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HIGH-TWIST ARTIFICIAL YARN PRODUCTION

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11 Claims. (Cl. 57—157)

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This invention relates to the production of high-twist synthetic fiber yarns and to agents for use in such production. The present application is closely related to the copending application, Serial No. 481,094, of Laurence E. Rossiter and Ralph M. Beach, "Production of high-twist artificial yarns," filed concurrently herewith.

It has long been recognized that a rather high degree of twist must be imparted to artificial yarns if such yarns are to compete with natural silk in elasticity, dull finish, tenacity and snag-resistance. This ideal has not been realized in practice, however, due to the intractability of high-twist artificial yarns, especially in knitting machines which require yarns which are both pliable and free from any tendency to snarl. In the absence of special treatment, high-twist artificial yarns have a strong tendency to snarl; on the other hand, when attempts are made to control this tendency by the use of gelatin or other similar sizes, the resultant yarns are inflexible, harsh and unmanageable upon knitting and working in other textile machines. To remedy this difficulty, it has been proposed to subject artificial yarns to reverse twisting operations designed to overcome their tendency to snarl. While these last processes secure the desired result, they obviously require twice the normal spinning capacity and involve an additional step in the processing of the yarns, which step is moreover unfamiliar to, and outside the experience of, those engaged in the art.

Accordingly, it is an object of this invention to produce artificial fiber yarns not subject to snarl but nevertheless possessing the degree of pliability necessary for machine processes such as knitting.

Another object is to produce pliable, snarl-free artificial yarns without the use of excess spinning capacity or other equipment not required in the conventional processing of artificial yarns.

A further object is to produce such yarns with the minimum of departure from processes familiarly employed in connection with artificial yarns.

The foregoing and other objects are secured in accordance with this invention by applying a hydrogenated fatty oil to an artificial yarn, throwing and twisting the yarn, and applying heat to the treated yarn to coalesce the hydrogenated oil. The coalesced coating of hydrogenated oil serves to retain the twist in the yarn throughout all subsequent mechanical processing, while nevertheless leaving the yarn in a sufficiently pliable condition for operation in the most exacting mechanical processes, such as knitting. By the use of this invention, for instance, it has been made possible to produce satisfactory full-fashioned knitted hosiery from high-twist artificial yarns, a result not hitherto obtainable on a practical basis.

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Treatment according to this invention is applicable to any artificial yarn to which it may be desired to impart a high degree of twist, including the regenerated cellulose yarns such as viscose and cuprammonium yarns, cellulose derivative yarns such as cellulose acetate, propionate, butyrate and ethyl ether yarns, and non-cellulosic yarns such as the linear polyamide and polyvinyl yarns.

Hydrogenated fatty oils which may be applied to artificial yarns for the purposes of this invention may be any hydrogenated animal, vegetable or marine oils or fats having melting points upwards of 30° and preferably upwards of 50° C. Selection of oils in regard to melting point is to be made with a view to the maximum temperature at which the treated yarns are to be worked, higher melting points being chosen when it is expected that the yarn will be worked at high temperature, i. e., in the summer time or in warm climates. Practically any commercial animal, vegetable or marine oil can be hydrogenated to the degree necessary for this purpose. Examples of oils which when hydrogenated possess properties suitable for use in this invention include animal oils such as beef tallow, mutton tallow, lard oil, lard, wool fat, bone fat and horse fat; vegetable oils such as mustard, castor, coconut, corn, cottonseed, grapeseed, olive, palm, palm kernel, peanut, soyabean and teaseed oils; and marine oils such as cod, pilchard, whale blubber, sperm and train oils.

The hydrogenated oil may be applied to the selected synthetic yarn by any convenient method, the particular method not being critical to this invention since it is merely necessary to secure the mechanical result of uniformly dispersing the hydrogenated oil throughout the yarn; thus, the oil may be applied to the yarn in molten form as, for instance, by passing the yarn over a wick or a roller applicator immersed in the molten oil. However, it is more convenient in most cases to apply the oil to the yarn by preliminary soaking in an organic solvent solution of the hydrogenated oil, since the apparatus and technique employed in such soaking are more or less familiar to textile operatives in other connections, such as the preliminary size soaking of rayon yarns intended for crepe fabrics. Such

