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MANUFACTURE OF ARTIFICIAL YARNS

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This invention relates to improvements in the manufacture of artificial materials and is more particularly concerned with the production of artificial yarns and similar products having an increased voluminosity.

We have found that by spinning a solution of cellulose acetate or other cellulose derivative containing paradichlorbenzene or other plasticising agent for the cellulose derivative so as to obtain filaments containing a preponderating proportion of flat cross-sections, and subsequently treating the filaments so obtained with a hot aqueous medium, a very considerable crinkle or crimp is imparted to the filaments, and in consequence a yarn containing such filaments has a high degree of voluminosity. The most important way of putting this discovery into practice so as to obtain a woolly yarn is to convert the yarn containing flat filaments into a yarn containing staple fibre before treating it with the hot aqueous medium, or alternatively to "voluminise" the yarn by applying a relatively high degree of twist, setting the twist and subsequently untwisting before applying the treatment with the hot aqueous medium. In both these cases the crimp or crinkle imparted to the flat filaments containing the plasticiser by the treatment with the hot aqueous medium appears to be much greater than in the absence of the step of "voluminising" or conversion to a yarn containing staple fibre.

However, the invention includes the simple process of treating with a hot aqueous medium the flat filaments containing the plasticiser, and also includes such a process with a step of conversion to a yarn containing staple fibre and/or an operation of twisting, setting the twist and untwisting whenever such a step or operation is applied during the process. For example, the conversion to yarn containing staple fibre or the twisting, setting and untwisting operation may take place after a treatment with the hot aqueous liquid, and, in the case of applying both steps, these may be applied in either order. Further, the treatment with the hot aqueous medium may, in the case of applying an operation comprising twisting, setting the twist and untwisting, actually set the twist, so that in this case the series of operations comprises applying a relatively high degree of twist to a yarn containing flat filaments which contain a plasticiser, setting the twist by treatment with a hot aqueous medium which at the same time imparts crinkle or crimp to the filaments, and subsequently untwisting, whether or not a step to convert the yarn into a yarn containing staple fibre is applied at any stage. However, it is preferred to apply the treatment with the hot aqueous medium to impart crinkle or crimp as an operation separate from the setting of the twist, and preferably as the last operation in the whole process.

While the treatment with the hot aqueous medium may comprise steaming the material with wet steam, it is much better to immerse the material in a hot aqueous liquor, and preferably an aqueous liquor which is boiling or nearly boiling. Such a liquor may contain a suitable wetting agent, for example a water-soluble soap or a sulphonated oil, for example Monopol soap or Turkey red oil, 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 a treatment at the boil for ½ hour to 1½ hours in water containing a small proportion, for example up to 1 gram per litre, of wetting agent. The treatment with the hot aqueous liquor may be sufficient to eliminate or substantially eliminate the plasticiser.

The treatment with a hot aqueous liquor may be operated so as to exercise a control over the lustre of the final product. A treatment of a cellulose acetate material with a boiling soap solution as described above produces a substantial reduction in lustre. A similar treatment with boiling water produces a much smaller reduction in lustre but still results in a product of substantially reduced lustre. If desired, salts or sugars may be added to the aqueous liquor, for example in a concentration up to 10 or 20% so as to reduce the loss in lustre occasioned by the hot aqueous treatment. Thus, for example, we may dissolve up to 10% of sodium chloride or up to 20% of sodium sulphate in the liquor and obtain a product which has a very good lustre and, at the same time, is well crinkled or crimped. For further information relating to these salts or sugars which have the effect of protecting the lustre of the material, reference is made to U. S. Patents Nos. 1,765,581, 1,939,261, 1,978,792 and 1,808,061. If desired the treatment with a hot aqueous medium may take place under pressure so as to enable temperatures higher than 100° C. to be used.

The production of the flat filaments may be effected by a suitable adjustment of the spinning conditions, and in particular of the concentration of cellulose acetate or other cellulose derivative in the spinning solution and of the proportion of

plasticiser to the cellulose derivative. For example, filaments which are very suitable for the purpose of the present invention may readily be produced by spinning under ordinary spinning conditions a 27.5% solution of cellulose acetate in acetone to which is added a proportion of 20% of paradichlorbenzene based on the weight of the cellulose acetate. Where the concentration of the cellulose acetate alone in the acetone is less than 27%, the proportion of paradichlorbenzene may be correspondingly reduced. For example, starting with a concentration of cellulose acetate in acetone of about 25%, it is sufficient to add a proportion based on the cellulose acetate of about 10–15% of paradichlorbenzene. These solutions produce irregular or thin flat cross-sections which give better voluminosity than bone-shaped flat cross-sections.

