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METHOD OF MAKING STABLE DETWISTED YARNS AND FABRICS COMPRISING THE SAME

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This invention relates to the manufacture of yarns having little or no twist therein, and capable of withstanding the stresses and strains incidental to the manufacture of fabrics without loss of continuity of the yarn structure.

Yarns, and especially yarns comprising short or staple fibers, normally do not have sufficient strength to permit of their being converted to a fabric, unless they are first given a high twist, to insure coherence of the fibers, and fabricated in the twisted condition. The yarns fabricated, as by weaving or the like from the twisted yarns, are characterized by a somewhat harsh feel or hand, and low bulk or covering power.

The object of the present invention is to provide low twist or twistless yarns which are stabilized in the low twist or twistless condition, and which can be converted to a fabric without loss of continuity of the yarn structure as such, and occur in the fabric form in the low twist or twistless state. In accordance with the invention, yarns, including slivers, which have been given a twist as a step in their manufacture, are provided with a continuous, hard or firm, but flexible or plastic, protective or supporting film which serves to hold the fibers in the coherent state resulting from the twisting, and are then detwisted to remove all or part of the twist to produce a yarn consisting of detwisted fibers and the continuous hard, but flexible, protective film.

For the successful performance of the method of this invention, twisted yarns must be provided with a continuous protective film of a substance conforming to certain rigid minimum requirements. Thus, an essential requirement is that the film must consist of a substance which is stable under normal temperature and humidity conditions for indefinite periods, to permit storage of the detwisted yarns in the interim between their production and their conversion to a fabric, without deterioration or embrittlement of the film. Further, the film must consist of a substance the viscosity of which is such that during the impregnating or treating step, the impregnant is readily distributed evenly over the entire surface of the yarn and penetrates all of the fibers uniformly. Another requirement is that the film formed on the twisted yarns must have sufficient strength to withstand the working to which it is inevitably subjected during the detwisting step, as well as the tensions encountered during winding, weaving, etc., and at the same time, the film, while being hard and solid, must have a high degree of flexibility or plasticity to permit movement of the fibers relative to each other to facilitate high speed detwisting operations. A further requirement is that the film must consist of a substance which is capable of withstanding exposure to high relative humidity. In addition, the protective or supporting film must consist of a substance which is readily soluble in aqueous media at temperatures well below the temperatures at which the fibers comprising the yarns are damaged.

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I have found that there are a number of substances which meet the foregoing requirements, and which may be broadly defined as organic filament-forming polyhydroxy compounds which are soluble in water or weakly alkaline aqueous solutions. Such compounds which are suitable for use for the purposes of this invention are, for example, polyvinyl alcohol, hydroxy-ethyl cellulose, sodium and calcium alginates, and water soluble alkyl ethers of cellulose generally. Of the substances mentioned, polyvinyl alcohol is preferred since I have found that it has properties and characteristics which render it particularly suitable for use for the present purposes. An outstanding advantage of polyvinyl alcohol is that, at high humidities, such as generally prevail in spinning rooms, it becomes highly elastic and rubbery, which makes it possible to detwist yarns carrying a continuous film of the polyvinyl alcohol at extremely high speeds, at high relative humidities, without breaking or cracking of the film. The flexibility of the polyvinyl alcohol film may be controlled or regulated by the addition of small amounts of an assistant such as glycerol to the impregnating bath. Polyvinyl alcohol is prepared commercially by saponification of polyvinyl acetate and may contain a higher or lower proportion of residual acetate groups. For the present purposes, a polyvinyl alcohol resulting from the substantially complete deacetylation of polyvinyl acetate, and soluble in water at room temperature, is preferred.

In carrying out the invention, the twisted yarn, in any suitable wound package form, such as cheeses, cops, skeins, etc., or as a running length, is treated with a solution of the selected organic filament-forming polyhydroxy compound in a suitable solvent, which may be either plain water or a weakly alkaline aqueous solution, depending upon the particular polyhydroxy compound employed, and which, in the case of polyvinyl alcohol, more particularly, may also contain a small proportion of a substance such as glycerol which assists in controlling the flexibility of the film deposited on the yarns. Preferably, impregnating solutions containing the filament-forming

polyhydroxy compound in concentrations of from about 4 to 8% are employed. Excess impregnating solution is removed, and the impregnated yarns are then treated to effect hardening of the filament-forming polyhydroxy compound carried thereby. This hardening may be effected by exposing the yarns to drying temperature if desired. However, it is preferred to effect the hardening by treating the impregnated yarns with a hardening liquid. For example, yarns carrying polyvinyl alcohol may be treated with acetone to effect hardening of the polyvinyl alcohol which occurs on the yarns in the form of a continuous hard but flexible film.

