Patented Nov. 16, 1937 2,098,980

UNITED STATES PATENT OFFICE

2,098,980

YARN MANUFACTURE

Percy Frederick Combe Sowter, Spondon, near Derby, England, assignor to Celanese Corporation of America, a corporation of Delaware

No Drawing. Application January 14, 1933, Serial No. 651,847. In Great Britain February 5, 1932

6 Claims. (Cl. 19—1)

This invention relates to the manufacture of yarns, and particularly yarns of cellulose acetate or other organic derivatives of cellulose, having the appearance of spun yarn or yarn made from staple fibre, and also relates to fabrics made therefrom.

In the manufacture of spun yarn from artificial fibres the usual practice is to cut the continuous artificial filaments or waste filaments into comparatively short lengths, for example of 1½ to 2 inches or more, and then to subject the staple fibres thus produced to a series of operations appropriate to the length of the fibre, such operations being similar to those accorded to natural fibres, such as cotton or wool, including opening, carding, drawing and spinning. These operations, while presenting comparatively little difficulty in the case of the cellulosic type of fibre, which, as is well known, is produced exclusively by wet spinning processes and is not susceptible to electrification, are somewhat tedious and difficult in the case of cellulose acetate and similar yarns which are usually produced by the dry spinning operations, and which are liable, particularly on the carding machines and in the light twisting and drawing of the slivers, to acquire a degree of electrification which considerably impedes the said operations.

The present invention aims to produce a "spun yarn", and especially a spun yarn of cellulose acetate or other organic derivative of cellulose, whilst avoiding the said disadvantages. According to the present invention during or subsequent to the spinning or extrusion of the filaments to form a yarn of continuous filaments the materials are subjected to a stretch while in a softened state so as to break the continuity of one or more filaments, but not all the filaments associated in the bundle, so that the resulting yarn has a number of broken ends which give it when twisted, and particularly when doubled with a number of such bundles, the appearance of a spun yarn.

I find that the best means of achieving this object is to stretch the yarn subsequent to the manufacture of the yarn and with or without previous twisting and to stretch it to a point at which the main filament bundle does not break but individual filaments thereof are broken. If such a yarn is twisted or if a number of similar yarns are doubled together a product having the appearance of a spun fibre is very readily produced. In order to have as many broken ends as possible in the whole filament bundle consistent with a yarn of moderate denier, it is desirable to effect a very considerable stretching of the filament bundles, so that reduction in denier takes place and, when a number of the filament bundles is subsequently doubled to produce the yarn, the latter has not an unduly high denier. The stretching operation may take place for example while the yarn is in hank form or while it is travelling from point to point, as for example from bobbin to bobbin or from any other yarn package to a winding device, and also from a spinning machine to a winding device. If desired a sheet of associated filaments, as for example in a warp or a warp formation, may be stretched simultaneously so as to bring about the desired breakage of some of the individual filaments and a number of such bundles, for example 5 to 10 or more, may be associated continuously with the stretching operation and twisted to produce the spun yarn directly.

The stretching may be carried out by passage of the filaments in substantially non-slipping contact with two or more rollers rotating at different peripheral speeds.

As previously stated it is desirable to reduce the denier of the initial filament bundles as much as possible. This may be achieved by applying a relatively high stretching treatment and suitably softening the filaments so that breakage only takes place after a relatively high stretch, such as 300 to 500% on the initial length of the filaments. Thus for instance in the case of threads of acetone-soluble cellulose acetate a soaking in 40–50% dioxane, or an equivalent concentration of diacetone alcohol, ethyl lactate, glycol monoacetate, methyl glycol monoacetate or the like, may take place and the filament bundle then stretched to 300–500% or until a sufficient number of filaments have been broken.

The stretching to the breaking point of some of the filaments may take place as described above continuously with the production of the filaments and also even during their manufacture. For example in a dry spinning operation the stretch imparted by the customary feed roller may be sufficiently high to produce the requisite number of breakages. In such case it is desirable to adopt means, for example a suction at the point of exit of the filaments, so as to carry the broken ends along with the main yarn. Similarly in wet spinning operations the stretch may be such as to break some filaments of the filament bundle during the actual formation in the coagulating bath. For suitable coagulating baths designed to produce filament bundles of low total denier reference is made to U. S, appli-

cations S. Nos. 402,785 filed October 26th, 1929, 418,414 filed January 3rd, 1930, 437,423 filed March 20th, 1930, 469,622 filed July 21st, 1930, 573,421 filed November 6th, 1931, 589,428 filed January 28th, 1932 and 607,668 filed April 26th, 1932. It is only necessary to supply sufficient stretching by the usual feed roller or other stretching device to produce an elongation greater than the filaments will withstand having regard to the amount of plasticity induced by the coagulating bath. In wet spinning operations the body of liquid carried by the main yarn is usually capable of carrying the broken ends, so that no special means need be adopted to achieve this object.

Breakage of the filaments results in a number of filament ends projecting from the yarn. If considerable hairiness of this character is not desired, twisting may serve to bind the ends as far as possible in the yarn. If desired the yarn may be treated, as for example by passage between or over brushes or between rollers, so as to lay the ends substantially in the direction of the length of the yarn to facilitate twisting-in of the ends. The yarn may be subjected to a gassing operation to remove superfluous projecting filaments.