soaking may be effected by simply immersing the yarn in the form of skeins, cakes or similar yarn packages in a vessel containing the solution; or by means of skein soaking machines; or by the use of a pressure chamber, this last method being particularly adapted to the treatment of yarn in the form of spinning-bucket cakes. Whatever method is selected for the soaking treatment, particular care should be taken to insure access of the solution to all portions of the yarn being treated, since the treatment greatly modifies the working properties of the yarn and any unevenness of application will interfere with subsequent mechanical processing. Accordingly, the temperature of the solution should preferably be maintained high enough, for instance between about 140° and 180° F., to reduce the viscosity of the soaking medium whereby to insure rapid and complete penetration of the yarns. Likewise when the yarns are soaked in open vats or tubs, precautions should be taken to introduce the skeins, bundles or any other packages or yarn into vats in individual layers and each layer should be completely immersed before the succeeding layer is introduced. In all soaking procedures the yarn should be retained in the bath for a sufficiently long time to insure complete and thorough penetration of the treating fluid into the yarn, periods of from about one-quarter of an hour to one hour generally sufficing for this purpose.

The amount of hydrogenated oil to be applied to yarns in accordance with this invention will vary greatly depending upon the nature of the fiber treated, the degree of twist to be inserted thereinto and the conditions and nature of intended subsequent working, and accordingly this quantity is best determined in each individual case by preliminary experiment. In general, the fiber should have deposited thereon between about 2% and about 30% of hydrogenated oil, based on the weight of the original untreated fiber, for best results. This amount may conveniently be regulated by adjusting the concentration of the hydrogenated fat in the solution during the soaking of the yarn therein. In general, soaking treatments conducted upon synthetic fibers with solutions of hydrogenated oils will, after centrifuging, leave thereon approximately 20% by weight of the solution, based on the weight of the original untreated fiber, and accordingly the concentration of the treating liquid will generally be approximately five times the concentration of hydrogenated oil desired in the treated fiber. If greater amounts of treating fluid are left on the fiber by the soaking treatments, a lesser concentration of hydrogenated fat should be employed, and vice versa.

In the event that it is decided to apply the hydrogenated fat in the form of a solution, practically any fat-solvent will be suitable for this purpose, providing, of course, that it exerts no deleterious effect upon the yarn to be treated, the nature of the solvent not being particularly critical to the practice of this invention since all that is required is the mechanical result of dispersing the fat throughout the yarn. Examples of suitable fat solvents having no deleterious effect upon any common types of artificial fiber are petroleum solvents such as petroleum ether, kerosene, naphtha or the composition known as Stoddard solvent; chlorinated hydrocarbon solvents such as carbon tetrachloride or ethylene dichloride; and coal tar distillates such as benzene, toluene, xylene and the like. In the case of the insoluble

regenerated cellulose filaments, other fat solvents such as acetone, isopropanol, butanol, ethyl ether and the like may also be used.

After the soaking operation the yarn should be drained of that portion of treating solution freely flowing therefrom, after which still further quantities may be removed by centrifugation. The degree to which the treating fluid is removed may be varied, but in general it will be convenient to leave, in the case of solutions, 20% of treating fluid in the yarn, based on the untreated weight thereof, since this amount is left in yarns by centrifugation as ordinarily carried out.

When the treatment has been carried out with solutions of hydrogenated oils, the yarn should not be permitted to dry out after centrifugation, since this will result in a concentration of the oil on the surface areas of the yarn. Accordingly, the yarn should either be thrown and twisted immediately after the soaking operation or alteratively should be stored in containers excluding direct access of the atmosphere until such time as it is convenient to throw and twist the yarn. The twisting will, of course, be of the desired high degree, which may be as high as 60 turns per inch in accordance with the invention without resulting in any serious tendency to snarl.

The degree of twist at which the treatment of this invention becomes advantageous, i. e., at which serious snarling will occur in the absence thereof, varies greatly with the composition, denier and filament number of the yarn and with the nature of the mechanical working to which it is to be subjected and, accordingly, no attempt will be made to lay down a rule on this point. By way solely of example, it has been found that trouble is experienced with a particular brand of viscose yarn when more than 5 turns per inch are inserted into 200 denier yarn, or when more than 20 turns per inch are inserted into 50 denier yarn, the limit in general varying inversely to the denier of the yarn.

Following the twisting, regardless of the method by which the hydrogenated oil was applied to the yarn, the twist is preferably set by treatment in a steam cabinet in the usual manner with the exception that the time and the temperature of steaming may be somewhat less than those required for other purposes such as steaming of yarns for crepe effects. In some cases where the twist is not too high, the twist setting may even be entirely omitted. The steaming, when applied, causes the hydrogenated oil to flow and coalesce into a homogeneous film which retains the twist in the yarn during subsequent working while nevertheless leaving the yarn in a highly flexible and pliable condition.

