

Dec. 2, 1941.

W. I. TAYLOR ET AL

2,264,415

MANUFACTURE OF ARTIFICIAL FILAMENTS, YARNS, AND SIMILAR MATERIALS

Filed Feb. 23, 1938

FIG. 1

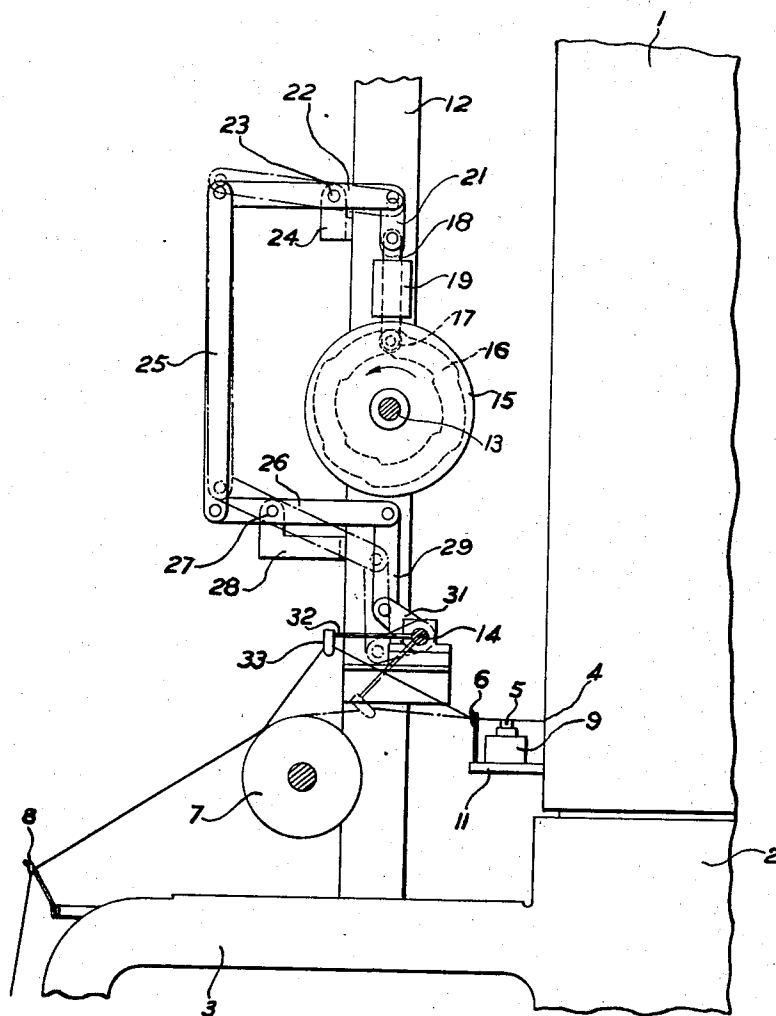
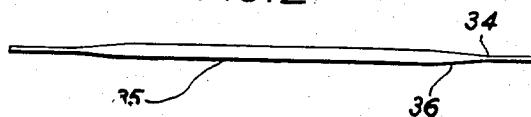


FIG. 2



WILLIAM I TAYLOR
LESLIE B. GIBBINS
INVENTORS

J. Seltzer & Co.
ATTORNEYS

UNITED STATES PATENT OFFICE

2,264,415

MANUFACTURE OF ARTIFICIAL FILAMENTS,
YARNS, AND SIMILAR MATERIALS

William Ivan Taylor and Leslie Brisbane Gibbins,
Spondon, near Derby, England, assignors to
Celanese Corporation of America, a corporation
of Delaware

Application February 23, 1938, Serial No. 191,949
In Great Britain March 19, 1937

6 Claims. (Cl. 18—54)

This invention relates to improvements in the manufacture of artificial materials, and particularly to improvements in the manufacture of artificial filaments and similar materials made of organic derivatives of cellulose.

It has been discovered that artificial filaments and similar materials having a basis of an organic derivative of cellulose and of flat cross-section and varying denier along their length are very valuable for the production of crinkled products and that they may also be employed in the production of fabrics showing special effects. Both the materials of flat cross-section and varying denier and also the crinkled products obtained therefrom are novel and form part of the invention.

The filaments and similar materials of flat cross-section and of varying denier made of cellulose acetate or other organic derivative of cellulose may be produced by spinning filaments of flat cross-section and stretching them to a varying extent in a regular or irregular manner either during the course of their production or in an after-treatment operation. The term "flat cross-section" is employed in the sense which it usually has in the art, as differentiating from the bulbous type of filaments which are considered preferable for most purposes.