While a number of specific methods of introducing discontinuities in the individual filaments have been described above, the invention envisages the broad principle of introducing such discontinuities by stretching softened yarn to an extent such that individual filaments are broken while the continuity of the yarn as a whole is preserved. As already indicated the invention is of most practical importance in relation to the production of "spun yarns" of cellulose acetate or other organic esters, ethers, mixed esters or ethers or ether-esters of cellulose, for instance cellulose formate, cellulose propionate and cellulose butyrate, nitro-acetate and methyl, ethyl and benzyl cellulose.

Yarns having broken filaments, produced as described above, may be doubled with any type of yarn of a similar or dissimilar nature, whether as regards type of constituent filaments or fibres, continuous or discontinuous, or as regards the substance constituting the filaments or fibres. Two or more broken filament yarns may be doubled together for the purpose of increasing the denier and/or improving the regularity or for any other purpose, such as the production of a yarn having differential dyeing properties.

The basic yarn may be of high, medium or low lustre, the lustre being modified for example by incorporation of pigments, by treatment with boiling soap or other aqueous liquors or by any other method, and similarly the lustre of yarns doubled therewith may be either that normal to the fibre in question or may be suitably modified. Association of lustrous and non-lustrous yarns or filaments may take place before or after breaking of constituent filaments.

The yarns may be subjected to any desired after-treatment to modify their properties or appearance, e. g. they may be treated with shrinking agents in order to improve their extension or other properties or for the production of effects, in which connection reference is made broadly to the processes described in U. S. applications S. Nos. 611,240 filed May 13th, 1932, 607,667 filed April 26th, 1932 and 609,255 filed May 4th, 1932.

The yarns or mixed yarns of the invention may be woven, knitted or otherwise made up into fabrics consisting solely of the said yarns or containing them in admixture with other yarns. For example, the yarns may be introduced into the weft or warp or both to produce a woven fabric having the appearance of one constituted wholly of staple fibre yarn or having pattern effects with or without differential lustre. Similarly, knitted fabrics of all kinds may contain the yarns either as effect yarns or as the sole or principal constituent of the fabrics.

The following examples are given in order to illustrate the invention but it is to be clearly understood that they do not limit it in any way:—

Example 1

A cellulose acetate yarn of 1000 denier, 104 filaments and 1 turn per inch twist, is run at a rate of 2 metres per minute take up speed through a bath of 40 to 48% dioxane in water at 22° C. between rollers about 10 feet apart which impart a stretch of from 2½ to 3:1. Under these conditions the yarn does not break completely but single filaments rupture so that the whole, on drying and release of tension, presents a hairy and wooly appearance and gives when twisted up a semi-lustrous yarn resembling "staple fibre" yarn. The yarn may be dried without washing.

Example 2

A similar yarn to that employed in the above example is run at a rate of 2 metres per minute take up speed through a bath of 30% aqueous acetic acid at 25° C. between rollers 10 feet apart which impart a stretch of 2 to 1. The filaments in this condition are readily broken and further hairiness may, if desired, be produced by passing the whole over a roughened surface or edge during washing or drying. The yarn is washed in cold water and when twisted has a matt appearance.

Example 3

A cellulose acetate yarn of 750 denier, 150 filaments is run through a bath of 40 to 48% dioxane in water at 22° C. between rollers which are 100 feet apart and driven to impart a stretch of from 3 to 4:1. The stretching roller is driven at 25 metres per minute and either it has a slipping drive or alternatively the yarn is allowed to slip on it so that total breakage does not occur, but individual filaments are ruptured. The total stretch is less than the ratio of the circumferential velocities of the supply and take-up rollers by about 25%. The yarn is then passed over a roughened surface to fray out the broken filaments and collected with washing in a Topham box running at 5,000 revolutions per minute and putting in a twist of 8 turns per inch.

Example 4

A 25% solution of cellulose acetate is extruded through a spinning jet having 26 holes of .08 mm. diameter into an aqueous bath containing 40–45% diacetone alcohol. The filaments are passed round a draw roller and then round a second roller rotating at a higher peripheral speed so as to impart a stretch such that breakage of the individual filaments occurs, e. g. 400–500%, and are then collected with washing in a Topham box.

What I claim and desire to secure by Letters Patent is:—

1. Process for the manufacture of imitation spun yarn, which comprises softening the whole of a bundle of filaments having a basis of an organic derivative of cellulose and stretching the softened bundle of filaments while in transit to

such an extent that individual filaments are broken while the bundle still contains long lengths of unbroken filaments.

2. Process according to claim 1, wherein the bundle of filaments is softened to such an extent that it is necessary to stretch the bundle to a high degree to obtain the desired number of individual broken filaments.

3. Process for the manufacture of imitation spun yarn, which comprises softening the whole of a bundle of filaments having a basis of cellulose acetate, stretching the softened bundle of filaments while in transit to such an extent that individual filaments are broken while the bundle still contains long lengths of unbroken filaments, and twisting the bundle while in a softened condition.

4. Process according to claim 3, wherein the bundle of filaments is softened to such an extent that it is necessary to stretch the bundle to at least 300% of its original length to obtain the desired number of individual broken filaments.

5. Process for the manufacture of imitation spun yarn, which comprises softening the whole of a bundle of filaments having a basis of an organic derivative of cellulose, stretching the softened bundle of filaments while in transit to such an extent that individual filaments are broken while the bundle still contains long lengths of unbroken filaments, and subjecting the yarn containing the broken filaments to a shrinking operation.

6. An imitation spun yarn which contains broken filaments having a basis of cellulose acetate and long lengths of unbroken filaments having a basis of cellulose acetate.

PERCY FREDERICK COMBE SOWTER.