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Processes for Producing Crimped Heterofilament Yarns

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10 Claims

ABSTRACT OF THE DISCLOSURE

Yarns containing potentially crimpable heterofilaments are crimped, as by heat retraction, after first separating the filaments forming the yarn from each other so that the crimp develops fully in each filament.

DISCLOSURE

The present invention relates to an improved process for the production of crimped heterofilament yarns.

The use of continuous filament crimped yarns formed from synthetic polymers in apparel wear has increased greatly in recent years. Normally such yarns are obtained by subjecting the filaments to a mechanical crimping operation, such as false twist, stuffer box crimping or edge crimping, after spinning and drawing. Such operations, which are necessarily relatively slow, add greatly to the cost of the yarn. Considerable research has therefore been expressed in yarns composed of heterofilaments which have a spontaneous or potential crimp. Heterofilaments are composite filaments consisting of at least two polymer components which exist in eutectic relationship continuously along the length of the filament in a side-by-side or sheath and core arrangement. The polymer components are normally different polymers which differ in respect of their physical properties which will cause the filament to crimp, e.g., in shrinkage and/or recovery properties. The components may also be of the same polymeric material, but differing in respect of their degree of polymerisation. In the former heterofilaments the crimp is usually developed by subjecting the filaments to a relaxing process, e.g., overfeeding into a hot-air tube, after they have been drawn; and in it the latter mentioned type the crimp frequently occurs spontaneously when the tension in the filaments is released after drawing, although the crimp may often be further developed by a hot relaxing process.

The development of crimp in heterofilaments of either of the above types occurs only when the filaments are held under zero or very low tension since the crimping force in a heterofilament is small. In monofilament yarns crimp is developed quite readily, but in multifilament yarns, the interfilament cohesion may be strong enough to prevent individual filaments from crimping and the resultant yarns then have a poor crimp.

I have now found that the crimp of multifilament yarns containing heterofilaments can be considerably enhanced if the filaments forming the yarn are temporarily separated whilst development of the crimp is taking place.

Accordingly, therefore, the present invention provides a method for the manufacture of a crimped multifilament drawn yarn containing a major proportion of potentially crimpable heterofilaments wherein the filaments in the yarn are separated before the crimp is developed.

The crimp in the heterofilaments may be developed, in the case of spontaneously crimping heterofilaments, by relaxation of the drawing tension, but it is preferred that it be developed by subjecting the yarn to a heat retraction treatment. Such treatment involves heating the separated filaments with, for example, hot air, steam or radiant heat, whilst they are in an untensioned free to shrink condition. Thus the filaments may be overfed into a hot air tube, in which the temperature of the air is in the range of 150° C. to 300° C.

In the context of this specification the term potentially crimpable when applied to heterofilaments includes drawn yarns which crimp on release of drawing tension as well as drawn filaments which crimp only when subjected to a heat retraction treatment.

By "a yarn containing a major proportion of heterofilaments" is meant a yarn in which at least two thirds of the filaments are heterofilaments.

I have found that the filaments may be separated by inserting a false twist into the yarn which twist is substantially removed before the hot retraction treatment. Conveniently this separation may take place during the drawing process. A suitable apparatus for achieving this effect is described in the specification of British Patent 899,053 and is illustrated in the said figure herein.

The apparatus comprises means for drawing yarn consisting of a feed roll 1 and a draw roll 3 spaced a distance apart, with a snubbing pin 2 therebetween. The draw roll, which is associated with a separator roll 4, is provided with a flange 5 which causes a yarn 7 in contact therewith to be rotated about its axis. No means for heating the yarn 7 during its passage between the two sets of rolls is employed.

In carrying out the process of the present invention using the above-mentioned apparatus, undrawn yarn, containing at least 66% of heterofilaments, in a substantially twistless condition is passed round the feed roll 1 to the snubbing pin 2 around which it makes about two passes and thence to the draw roll 3. In its passage from the snubbing pin 2 to the draw roll 3, the yarn 7 makes frictional contact with the flange 5 which causes the yarn 7 to rotate about its axis and imparts a false twist thereto. Since heat is not applied to the yarn 7 during the process the false twist is not set and the yarn 7 becomes substantially free thereof before it is wound up, any twist liveliness remaining being insufficient to impart additional bulk to the yarn. After leaving the drawing section 3 the yarn 7 is subjected to a hot retraction treatment under low tension, conveniently a tube 8 through which the yarn passes and into which hot air or steam can be introduced, and is subsequently wound up as a cheese or on a bobbin 6, the crimp being largely pulled out during wind-up. When this yarn is knitted into a fabric and relaxed, for example by immersion in boiling water, an extremely high bulk develops.

The process of this invention will now be more fully illustrated in the following examples which are not intended to limit the invention.

Examples 1 and 2

In these examples the yarn was undrawn 360 denier 30 filament yarn, the filaments being potentially crimpable two-component side-by-side heterofilaments composed of 66 nylon as one component and an 80/20 copolymer of 66 nylon and 6 nylon as the other component there being equal proportions by volume of each of these components.

In Example 1 the yarn was processed using the apparatus described above for separation of the filaments by the insertion of a temporary false-twist during drawing. The yarn was drawn at 1000 ft./min. at a draw ratio of 4.0, relaxed by a controlled amount in a tube through which was passed hot air at 230° C. to develop the crimp in the yarn and then wound up on a surface driven roll, the speed of the roll being adjusted to give a wind-up tension of 0.2 g. per denier. Most of the crimp was pulled out of the yarn during winding. The yarn was knitted into a
3,462,938

fabric having a loose stitch structure to allow redevelop-
ment of crimp and the fabric immersed in boiling water
for 5 minutes.