The plasticiser employed in the spinning solution may be soluble in water, as in the case of glycerine and glycol mentioned below, or may be difficultly soluble in water, as with paradichlorbenzene and diphenyl. It is desirable that the plasticiser should be substantially non-volatile under the spinning conditions, should not have too high a solvent power for the cellulose derivative, i. e., should not be compatible therewith (without blooming) in high proportions, and may with advantage be solid at ordinary temperatures. For example, better results appear to be obtained with plasticisers which are not compatible to an extent of more than 50%, and preferably not more than 20% on the weight of the cellulose derivative, than with plasticisers which are compatible in higher proportions. For instance, hydroquinone, which is both water-soluble and highly compatible with cellulose acetate, gives a completely matt product and a substantial reduction in tenacity and extension. Plasticisers which tend to develop colour either during the spinning operation or on standing, for example the phenolic compounds, quinones and aromatic amines, are preferably not used for the purpose of the present invention. Paradichlorbenzene is the best substance so far found for this purpose, since it enables a product to be produced which has substantially the same tenacity and extension as the product obtained from a normal spinning solution without paradichlorbenzene, it does not develop colour either during the spinning or on allowing the filaments to stand, and it gives a high degree of crinkle in the filaments on subsequent treatment with hot aqueous media. Diphenyl and similar substantially non-volatile aromatic hydrocarbons are also very suitable, as are glycerine, glycol, diethylene glycol and similar di- or poly-alcohols. Naphthalene is rather too volatile during the spinning operation and, further, tends to give rise to colour. Orthodichlorbenzene and the ordinary commercial plasticisers, such as dibutyl phthalate and diamyl phthalate, may be used, though the latter, while producing a good crinkle, tend to reduce the tenacity somewhat. Other substances which may be used include acidylated amines of low volatility, for example acidylated aromatic amines or amides of aromatic sulphonic or carboxylic acid, e. g. toluene sulphonethylamide and the isomeric xylene sulphon-methylamides.

Where a step is included in the process which converts the yarn into a yarn containing staple fibre, the conversion may take place either by cutting the continuous filaments into staple length and subsequently spinning the cut filaments into a yarn, or by a direct conversion process such as those described in British Patents Nos. 424,683 and 424,830. The phrase "direct conversion to a yarn containing staple fibre" means that the yarn does not at any stage from the continuous filament yarn to the yarn containing staple fibre lose its continuity, and therefore does not include a process in which the filaments are cut to staple length and the staple fibres subsequently spun into a staple fibre yarn. Where the conversion into a yarn containing staple fibre takes place by the indirect process of cutting the continuous filaments into staple length and subsequently spinning into yarn, the treatment with the hot aqueous meedium may be applied either to the spun yarn or to the cut fibres.

Again, as previously indicated, a voluminising step may be applied to the materials, i. e. a step involving the operation of applying a substantial degree of twist, setting the twist and untwisting. In such an operation the setting is preferably carried out while the yarn is travelling, for example while it is travelling during the twisting operation or while it is travelling during the untwisting operation. Steam is the most suitable setting medium. Processes of this character are described in detail in our British Patents Nos. 424,880, 422,073 and 464,981. In particular the twist inserted may be a false twist, in which case the degree of untwisting will be the same as the degree of twisting.

Whatever order of operations is adopted, it is preferable in order to obtain a yarn of very woolly characteristics to finish with a doubled yarn having a light doubling twist which is reverse in direction to any twist in the constituent yarns. The twist, if any, in the constituent yarns should also be light. It is further very advantageous to have the product in this form before applying the treatment with the hot aqueous medium. This form of product may result directly from a twisting, setting and untwisting step. For example, two or three yarns having either no twist or each having a light degree of twist in the same direction may be twisted together with a relatively high degree of twist, the twist set, as for example by means of steam, and the doubled yarn then untwisted so as to leave in the final yarn a light doubling twist, reverse in direction to any original twist in the constituent yarns. Where, as is preferred, the twisting, setting and untwisting operation comprises the insertion of false twist, the production of a doubled yarn of the character referred to will take place in a separate operation, and may either precede or follow the voluminising step.

Generally, 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 2 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 may be doubled together with a doubling twist of 2 turns per inch reverse in direction.

