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3,103,732

COMPOSITE BULKY REGENERATED CELLULOSE YARN

Filed Dec. 11, 1958

2 Sheets-Sheet 1

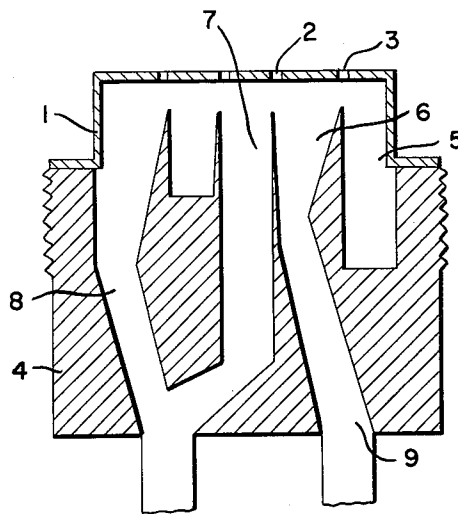


FIG. 1

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FIG. 4

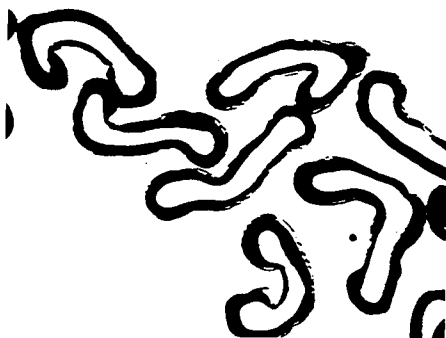


FIG. 3



FIG. 2

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COMPOSITE BULKY REGENERATED
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4 Claims. (Cl. 28—81)

This invention relates to a new and useful bulky continuous filament yarn and a process for its production.

Although artificial fibers are produced most easily as continuous filaments, conventional continuous filament yarns because of their extreme uniformity and lack of discontinuities are much denser than their staple counterparts. The filaments lie close together in the yarn, and adjacent strands of continuous filament yarn in fabrics are closely and evenly spaced. Fabrics made from conventional continuous filament yarns are therefore lacking in lightness and covering effectiveness as well as in interesting decorative surface effects which are commonly achieved with yarn spun from staple fibers.

One method of increasing the bulkiness of continuous filament yarns is to spin under conditions such that the yarn develops a crimp when exposed to a swelling agent in a relaxed condition as described by Nicoll in U.S. 2,515,834. While crimped yarns made in accordance with the above patent have proved highly useful, they suffer from the disadvantage that in certain end uses, such as in plain weave, woven fabrics for draperies and upholstery where the yarn is subjected to a certain amount of tension during the textile handling and weaving operations, the crimp is removed.

It is accordingly an object of the present invention to provide a crimped yarn which may be subjected to tension without removal of the crimp.

Another object is to provide a process to produce the yarn of the present invention.

Other objects will become apparent from the examples and discussions to follow.

In accordance with the present invention a yarn is provided comprising a plurality of crimped (multiple component) filaments having combined therewith a plurality of substantially straight, uncrimped (single component) filaments which are grouped together and adhere to one another sufficiently to form a coherent tension supporting strand, the crimped filaments constituting a majority of the filaments.

The yarn is produced by supplying at least two viscoses to a common spinneret at substantially the same volume rate, extruding the viscoses through the spinneret into a coagulating and regenerating bath, one of the viscoses containing a coagulation modifier and having a higher salt index than the other viscose, the other viscose containing no coagulation modifier, the viscose containing the coagulation modifier being extruded through part of the spinneret holes (producing uncrimpable single component filaments) and both the viscoses being extruded simultaneously through the remaining holes (producing crimpable multicomponent filaments) the coagulating bath containing from about 8 to 12% sulfuric acid, from about 3 to about 15% zinc sulfate and from about 10 to about 24% sodium sulfate, stretching the yarn and thereafter permitting the yarn to relax.

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In order that the tension-supporting strand have sufficient strength, it must include a substantial number of filaments. The exact number required will depend on the filament denier, the total denier of the yarn and other factors. However, in general, it is desirable that this strand consist of about 10 to 40% of the total filaments in the yarns.

In a preferred embodiment the uncrimped filaments are grouped together in the interior of the filament bundle.

FIGURE 1 is a sectional elevation of a spinneret positioned upon an adapter suitable for preparing the yarn of the present invention.

FIGURES 2, 3, and 4 are cross-sectional views of the filaments occurring in the yarn of the present invention, 500 times actual size, made from photomicrographs. FIGURE 2 shows the mixture of uncrimped single component filaments and crimped multiple component filaments present in the yarn. FIGURE 3 shows a number of uncrimped single component filaments adhering to one another at a few points, and FIGURE 4 shows a number of crimped multiple component filaments, in each case separated from the yarn shown in FIGURE 2.

