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FILAMENT AND THREAD TREATMENT

John L. Bitter, Elizabethton, Tenn., assignor to
North American Rayon Corporation, a corporation of Delaware

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My present invention has to do with a new and novel method for producing first quality artificial filaments.

More especially, my invention concerns a method for producing artificial filaments possessing even dyeing properties.

The objects of the present method will become apparent from a reading of the following specification and claims.

10 In the manufacture of artificial filaments, so-called "rayon", from cellulosic solutions, a solution of cellulose is extruded or spun through minute orifices into a coagulating, precipitating or hardening medium.

15 The following discussion is given with particular reference to the viscose process, but I do not wish to have my invention limited to this process, otherwise than in the manner set forth in the accompanying claims.

20 In one method of producing viscose filaments, the cellulosic solution is extruded into a coagulating or spinning bath, and then collected upon foraminous or perforated spools or bobbins.

The filaments wound upon these spools are then after-treated, i. e. deacidified, desulphurized, bleached, washed, etc., and then dried. When rigid spools are used, it has been found that dyeing differences exist between those filaments on the inside of the spools and those on the outside. Hitherto it has been suspected that this was due to the fact that the innermost layers of the filaments are not allowed to contract as are the outermost layers, and that the dyeing differences were therefore attributable to unevenness of shrinkage of spooled yarn upon drying. This theory was formerly held to be sound, more especially, because yarn spun upon the so-called collapsible spools does not show the dyeing differences so apparently as yarn spun upon rigid spools. It has also been found that when a bobbin is taken from a spinning machine, twisted into a pot and then, while still in an acidified condition, reeled into skeins, the inside-outside dyeing differences are not so apparent.

45 According to my new invention, however, I shall show that there is no direct relationship between inequalities of shrinkage and unevenness of dyeing. Further, I shall show that unevenness of dyeing may be avoided in direct spun yarn or filaments, i. e., filaments spun upon rigid spools as outlined above.

50 According to prevalent theories, fibres of cellulose are made up of a large number of micellae, or crystallites. In cotton, for example, these

micellae are said to be oriented, i. e., the long axis of each micella lies in the same direction as every other. In filaments of artificial origin, however, it has been determined that the long axis of the micellae do not all lie in the same direction. These micellae are believed to be oblong in shape and flexible, and are therefore usually described as "worm-like" in form. It has been found that certain treatments of formed filaments tend to cause the micellae to become oriented to a certain degree, i. e. tend to cause the micellae to flow when the yield point is reached. In this specification, I give to the term "yield point" the same meaning as that employed by the Society of Testing Materials and the text books and technical papers dealing with the physical chemistry of cellulose, i. e. the yield point is the point where the so-called flowing or orientation commences under stress.

The generally prevalent opinion indicates that if any flowing is prevented and the original micella structure of the individual filaments is maintained, unevenness of dyeing is eliminated. Ordinarily, when direct spun filaments are dried, the filaments innermost in the cake formed upon the spool do not take the dyestuff as readily as the outermost filaments. This inside-outside dyeing difference is readily apparent in the finished goods. Extensive shrinkage experiments have proved that although the ordinary differences in shrinkage can be eliminated, no apparent affect upon the inside-outside dyeing effect may be observed, i. e. the correction of shrinkage difficulties has not solved the problem of variations in dye affinity.

35 In the following discussion I refer specifically to the direct spool process of viscose filament manufacture, that is, where the filaments, as they are extruded, are collected directly upon revolving rigid spools. I do not wish, however to be limited to this particular process since my invention is applicable to other processes. Therefore, I wish to be limited only so far as is indicated by the scope of the appended claims.

40 In accordance with my theory, I have noticed that when freshly spun filaments are treated with water they immediately swell, and then gradually the swelling is reduced. In accordance with my theory this swelling takes place because of the wide difference in the osmotic pressure between the inside and the outside of the individual filament. Within this filament certain salts are present from the spinning bath. In accordance with my theory the presence of these salts within the filament tends to produce an area having a

very high osmotic pressure. Pure water and, more particularly, heated water, however, possesses a very low osmotic pressure. Upon introducing such a filament into water, therefore, there is a tendency for the water first to pass into the interior of the individual fibre tubes and thus swell them. The difference of osmotic pressure is very great, oftentimes reaching to 100 atmospheres or more. After this passage of the water into the hull there is a gradual passage outwardly of the salts. This swelled condition causes a change in the micella orientation of the filaments whenever the filaments are under tension.