The production of filaments of flat cross-section may be effected by the use of a spinning solution containing an organic derivative of cellulose in a concentration lower than that yielding filaments of a bulbous cross-section, for example in the case of a solution of cellulose acetate in acetone in a concentration of below about 24%, for example 20%, and particularly about 22 to 23%. Filaments of flat cross-section may also be obtained by spinning a solution of an organic derivative of cellulose which contains paradi-chlor-benzene or other suitable plasticiser therefor as described in U. S. application S. No. 83,274 filed June 3, 1936.

The production of filaments of varying denier may be effected by means of the apparatus illustrated in the accompanying drawing, wherein

Fig. 1 is a view of a part of a spinning cabinet and stretching device, and

Fig. 2 is a plan view of a length of yarn produced by the device shown in Fig. 1.

A spinning cabinet 1 of any suitable design which is equipped with any desired number of spinning jets, ducts for supplying and withdrawing evaporative atmosphere, guides, and heating or cooling elements, rests on a suitable base 2 having a forwardly projecting platform 3. For each spinning jet or series of spinning jets con-

tained in the spinning cabinet or metier there is provided in the side wall thereof a port 4 through which the yarn is drawn as it is being formed.

In spinning, the thread leaves the spinning cabinet or metier at the port 4, crosses a wick 5 through a guide 6 around a drawing roll 7, then through a guide 8 and on to a take-up package (not shown). The wick 5 supplies to the yarn any suitable material such as lubricants, conditioning agents and the like which are contained in a receptacle 9 which rests on a shelf 11 attached to the cabinet.

At the end of the spinning cabinet or metier there is an upright frame member 12 having journaled therein shafts 13 and 14. Mounted on shaft 13 is a multi-lift cam 15 provided with a cam groove 16. In the cam groove 16 is a cam follower 17 journaled in a suitable connecting rod 18 which is mounted for reciprocal movement in a bearing 19.

The connecting rod 18 is pivotally connected to a connecting link 21, which connecting link is pivoted at its other end on a lever arm 22. The lever arm 22 is pivoted on the support 23 and pivotally connected by a link 25 to a second lever arm 26 which is pivoted on a support 27 mounted in a bracket 28 attached to the upright member 12. The lever arm 26 is pivotally attached by a connecting link 29 to a crank 31. The crank 31 is fixedly connected to the shaft 14. At intervals along the shaft 14, which intervals correspond to the ports 4 of the spinning cabinet or metier, are mounted arms 32, each of which is provided with a head 33, to which is attached a porcelain or metallic thread guide through which the thread is adapted to pass.

In operation of the device, the filaments formed by extruding the spinning solution through jets are threaded through the cabinet port 4 across the wick 5, guide 6, the guide in the head 33 around the drawing or feed roll 7 and guide 8 to the take-up package. At the same time as the yarns or thread are being drawn from the spinning jets by means of the roll 7, the shaft 13, driven by any suitable source of power, is rotated in a counter-clockwise direction as indicated by the arrow on the drawing. The rotation of the cam, through the lever arrangement raises and lowers the arm 32 such that, although the roll 7 rotates at a constant speed, the yarn is drawn at varying linear speeds from the jets in the cabinet. To produce a yarn as shown in Fig. 2, having a small denier portion 34 and a large denier portion 35 and having a relatively

abrupt change between the two, as shown at 36, the cam 15 is so shaped that the arm 32 is slowly raised and then allowed to drop abruptly. By this means there is a short interval of time in which the feed roll 7 is exerting no drawing action on the filaments issuing from the jets. This interruption of the drawing action of the feed roller 7 produces a thick slub on each filament and as soon as the feed roll 7 takes up the slack produced by the dropping of the arm 32, the feed roll 7 again commences drawing the filaments from the jets, thus again reducing their denier.

The spacing of the swells and depressions in the cam may be of any suitable arrangement such that there are produced slubs of equal length or slubs of varying length, or such that there is varying intervals between the slubs. Furthermore, the shaft 13 may be rotated by means of elliptical gears or sets of cone pulleys having a reciprocating drive belt from one to the other or other means such that the shaft 13 rotates at a constantly or an irregularly varying speed so as to produce slubs on the yarn at irregular intervals.

Filaments may also be stretched by means of a similar device during their travel through a stretch-assisting medium, which may be a solution of an organic liquid, e. g. dioxane, acetone or methylene ethylene ether in aqueous solution, or wet steam or hot water at a temperature above 100° C., as described, for example, in Patents Nos. 2,142,721, 2,142,722 and 2,142,909.