The following example is cited to illustrate the invention. It is not intended to limit it in any manner.

Example

Two viscoses, designated hereinafter as viscoses A and B, are prepared. Viscose A, containing 6.55% by weight of recoverable cellulose and 7.93% alkali calculated as sodium hydroxide, is prepared in the conventional manner using 40% carbon disulfide. During the mixing operation sufficient sodium N-methylcyclohexyldithiocarbamate is added to give a concentration of 0.59% based on weight of the viscose. The viscose is filtered, deaerated and ripened to a salt index of 15 and a viscosity of 47 poises. Viscose B is prepared in a similar fashion except that the recoverable cellulose content is 6.12% and the alkali 5.14%. Viscose B is prepared with 30% carbon disulfide and the sodium N-methylcyclohexyldithiocarbamate is omitted. Viscose B is filtered, deaerated and ripened to a salt index of 2.8 and a viscosity of 44 poises. Viscosities A and B are then extruded through a common spinneret, as shown in FIGURE 1, the total rate of flow through the spinneret being 77.5 grams per minute and the two viscoses being supplied to the spinneret at approximately the same rate of flow.

Referring to FIGURE 1 the apparatus employed comprises a spinneret 1 containing 120 holes of 0.008 inch diameter arranged as inner 2 and outer 3 concentric circles. The said spinneret is positioned upon a viscose separator 4 by means of a threaded collar (not shown), the said separator having an outer circular channel 5 and an inner circular channel 6, each of the said channels being concentric on central conduit 7. A branch 8 of central conduit 7 feeds the outer circular channel. An independent conduit 9 feeds the inner circular channel. Viscose A is introduced through independent conduit 9 while viscose B reaches the spinneret through branched conduits 7 and 8. Mixing of the viscoses occurs just prior to extrusion from holes 2 and 3 except that since the feeds are at the same rate of flow and since viscose A is supplied to the adapter by a single conduit, whereas viscose B is supplied by two conduits, a localized high pressure is produced by the viscose A stream with the result that

viscose B is completely displaced from a number of the holes of the inner circle 2 and viscose A alone is extruded from these holes.

The viscoses are extruded into a coagulating and regenerating bath containing 11.0% sulfuric acid, 17.5% sodium sulfate and 9.5% zinc sulfate, the bath being maintained at a temperature of 60° C. The coagulated filaments are led for a distance of 45 inches through the bath, then over a Y-guide to converge the filaments and for a further distance of 396 inches through the bath where the yarn is confined by means of suitable roller guides. The yarn is stretched 40% in the primary bath. The yarn is then passed for a distance of 160 inches through a hot secondary bath containing 2.0% sulfuric acid, 3.9% sodium sulfate and 2.1% zinc sulfate, the temperature of the bath being 95° C. The yarn is stretched 23% in the secondary bath by means of power driven rollers. The yarn is then passed into a centrifugal spinning bucket in the conventional manner and wound into a cake at a speed of 50 yards per minute.

The yarn is then purified, finished and dried in the conventional manner. The final yarn has an excellent crimp, the crimp being retained when the yarn is placed under tension. This retention of the crimp under tension is found to be due to the fact that the filament bundle contains about 25 filaments which are shorter, when straightened, than the remainder of the filaments. When the yarn is placed under tension, these filaments support the load and the other filaments remain in the crimped condition. It is found that a considerable number of these short filaments are stuck together at various points. When the short filaments are embedded in wax, cross sections cut and examined microscopically in the conventional manner, the filament cross sections have the same appearance as those obtained by spinning viscose A alone (FIGURE 3). On the other hand, cross sections of the longer, crimped filaments show the presence of both components (FIGURE 4).

The yarn, which has a denier of 2598 is woven into a plain-weave flat fabric. The fabric has a bulky, spun-like appearance.

The essential modifications in conventional regenerated cellulose yarn production required in producing the yarn of this invention are (1) the simultaneous extrusion of multiple viscoses which produce cellulose structures of different shrinkage characteristics through part, preferably a majority, of the holes of the spinneret and (2) extruding the viscose which produces the more shrinkable structure through the remaining holes. The difference in shrinkage of the two components in the multiple component filaments results in the crimping of those filaments while the higher shrinkage of the single component filaments provides the necessary tension-supporting strand.

In order that the uncrimped filaments adhere to one another sufficiently to form a coherent strand, the acidity of the bath must be regulated in accordance with other prevailing process conditions, and especially in relation to the alkali content of the viscose, to achieve the desired effect. This may be accomplished for any given set of conditions by spinning a small amount of yarn, examining the yarn, and if the uncrimped filaments do not adhere, i.e., they are not fused together at numerous points along their length, adjusting the acid concentration downwardly until these filaments do adhere. It is desirable that the filaments adhere to one another at a sufficient number of points to provide a single filament bundle which is not readily separated.