In Example 2, which is included for the purpose of
comparison only, the yarn was subjected to the same
process except that the filaments were not separated be-
fore the crimp was developed. Details of the resulting
yarns and fabrics are given in Table 1.

<table>
<thead>
<tr>
<th>Example</th>
<th>Percent retention in relaxation treatment</th>
<th>Percent crimp of yarn</th>
<th>Percent shrinkage</th>
<th>Bulk in fabric after knitting</th>
<th>Bulk in fabric after B.W. treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10.9</td>
<td>24.2</td>
<td>3.6</td>
<td>Poor</td>
<td>Good</td>
</tr>
<tr>
<td>2</td>
<td>10.9</td>
<td>12.4</td>
<td>2.7</td>
<td>Nil</td>
<td>Poor</td>
</tr>
</tbody>
</table>

1 B.W.—Immersion in boiling water for 5 minutes.

Comparison of these examples clearly shows that a
marked increase in crimp is obtained when the filaments
of a multifilament heterofilament yarn are separated be-
fore the crimp is developed.

The percentage crimp retraction, which is a measure
of yarn bulkiness, was determined as follows. A 50 cm.
skein of yarn was boiled for one minute under a load of
1.2 x 10^3 g./d. dried in air for one hour under the same
load and the length of the skein b measured. The same
skein was then loaded to 0.33 g./d. in air and the length
measured c. Crimp retraction (C.R.) was then calculated
from the expression

\[ C.R. = \frac{c - b}{c} \times 100\% \]

Shrinkage was determined by loading a 50 cm. skein to
0.33 g./d. in air and measuring its length a. The skein
was then boiled in water for one minute and dried in air
for one hour under the same load and its length measured
c. Shrinkage S was then calculated from the expression

\[ S = \frac{a - c}{c} \times 100\% \]

Examples 3–7

A series of experiments using the heterofilament yarns
of Examples 1 and 2 was carried out under identical
conditions to Example 1 except that air at different tem-
peratures was used in the relaxing tube. Crimp retraction
values for yarns relaxed at various temperatures are given in Table 2.

<table>
<thead>
<tr>
<th>Example</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air temperatures, °C.</td>
<td>150</td>
<td>175</td>
<td>200</td>
<td>220</td>
<td>280</td>
</tr>
<tr>
<td>Percent crimp retraction</td>
<td>13.8</td>
<td>18.7</td>
<td>20.2</td>
<td>21.9</td>
<td>28.6</td>
</tr>
</tbody>
</table>

Air temperatures below 150 °C. were found to be in-
sufficient to develop the crimp in the yarn.

The method of the present invention is not, of course,
limited to use with heterofilaments consisting of poly-
amides, and heterofilaments composed of any polymer
pairs exhibiting a potential crimp may be used.

The insertion of a temporary false twist to separate
the filaments in the yarn may be achieved by any other
convenient process, for example by the use of a false
twist bush, of the type described in the specification of
British Patent No. 797,051, between the draw rolls and
the hot retraction stage in place of the flange in the above
described method. The process may, if desired, be carried
out on filaments that have been partially drawn from a
cheese, but it is clearly advantageous economically to
combine the process with the drawing process.

The invention is not limited to the separation of fila-
ments of the yarn by insertion of a temporary false twist,
any other convenient method of separation may be em-
ployed, thus the filaments may be separated by means of
an air jet, but care should be taken to ensure that the
filaments do not become so tightly intermingled as to
inhibit the formation of crimp in the same way as in a
standard yarn. This method for the separation of fila-
ments in a yarn is, however, less effective than that pre-
viously described.

What I claim is:

1. A method for the manufacture of a crimped multi-
filament drawn yarn comprising at least two thirds poten-
tially crimpable heterofilaments, said method comprising
temporarily separating the filaments forming the yarn
from each other without separating the components of
the individual filaments and developing the crimp in said
filaments while separated.

2. A method according to claim 1 wherein the crimp
is developed by subjecting the yarn to a heat retraction
process.

3. A method according to claim 2 wherein the yarn is
composed entirely of heterofilaments.

4. A method according to claim 2 wherein the heat
retraction treatment comprises feeding the yarn into a
heated tube.

5. A method according to claim 4 wherein the tube is
heated by the passage therethrough of air at 150–300 °C.

6. A method according to claim 2 wherein the filaments
are separated by the insertion of a false twist which is not
set, the yarn being substantially free of twist lineal-
ness when the crimp is developed.

7. A method according to claim 6 wherein the yarn is
initially undrawn and further including drawing said
yarn while inserting a false twist therein.

8. A method according to claim 7 including passing
the undrawn yarn round a first set of feed rolls thence to
a snubbing pin around which it makes about two passes
and finally to a draw roll fitted with a flange with which
the yarn makes contact in its passage to the said draw
roll and rotating the yarn about its axis and imparting a
false twist thereto.

9. A method according to claim 7 wherein the false
twist is inserted by means of a false twist bush.

10. A method according to claim 9 wherein the bush is
positioned immediately following the draw rolls in a yarn
drawing apparatus.

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