Similarly, where the process includes the step of converting the product to a yarn containing staple fibre, a doubled yarn having the above characteristics may be obtained directly during

such conversion step. For example, a number of continuous filament yarns having no twist or a light twist in one direction may be converted into yarns containing staple fibre by the process of British Patent No. 424,830, and a number of such yarns travelling from this direct conversion process doubled together with a light twist, reverse in direction to any original twist in the yarn.

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

1. Process for the production of voluminous yarns, which comprises subjecting yarns containing filaments of an organic derivative of cellulose of flat cross-section and containing a plasticiser for the cellulose derivative to the operations of converting the yarn into a yarn containing staple fibre and of treating with a hot aqueous medium.

2. Process for the production of voluminous yarns, which comprises converting a yarn containing continuous flat filaments of cellulose acetate containing 5 to 25% of a plasticiser for the cellulose acetate into a yarn containing staple fibre, and subsequently treating with a hot aqueous liquor.

3. Process for the production of voluminous yarns, which comprises directly converting a yarn containing continuous flat filaments of cellulose acetate containing a plasticiser for the cellulose acetate into a yarn containing staple fibre, and subsequently treating with a hot aqueous liquor.

4. Process for the production of voluminous yarns, which comprises applying to a yarn containing flat filaments of an organic derivative of cellulose containing a plasticiser for the cellulose derivative the operations of twisting to a relatively high degree, setting the twist and untwisting; converting the yarn to a yarn containing staple fibre; and treating with a hot aqueous medium.

5. Process for the production of voluminous yarns, which comprises applying to a yarn containing flat filaments of cellulose acetate containing 5 to 25% of a plasticiser for the cellulose acetate the operations of twisting to a relatively high degree, setting the twist and untwisting; converting the yarn to a yarn containing staple fibre; and treating with a hot aqueous liquor containing a salt.

6. Process for the production of voluminous yarns, which comprises applying to a yarn containing flat filaments or fibres of an organic derivative of cellulose containing a plasticiser for the cellulose derivative the operations of twisting to a relatively high degree, setting the twist and untwisting; and treating with a hot aqeuous medium.

7. Process for the production of voluminous yarns, which comprises applying to a yarn containing flat filaments or fibres of cellulose acetate containing 5 to 25% of a plasticiser for the cellulose acetate the operations of twisting to a relatively high degree, setting the twist and untwisting; and treating with a hot aqueous liquor containing a salt.

8. Process for the production of voluminous yarns, which comprises spinning a yarn containing flat filaments from a solution of an organic derivative of cellulose containing a plasticiser for the cellulose derivative, and subsequently treating the material with a hot aqueous medium.

9. Process for the production of voluminous yarns, which comprises subjecting yarns containing filaments of cellulose acetate of flat cross-section and containing paradichlorobenzene to the operations of converting the yarn into a yarn containing staple fibre and of treating with a hot aqueous liquor.

10. Process for the production of voluminous yarns, which comprises subjecting yarns containing filaments of cellulose acetate of flat cross-section and containing diphenyl to the operations of converting the yarn into a yarn containing staple fibre and of treating with a hot aqueous liquor.

11. Process for the production of voluminous yarns, which comprises spinning a yarn containing flat filaments from a solution of cellulose acetate containing paradichlorbenzene, and subsequently treating the material with a hot aqueous liquor.

12. Process for the production of voluminous yarns, which comprises associating a number of yarns each individually having little or no twist and each containing flat filaments of cellulose acetate containing a non-volatile plasticiser for the cellulose acetate insoluble or difficultly soluble in water by applying a light doubling twist, reverse in direction to any initial twist in the constituent yarns, and thereafter crinkling by applying a treatment with a hot aqueous liquor.

13. Process for the production of voluminous yarns, which comprises subjecting yarns containing filaments of cellulose acetate of flat cross-section and containing a plasticizer for the cellulose acetate to the operations of converting the yarn into a yarn containing staple fibre and of treating with a hot aqueous liquor containing a sugar.

14. Process for the production of voluminous yarns, which comprises subjecting yarns containing filaments of cellulose acetate of flat cross-section and containing 5–25% of paradichlorbenzene to the operations of converting the yarn into a yarn containing staple fibre and of treating with a hot aqueous liquor containing a salt.

15. Voluminous yarns, resembling wool, of great voluminosity and composed substantially of fibres of organic derivative of cellulose of flat cross-section containing plasticizers.

16. Voluminous yarns, resembling wool, of great voluminosity and composed substantially of fibres of cellulose acetate of flat cross-section and containing paradichlorbenzene.

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