As stated above the flat filaments of varying cross-section are of particular value as starting materials for the production of crinkled filaments. The crinkling may be effected by subjecting the filaments to treatment with hot aqueous media, for example wet steam, and particularly hot aqueous liquors, while they are free to contract. The hot aqueous liquor may, for example, be at a temperature of 80 or 90° C. up to 100° C., or even more if the operation is carried out under pressure, and may contain a wetting agent, for example a water-soluble soap or a sulphonated oil, for example Turkey red oil or the oil sold under the registered trade-mark "Monopol" soap, or other sulphonated higher aliphatic compound, for example a sulphonated higher fatty acid or a sulphonated higher fatty alcohol, or true sulphonic acids of the higher members of the aliphatic series, or salts thereof. The treatment may, for example, be carried out at the boil for 2-4 hours in water containing a small proportion of wetting agent, e. g. .1 or 1%. Preferably after the treatment the filaments are given a final wash off, for instance in warm or hot water, and this washing off may be repeated several times. Treatment with the hot aqueous media gives particularly valuable products when the filaments treated contain para-dichlor-benzene or other plasticiser as described in U. S. application S. No. 83,274 filed June 3, 1936 (Patent No. 2,216,810). A treatment with a hot aqueous liquor may be sufficient to eliminate or substantially eliminate the plasticiser.

The filaments are preferably treated in the form of hanks, which should be loose so that the filaments are free to crinkle and contract. They may be suspended on canes or other supports in a hot aqueous medium and may be moved round from time to time, for example every 5, 10 or 15 minutes, so that the point of support is changed periodically. Alternatively, the supports may be rotated by mechanical means.

The treatment with a hot aqueous medium

may be controlled so as to modify the lustre of the final product. Thus a treatment of cellulose acetate filaments with a boiling soap solution as described above produces a substantial reduction in lustre, while a similar treatment with boiling water produces a smaller reduction in lustre. If desired salts or sugars may be added to an aqueous liquor, for example in a concentration of 10 or 20% so as to reduce the loss in lustre occasioned by the hot aqueous treatment. Thus, for example a liquor containing up to 10% of sodium chloride or up to 20% of sodium sulphate may be employed to obtain a product which has a good lustre and, at the same time, is well crinkled. For further information relating to the use of salts and sugars to preserve lustre reference is made to U. S. Patents Nos. 1,765,581 and 1,808,061.

If the lustre is required to be reduced still further the process may be combined with a special delustring treatment, for example by incorporating white pigments into the materials either during the spinning process or by an after-treatment.

The crinkling process with hot aqueous media may be combined with other crinkling processes in order to increase the crinkle still further. Thus, for example, filaments may be crinkled by imparting a twist to a yarn and setting it while the yarn is travelling and subsequently removing twist from the yarn as described in U. S. application S. No. 106,590 filed October 20, 1936, and Patents Nos. 2,089,198 and 2,089,199. Preferably this operation is carried out before subjecting the filaments to the treatment with a hot aqueous medium.

The materials treated according to the present invention may either be continuous filaments or be short lengths of filaments in the form of staple fibres or spun yarn, and the term "filaments" as employed in the present specification is, where the context permits, to be understood to include filamentary materials whatever their length. Spun yarns may be produced either by cutting continuous filaments into suitable lengths and subsequently spinning the cut filaments or by direct conversion processes such as are described in U. S. Patents Nos. 2,077,078 and 2,077,079. When a spun yarn product is required the conversion of continuous filamentary materials into spun yarn may be effected during the crinkling process, for example between an operation in which twist is set in the travelling yarn and subsequently removed and an operation in which the yarn is treated with an aqueous medium, or after completion of the crinkling operation or operations. Further, when at an intermediate stage of the conversion to spun yarn the material exists in the form of staple fibres, the treatment with a hot aqueous medium may be applied to the materials in this form before they are spun into a yarn.

Finished yarns produced according to the process of the present invention may consist of a single end or of a number of ends doubled together, the constituent yarns of the doubled yarn being yarns of low twist and the doubling twist being preferably in the reverse direction to the twist in the individual yarns. The production of doubled yarns may actually take place during a twisting, setting and untwisting operation when this operation is performed. For example a number of yarns, say two or three yarns, each having a low twist, may be fed into a device for inserting a relatively high degree of twist, the high degree of twist set, and then

the doubled yarn untwisted and finally left in a state in which it contains a small degree of reverse doubling twist. It is of considerable advantage to have the product in this state of a yarn doubled with a light doubling twist reverse in direction to the small degree of twist of the constituent yarns at the time the product is subjected to the treatment with the hot aqueous medium.

