it will be understood that other polyamide synthetic yarns or other synthetic thermoplastic continuous filament yarns may be employed. Although spun rayon fibers are preferred as the wrapping material, such spun rayon fibers may be blended with or replaced by fibers composed of cellulose acetate or other synthetic fibers or by cotton, wool or other natural fibers.

It is also to be noted that instead of using caustic soda as above described to complete the setting of fabrics, piece goods or materials produced according to the present invention, other methods for completing stabilization thereof may be employed. For example, the goods may be padded through a solution of glyoxal and an acid catalyst. Another suitable method is by the application to the goods of synthetic resins of the thermosetting type such as, for example, urea formaldehyde or melamine formaldehyde resins in the presence of a catalyst. In such thermosetting applications, as will be understood, after depositing the resin containing a suitable catalyst on the fibers of the goods, heat is applied to polymerize or insolubilize the resin in situ. Other alkalies may be used such as ammonia and, less preferably, emulsions of plastic materials such as vinyl resins, vinylidine resins, styrene resins, and ethyl cellulose emulsions, soya bean protein, or casein, or a synthetic or natural latex emulsion.

Furthermore, it is to be noted that another method of partially or initially stabilizing fabrics or materials made according to the present invention is by setting the same with dry heat as, for example, by running the goods through a calender or over heated drums or rollers. This method or process of obtaining an initial stabilization or a partial setting of the fabrics is considered less preferable, however, to the methods previously described herein of setting such as by steam or boiling water. In setting by dry heat, particular care must be taken to avoid the application of heat to a degree which would cause substantial damage or injury or impairment to the goods. In any event and whatever the method of setting employed, the objects of the present invention contemplate that there will be no permanent adhesion, union or fusion between the individual fibers making up the composite yarns of the material or between the several yarns thereof with respect to each other.

The term "dyeing," as used herein, is intended to include any operation or series of operations by means of which textile material is processed into any desired shade. The term "staple fibers" as used above and in the claims hereafter, is intended to include discontinuous natural or synthetic fibers of any predetermined length, as for examples, spun rayon, spun acetate, cotton fibers, wool fibers and other natural or synthetic fibers or blends and mixtures thereof.

What is claimed is:

1. Method of manufacturing textile materials which includes the steps of spinning composite yarns, each made of a core portion of continuous filament thermoplastic material and a wrapper portion of synthetic fibers for each core, fabricating the yarns into textile materials, partially setting the same in boiling water while preventing any permanent adhesion between the thermoplastic core and the synthetic wrapper, processing the materials into the desired shade, and then completing the setting by applying thereto a synthetic resin of the thermosetting type in the presence of a catalyst.

2. Method of manufacturing textile materials including the steps of spinning composite yarns, each made of a core portion of thread sized continuous filament thermoplastic material and a wrapper portion for each core of synthetic fibers, fabricating the yarns into textile materials, partially setting the same in boiling water while preventing any permanent adhesion between the thermoplastic core and the synthetic wrapper, processing the materials into the desired shade, and then completing the setting by applying thereto a synthetic resin of the thermosetting type in the presence of a catalyst.

3. Method of manufacturing textile materials which includes the steps of spinning a plurality of composite yarns made of a core portion of thermoplastic material associated with a wrapper of synthetic fibers, fabricating the yarns into textile materials and then successively setting the same in boiling water while preventing any permanent adhesion between the thermoplastic core and the synthetic fibers, processing the materials into the desired shade, and then completing the setting by applying thereto a synthetic resin of the thermosetting type in the presence of a catalyst.

4. Method of manufacturing textile materials which includes the steps of spinning a plurality of composite yarns made of a core portion of thermoplastic material and a wrapper of staple fibers, fabricating the yarns into textile material and setting the same while preventing any permanent adhesion between the several yarn elements by first partially setting the goods with heat and subsequently completing the setting by subjecting the same to the action of an amide formaldehyde condensation product.

5. Method of making textile material which includes the steps of spinning composite yarns made of a core portion of thermoplastic material and a wrapper of staple fibers, fabricating the yarns into textile material and stabilizing the same while preventing any permanent adhesion between the core and wrapper elements by par-

tially setting the textile material in boiling water and subsequently completing the setting by applying thereto a synthetic resin of the thermosetting type in the presence of a catalyst.

6. Method of making textile material which includes the steps of spinning composite yarns having a core portion of a thermoplastic material and a wrapper portion containing natural fibers, fabricating the composite yarns into textile material and stabilizing the same while preventing any permanent adhesion between the core and wrapper portions by first partially setting the textile material in boiling water, and subsequently processing the materials into the desired shade and completing the setting by applying thereto a synthetic resin of the thermosetting type in the presence of a catalyst.

7. Method of manufacturing textile material which includes the steps of spinning composite yarns, each made of a core of thermoplastic material and a wrapper of staple fibers, fabricating the yarns into textile material, partially setting said material in boiling water while preventing any permanent adhesion between the core and wrapper, processing the material into the desired shade, and completing the setting by the application of a urea formaldehyde condensation product in the presence of a catalyst.

8. Method of manufacuring textile materials including the steps of spinning composite yarns, each having a core portion of continuous filament thermoplastic material and a wrapper of staple fibers, fabricating the yarns into textile material, and stabilizing the same while preventing any permanent adhesion between the core and wrapper elements, by preliminarily setting the textile material in boiling water, processing the material into the desired shade and completing the setting by applying thereto a melamine formaldehyde condensation product in the presence of a catalyst.

9. Method of stabilizing textile material made of composite yarns having a continuous filament thermoplastic core and a wrapper of staple fibers which includes the steps of partially setting the

material by means of dry heat and subsequently completing the setting by applying thereto a synthetic resin of the thermosetting type in the presence of a catalyst, while preventing any permanent adhesion between the core and the wrapper components.

10. Method of stabilizing textile material containing composite yarns having a continuous filament thermoplastic core and a wrapper of staple fibers which includes the steps of partially setting the material by means of heat and subsequently completing the setting by subjecting the same to the action of an amide formaldehyde condensation product, while preventing any permanent adhesion between the core and wrapper.

11. Method of stabilizing textile material containing composite yarns having a continuous filament thermoplastic core and a wrapper of staple fibers, which includes the steps of partially setting the same by means of steam and subsequently completing the setting by subjecting the same to the action of an amide formaldehyde condensation product, while preventing any permanent adhesion between the core and wrapper components.

12. A new article of manufacture comprising textile material made according to the method of claim 10.

ERIC E. WEISS.

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