The twisted yarns carrying the continuous protective or supporting film of the hardened filament-forming polyhydroxy compound may be taken to the creel of a ring spinning frame and back twisted and wound up on a bobbin, this being accomplished by carrying out the known movements of spinning, except that the direction of the twist is opposite to the direction of the twist initially put in the yarns prior to their impregnation. The twist initially imparted to the yarns may be taken out to any desired number of turns per inch, that is the magnitude of the reverse twist may be equal to or less than the magnitude of the twist initially put in the yarns.

The detwisted yarns carrying the continuous unbroken film of the hardened filament-forming polyhydroxy compound may be converted to a fabric according to any of the customary textile working processes, for example the yarns may be used as the warp or filling, or as the warp and filling, of a woven fabric. After the fabrication, the fabric is washed with water or aqueous media containing a mild alkali, whereby the film of the filament-forming polyhydroxy compound is removed to leave the detwisted yarns in situ in the fabric. In the case of polyvinyl alcohol, for example, the film is removed by washing the fabric with cold water. Water is also used as the film-removing wash liquor when the film comprises an alkyl ether of cellulose, whereas weakly alkaline solutions, such as an aqueous solution of sodium carbonate, are used for removing films comprising sodium or calcium alginate.

Removal of the protective film of the filament-forming polyhydroxy compound from the yarns in situ in the fabric has the effect of increasing the cross-sectional area of the yarns, and this tends to "open up" the fabric structure. The fabrics comprising the detwisted yarns are characterized by a soft hand or feel, high thermal insulating power, and increased voluminosity and covering power, and at the same time are light in weight. When the detwisted fibers comprise a hydrophilic material such as regenerated cellulose, they undergo maximum swelling in situ in the fabric, in the presence of moisture, by virtue of their low twist or twistless condition. As a result of such swelling, the interstices between the yarns are filled in, whereby the fabric is rendered wind and water-proof.

Since modifications and variations may be made in practicing the invention as specifically illustrated and described herein, it will be understood that the invention is not to be limited except as defined in the appended claims.

I claim:

1. The method of making a coherent yarn having low to zero twist from a relatively highly twisted yarn which comprises passing the relatively highly twisted yarn through an aqueous solution containing 4 to 8% of an organic film-forming polyhydroxy compound selected from the group consisting of a polyvinyl alcohol which is soluble in water at room temperature, hydroxyethyl cellulose, sodium alginate, calcium alginate and water-soluble alkyl ethers of cellulose, drying the polyhydroxy compound on the yarn to provide the yarn with a continuous, firm and flexible, plastic coating film of the polyhydroxy compound, then placing the treated yarn in a high humidity atmosphere, and removing at least some of the twist from the yarn while in said high humidity atmosphere whereby the film of the polyhydroxy compound remains in continuous condition on the yarn throughout the detwisting operation.

2. The method of making a coherent yarn having low to zero twist from a relatively highly twisted yarn which comprises passing the relatively highly twisted yarn through an aqueous solution containing a small proportion of glycerine and 4 to 8% of an organic film-forming polyhydroxy compound selected from the group consisting of a polyvinyl alcohol which is soluble in water at room temperature, hydroxyethyl cellulose, sodium alginate, calcium alginate and water-soluble alkyl ethers of cellulose, drying the polyhydroxy compound on the yarn to provide the yarn with a continuous, firm and flexible, plastic coating film of the polyhydroxy compound containing glycerine, then placing the treated yarn in a high humidity atmosphere, and removing at least some of the twist from the yarn while in said high humidity atmosphere whereby the film of the polyhydroxy compound containing glycerine remains in continuous condition on the yarn throughout the detwisting operation.

3. The method of making a coherent yarn having low to zero twist from a relatively highly twisted yarn which comprises passing the relatively highly twisted yarn through an aqueous solution containing 4 to 8% of a polyvinyl alcohol which is soluble in water at room temperature, drying the yarn thus treated and then treating it with acetone to provide the yarn with a continuous, firm and flexible, plastic coating film of the polyvinyl alcohol, then placing the treated yarn in a high humidity atmosphere, and removing at least some of the twist from the yarn while in a high humidity atmosphere whereby the film of the polyhydroxy compound remains in continuous, unsoftened firm and flexible condition on the yarn throughout the detwisting operation.

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