By a light twist is meant a twist of not more than 5 turns per inch. A doubled yarn of the character referred to may be built up, for example, by taking a number of single yarns, each having say 0 or up to 1 or 2 turns per inch, and doubling them together with a doubling twist of two turns per inch in the reverse direction to any initial twist in the singles. Again, where a product of very heavy denier is required, two doubling operations may be employed. Thus, a number of single yarns each having 1 turn per inch or less may be doubled together with a doubling twist of 1 turn per inch in the same direction, and a number of yarns so doubled together with a doubling twist of 2 turns per inch in the reverse direction.

The finished yarns may be of a low, medium or high denier, for example of 150, 300, 450 denier or more, and as stated above may contain one or more ends. Thus, for example, a 450 denier yarn may consist of one end or of three ends of 150 denier.

The material constituting the flat filaments of variable denier may be cellulose acetate or any other organic derivative of cellulose, for example cellulose formate, propionate or butyrate, or other organic ester or mixed ester of cellulose, or ethyl or benzyl cellulose or other cellulose ether or mixed ether of cellulose or a mixed ether-ester of cellulose. Yarns may also contain other filamentary materials, for example wool or cotton fibres, natural silk filaments, filaments of regenerated cellulose or the like, and when spun yarns are produced continuous filament constituents may be converted into staple fibre at the same time as the organic derivative of cellulose constituents. Further, when staple fibre is produced by means of a cutting device an additional yarn may be doubled with the product delivered from the cutting device. Thus a continuous filament yarn which is light in denier as compared with the denier of the bundle or bundles to be cut may be fed to rollers designed to draw the yarn to be cut between the cutting and presser surfaces, so as to proceed with the bundle or bundles of cut filaments to a twisting device in which both the yarn containing staple fibre and the additional yarn are doubled together.

The following examples illustrate the invention, but are not to be regarded as limiting it:

Example 1

A 22.5% solution of cellulose acetate in acetone is extruded into a dry spinning cell through which air at a temperature of 70 to 80° C. is passed, and the filaments are withdrawn from the cell and stretched by the device illustrated in the accompanying drawing.

Example 2

A solution containing about 27% of cellulose

acetate in acetone to which is added a proportion of about 20% of paradichlor-benzene based on the weight of the cellulose acetate, is dry spun and stretched as described in the previous example.

The filaments obtained according to each of the preceding examples have a denier which varies along their length.

Example 3

The yarn obtained according to either of the preceding examples is crinkled by treating it in hank form on slowly rotating rollers for 2 to 3 hours in a boiling aqueous bath containing about 0.1% of a soap.

Having described our invention, what we desire to secure by Letters Patent is:

1. Process for the production of crinkled filaments, yarns and similar materials, which comprises subjecting filaments, yarns and similar materials having a basis of an organic derivative of cellulose and of flat cross-section and a denier which varies along their length to treatment with hot aqueous media while they are free to contract.

2. Process for the production of crinkled filaments, yarns and similar materials, which comprises subjecting filaments, yarns and similar materials having a basis of cellulose acetate and of flat cross-section and a denier which varies along their length to treatment with hot aqueous media while they are free to contract.

3. Process for the production of crinkled filaments, yarns and similar materials, which comprises spinning artificial filaments, yarns and similar materials having a basis of cellulose acetate and of flat cross-section, stretching them to a varying extent so that products having a denier which varies along their length are obtained and subjecting the products to treatment with a hot aqueous medium while they are free to contract.

4. Process for the production of crinkled filaments, yarns and similar materials, which comprises spinning artificial filaments, yarns and similar materials having a basis of an organic derivative of cellulose and of flat cross-section, stretching them to a varying extent so that products having a denier which varies along their length are obtained and subjecting the products to treatment with a hot dilute aqueous solution of a wetting agent while they are free to contract.

5. Process for the production of crinkled filaments, yarns and similar materials, which comprises spinning artificial filaments, yarns and similar materials having a basis of an organic derivative of cellulose and of flat cross-section, stretching them to a varying extent so that products having a denier which varies along their length are obtained and subjecting the products for 2 to 4 hours to treatment with an aqueous liquid which is at a temperature of at least 90° C. while they are free to contract.

6. Process for the production of crinkled filaments, yarns and similar materials, which comprises subjecting filaments, yarns and similar materials having a basis of an organic derivative of cellulose and of flat cross-section and a denier which varies along their length to treatment while in hank form with hot aqueous media while they are free to contract.

WILLIAM IVAN TAYLOR.
LESLIE BRISBANE GIBBINS.