Following the setting, the yarn is wound into a cone package and is then in condition suitable for working up into fabrics. The treatment hereinabove set forth will have rendered the twist highly stable so that the yarn will be substantially free of any tendency to snarl even in the most exacting processes, such as knitting. The treatment will not, however, have unduly reduced the flexibility of the yarn, so that it remains amenable to any and all mechanical processes. In practice, for instance, it has been found possible to knit full-fashioned stockings from high twist yarns prepared in accordance with this invention with clear, uniform stitches—a result not hitherto obtainable on a practical basis with high twist synthetic yarns. The hydro-

genated oils applied to yarns in accordance with this invention may be readily scoured from the articles finally elaborated therefrom, and thus do not adversely effect any subsequent dyeing operations.

Following are examples of procedures in accordance with the general principle above outlined. All parts given are by weight.

Example I

	Parts
Hydrogenated soyabean oil	300
Stoddard solvent	300
	600

The solvent and hydrogenated oil were mixed and melted together in a steam-jacketed kettle at 160° F. The kettle was provided with a perforated basket and a hoisting apparatus for lowering and raising the basket into and out of the kettle.

100 parts by weight of 75 denier 30 filament viscose rayon were taken for treatment. The rayon came in skeins of one-half pound each and these skeins were wrapped into bundles of 4, each bundle then being covered with a light-weight cheesecloth having a construction of 20 warp and 16 filling threads per inch. A layer of these bundles was placed in the basket, which was then lowered sufficiently to immerse this layer in the solution in the kettle. Those packages which tended to float were forced under by means of a paddle and thereafter a second layer of bundles was placed in the basket, the basket lowered sufficiently to immerse this layer, floating bundles again forced under, and so on, successive layers of bundles being added and forced under until all of the yarn was in the bath. The yarn was allowed to remain in the bath for 20 minutes, after which the basket was hoisted from the kettle and the freely draining solution allowed to run back into the kettle; thereafter the yarn packages were removed from the basket and centrifuged until the yarn contained only 20% of solution, based on the original untreated weight thereof. The skeins were then removed from the bundles, placed on swifts and immediately thrown and twisted to 50 turns per inch. The twisted rayon was then steamed in a steam chest at 160° F. dry bulb, 155° F. wet bulb for 45 minutes to melt the hydrogenated oil into a homogeneous coating which served to set the twist. The rayon was then wound on cones and the cones used to knit directly the body of a 45 gauge full-fashioned stocking. The yarn behaved well on the knitting machine, yielding clear and even stitches and giving absolutely no trouble from snarling or unmanageability. The stockings so knitted were then scoured in a 0.1% soap bath at 190° F. for 45 minutes, rinsed, dyed in a bath consisting of a direct hosiery dye conventionally used on rayon, dried and boarded. The product stocking was evenly dyed, was characterized by a desirable dull finish, was highly resistant to snagging, and possessed an even construction of uniform, clear, open stitches.

Example II

The procedure of Example I was exactly repeated with the exception that a hydrogenated fish oil was substituted for the hydrogenated soyabean oil employed in Example I. The resultant treated yarn had the same excellent working properties, and the stocking body made

therefrom had the same high quality, as were secured in the procedure of Example I.

Example III

	Parts
Hydrogenated tallow	400
Xylene	200
	600

The above ingredients were melted together at 150° F. A 50 denier 36 filament cuprammonium rayon in skeins was soaked in this bath for 20 minutes. The skeins were then removed from the bath and centrifuged down to a take-up of 20%. Thereafter the skeins were placed in metal cans having close-fitting covers and stored for one week. The stored skeins were then removed from the cans, thrown, and twisted to 50 turns per inch. The twisted yarn was steamed at 140° F. wet bulb, 134° F. dry bulb, for 15 minutes. The yarn so produced had an excellent "hand" and was free of excessive tendency to snarl.

From the foregoing general description and specific examples, it is apparent that the applicants have devised a process whereby a result is obtained not hitherto realized, viz., the production of high twist synthetic yarns which are characterized by dull finish, elasticity, resistance to snag, and tenacity, but which are nevertheless amenable to the most exacting mechanical processes, particularly knitting. Moreover, the process fits in well with the conventional practice and apparatus employed in rayon throwing establishments, since it has been customary to soak rayon intended for crepe fabrics previous to the throwing operation by means of manipulative steps very similar to those involved in the present invention. The treatment is furthermore economical in that it may be carried out in a relatively short period of time and by relatively simple procedures and makes use of very plentiful treating agents, viz., the hydrogenated fatty oils.