The major factor in producing differences in shrinkage between filaments made from different viscoses is the difference in salt index which reflects the maturity or ripeness of the viscose. In general, the higher the index, the greater the shrinkage of the filaments. To produce the desired effect of the present invention a difference in salt index of at least 5 units is required. Preferably one of the viscoses has a salt index above 10 and the other viscose

a salt index below 5. It is also desirable that the viscose having the higher salt index contain a coagulation modifier since this enhances the shrinkage of the filaments and in addition leads to improved properties in the final yarn. The preferred modifiers are the amines described by Cox in U.S. 2,535,044, the dithiocarbamates described by Dietrich in U.S. 2,696,423, the quaternary ammonium compounds described by Cox in U.S. 2,536,014, the diamines described in British Patent 762,772, the ethers described in British Patent 741,728 and the polyethyleneoxides described in Italian Patent 561,552. Other suitable modifiers are described in U.S. Patents 2,777,775; 2,792,278; 2,792,279; 2,792,280; and 2,792,281; British Patents 723,435; 730,544; 748,147 and 765,905 and French Patents 1,102,898 and 1,111,580.

Viscoses containing 5 to 9.5% recoverable cellulose and 4 to 8% alkali, calculated as sodium hydroxide, are suitable for the purposes of this invention. The viscoses are prepared in the conventional manner using 25 to 60% carbon disulfide. Preferably, the viscose having the higher salt index is prepared using a larger amount of carbon disulfide than the viscose having the lower salt index. It will be readily appreciated by those skilled in the art that the amount of carbon disulfide required will be dictated to a considerable degree by the salt index requirement. Thus, to obtain a salt index of 10 or higher, more than 30% carbon disulfide will be needed.

As mentioned previously, the coagulating and regenerating bath should contain from about 8 to about 12% sulfuric acid, from about 3 to about 15% zinc sulfate, and from about 10 to about 24% sodium sulfate. Bath temperatures in the range of from about 40 to about 70° C. are satisfactory.

After extrusion, the filaments are led through the coagulating and regenerating bath where they are confined by means of suitable roller guides. The amount of bath travel required will depend on the composition and temperature of the coagulating bath, the composition of the viscose and other variables, but is easily adjusted by one skilled in the art. After leaving the primary coagulating and regenerating bath, the yarn is preferably passed through a hot secondary bath consisting of hot water, dilute acid or diluted primary bath at a temperature of 80 to 100° C.

The yarn is stretched at least about 60% while passing through the bath. Where a secondary bath is used, the stretch may be concentrated in this bath. However, it is usually preferable to apply part of the stretch in the primary bath and part in the secondary bath.

After the yarn leaves the bath, it is wound into a cake in a centrifugal spinning bucket or wound on a bobbin and thereafter purified and dried in the conventional manner.

If the yarn is permitted to relax during the processing as in a bucket-spun cake, then the yarn will be crimped without further treatment. However, if the yarn is wound on a bobbin under tension, it will be necessary to place the yarn in water or some other swelling medium in a relaxed state to permit it to crimp.

The yarns of this invention may be used wherever continuous filament yarns are customarily employed. However, they are particularly suitable for the production of fabrics in which a decorative surface effect is desired as in draperies, friezes, and jacquards.

Many equivalent modifications of the present invention will be apparent to those skilled in the art from a reading of the above without a departure from the inventive concept.

What is claimed is:

1. Composite, bulky, multi-filament yarn of regenerated cellulose possessing crimp retention when subjected to tension during textile handling and weaving operations consisting of crimped, heterogeneous, multiple component cellulose filaments together with tension supporting substantially straight, uncrimped, single component cellu-

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lose filaments, said crimped filaments consisting essentially of at least two celluloses possessing different shrinkage characteristics, and said tension supporting filaments being adhered to one another by cellulose fusion at a plurality of spaced points.

2. Composite, bulky, multi-filament yarn of regenerated cellulose possessing crimp retention when subjected to tension during textile handling and weaving operations as defined in claim 1 wherein the tension supporting filaments comprise from about 10% to about 40% of the total number of filaments in the yarn.

3. Composite, bulky, multi-filament yarn of regenerated cellulose possessing crimp retention when subjected to tension during textile handling and weaving operations as defined in claim 1 wherein the tension supporting filaments are grouped together in the interior of the yarn.

4. Composite, bulky, multi-filament yarn of regenerated cellulose possessing crimp retention when subjected to tension during textile handling and weaving operations

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as defined in claim 1 wherein the tension supporting filaments comprise from about 10% to about 40% of the total number of filaments in the yarn and are grouped together in the interior thereof.

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