I have found that in order that the micella arrangement may not be changed, i. e. that the yield point thereof may not be reached, it is essential that simultaneous swelling of and tension upon the individual filaments be avoided. According to my new theory, it is this coaction of the swelling and tension which causes the flowing of the micellae and the corresponding variation of orientation thereof.

When a viscose filament is spun or extruded into a precipitating bath, there is an interchange of electrolytes between the spinning bath and viscose contained in the cellulose-hydrate tube formed. Coagulation and precipitation shrink the yarn, and consequently, when the winding of the spool is completed, the innermost layers of yarn are held more tightly than the outermost layers. These spools are then wet treated. Since the innermost layers of filaments are under more tension than the outermost layers, any swelling produced by the wet-treatment tends to cause certain changes in the orientation of the micellae of the filaments. This causes differences in dye-stuff affinity between the inside and outside yarn on the spool. This being so, in order to prevent any unevenness it is necessary that either the swelling or tension be eliminated. Since only collapsible spools can eliminate the tension, in direct spool methods, it is necessary that the swelling be prevented.

I have accomplished this by providing for isotonic or is-osmotic pressures around the filaments to be treated. The osmotic pressure is then gradually lowered around the filaments until pure water alone is being used. Swelling is thus eliminated, and the finished filaments possess even inside-outside dyeing properties.

As examples of the manner in which my process may be carried out:

Example I.—A spool of freshly-spun viscose filaments is taken directly from the machine and dipped into a solution which has approximately the same osmotic pressure as the liquid within the filament. For example, a solution comprising:

	Per cent
Na_2SO_4 -----	30
MgSO_4 -----	30
H_2O -----	40

may be used. By the use of vacuum, pressure or any other washing apparatus, this liquid is forced through the filaments on the spool, and the con-

centration thereof is gradually decreased until pure water is passed through the filaments. The bobbin is later dried at about 65° C., and after subsequent treatment, such as twisting, coning and knitting, the yarn will be found to possess even inside-outside dyeing qualities.

Example II.—The process used in Example I was followed, but the liquid used was a portion of the spinning bath solution, the concentration of which was gradually weakened until pure water was used. In both of these examples the time of treatment may be varied according to the concentrations of salts and acids used, and may vary from 1 hour to two days or more.

The two examples just given refer specifically to the use of inorganic electrolytes in preventing the initial swelling of the formed filaments. However, I have found that non-electrolytes, such as the water-soluble organic compounds may likewise be used. As examples, a sugar solution may be mentioned, as well as organic alcohols such as methyl, ethyl, butyl and other alcohols of this group, paraldehyde and other aldehydes, and acids such as formic acetic, and butyric acid. The choice lies in a wide field, the only requisites being that the washing solution used should possess an osmotic pressure equivalent to the liquid absorbed by the freshly-formed filaments, and should not act disadvantageously therewith.

When other processes than viscose filament production in acid baths are employed, variations in the solutions used to provide an isotonic condition, must therefore be made.

Having now set forth my invention as required by the patent statutes, what I desire to claim is:

1. In the after-treatment of freshly-extruded spool-spun viscose filaments, the step of using first a liquid with an osmotic pressure isotonic with that of the filaments, and then gradually reducing the concentration of the liquid until pure water is employed.

2. In a process of producing viscose yarn with even dyeing properties, the step of first washing the freshly spun, coagulated filaments in an isotonic solution, said solution comprising a water-soluble electrolyte innocuous to the filaments to be treated.

3. In a process of producing viscose yarn with even dyeing properties, the step of first washing the freshly spun, coagulated filaments in an isotonic solution, said solution comprising a water-soluble non-electrolyte innocuous to the filaments to be treated.

4. In the process of producing viscose yarn with even dyeing properties, the step of first washing the freshly spun, coagulated filaments in an isotonic solution, said solution consisting of about 30% sodium sulphate, 30% magnesium sulphate and 40% water.

5. In the production of viscose filaments or yarn, the step of washing freshly-spun filaments in an isotonic solution, said solution being innocuous to the filaments or yarn so treated.

JOHN L. BITTER.