We therefore claim:

1. Process of producing high-twist, non-snarling artificial fiber yarn, which comprises distributing a hydrogenated fatty oil throughout an artificial fiber yarn; twisting the yarn to a degree which would normally result in excessive tendency to snarl; and setting the twist in the yarn by means of heat.

2. Process of producing high-twist, non-snarling artificial fiber yarn, which comprises distributing a solution of a hydrogenated fatty oil throughout an artificial fiber yarn; twisting the yarn to a degree which would normally result in excessive tendency to snarl; and setting the twist in the yarn by means of heat.

3. Process of producing high-twist, non-snarling viscose yarn, which comprises distributing a hydrogenated fatty oil throughout a viscose yarn; twisting the yarn to a degree which would normally result in excessive tendency to snarl; and setting the twist in the yarn by means of heat.

4. Process of producing high-twist, non-snarling viscose yarn, which comprises distributing a hydrogenated fatty oil throughout a cuprammonium yarn; twisting the yarn to a degree which would normally result in excessive tendency to snarl; and setting the twist in the yarn by means of heat.

5. Process of producing high-twist, non-snarling acetate yarn, which comprises distributing a hydrogenated fatty oil throughout an

acetate yarn; twisting the yarn to a degree which would normally result in excessive tendency to snarl; and setting the twist in the yarn by means of heat.

6. Process of producing high-twist, non-snarling artificial fiber yarn, which comprises distributing a solution of a hydrogenated fatty oil throughout an artificial fiber yarn; storing the yarn away from direct access of the atmosphere; twisting the yarn to a degree which would normally result in excessive tendency to snarl; and setting the twist in the yarn by means of heat.

7. Process of producing high-twist, non-snarling artificial fiber yarn, which comprises distributing throughout an artificial fiber 2% to 30% of a hydrogenated fatty oil, based on the dry, untreated weight of the yarn; twisting the yarn to a degree which would normally result in excessive tendency to snarl; setting the twist in the yarn by means of heat; and knitting the desired articles from the yarn.

8. Process of producing high-twist, non-snarling artificial fiber yarn, which comprises distributing a quantity of a solution of a hydrogenated fatty oil throughout an artificial fiber yarn sufficient to contain 2% to 30% of the oil, based on the dry, untreated weight of the yarn; twisting the yarn to a degree which would normally result in excessive tendency to snarl; and setting the twist in the yarn by means of heat.

9. Process of producing high-twist, non-snarling viscose yarn, which comprises distributing throughout a viscose yarn 2% to 30% of a hydrogenated fatty oil, based on the dry weight of the yarn; twisting the yarn to a degree which would normally result in excessive tendency to snarl; and setting the twist in the yarn by means of heat.

10. Process of producing high-twist, non-snarling cuprammonium yarn, which comprises distributing throughout a cuprammonium yarn 2% to 30% of a hydrogenated fatty oil, based on the dry, untreated weight of the yarn; twisting the yarn to a degree which would normally result in excessive tendency to snarl; and setting the twist in the yarn by means of heat.

11. Process of producing high-twist, non-snarling acetate yarn, which comprises distributing throughout an acetate yarn 2% to 30% of a hydrogenated fatty oil, based on the dry weight of the yarn; twisting the yarn to a degree which would normally result in excessive tendency to snarl; and setting the twist in the yarn by means of heat.

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DISCLAIMER

2,403,304.—*Edwin A. Robinson*, Chatham, and *Arthur De Castro*, Newark, N. J. HIGH-TWIST ARTIFICIAL YARN PRODUCTION. Patent dated July 2, 1946. Disclaimer filed Aug. 13, 1946, by the assignee, *National Oil Products Company*.

Hereby enters this disclaimer to that part of claim 7 in said specification which is in the following words, to wit: and knitting the desired articles from the yarn.

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10. Process of producing high-twist, non-snarling cuprammonium yarn, which comprises distributing throughout a cuprammonium yarn 2% to 30% of a hydrogenated fatty oil, based on the dry, untreated weight of the yarn; twisting the yarn to a degree which would normally result in excessive tendency to snarl; and setting the twist in the yarn by means of heat.

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