United States Patent [19]

Brassard et al.

[11] **3,899,927**

[45] **Aug. 19, 1975**

[54] **METHOD AND APPARATUS FOR THE MEASUREMENT OF CRIMP CONTRACTION**

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[30] **Foreign Application Priority Data**

Nov. 4, 1972 Germany 2254026

[52] **U.S. Cl.** **73/160;** 73/95.5

[51] **Int. Cl.** **G01n 3/28**

[58] **Field of Search** ..... 73/95, 159, 160, 95.5; 28/72 TCR; 33/147 D, 148 D

[56] **References Cited**

UNITED STATES PATENTS

464,766	12/1891	Wendler	73/95
598,205	2/1898	McKnight	73/95
2,724,264	11/1955	Dart et al.	73/95
3,216,082	11/1965	Goy	28/72 TCR
3,333,467	8/1967	Hoskins	73/160
3,726,137	4/1973	Denton	73/160
3,762,220	10/1973	Gusack et al.	73/160

OTHER PUBLICATIONS

Textured Yarn Technology, ed. by G. D. Wilkinson, Monsanto Company, 1967, Vol. 1, pp. 267, 268 and 272–276 relied on.

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Assistant Examiner—Frederick Shoon
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[57] **ABSTRACT**

Apparatus and method for the rapid measurement of the crimp contraction of a texturized yarn wherein two yarn clamping means slidably adjustable with reference to each other, preferably in a horizontal direction, receive a predetermined length of texturized yarn held in an initial straight line path under a preliminary tensional load to at least partly draw out the normal crimp of the yarn, the yarn is briefly extended by movement of a first one of the clamping means away from the second clamping means and is then immediately relaxed by an opposite movement of the first clamping means in order to redevelop the crimp, after which the yarn is again extended by a return movement of the first clamping means until the yarn just comes back to approximately its initial straight line path. At this point, the first clamping means is displaced with reference to its initial clamping position so as to permit the crimp contraction to be measured directly on a scale extending along a horizontal reciprocal path indicated by the first clamping means. The invention is particularly useful in comparing and grading texturized yarns on cops, spools, bobbins or the like in commercial textile operations.

7 Claims, 4 Drawing Figures

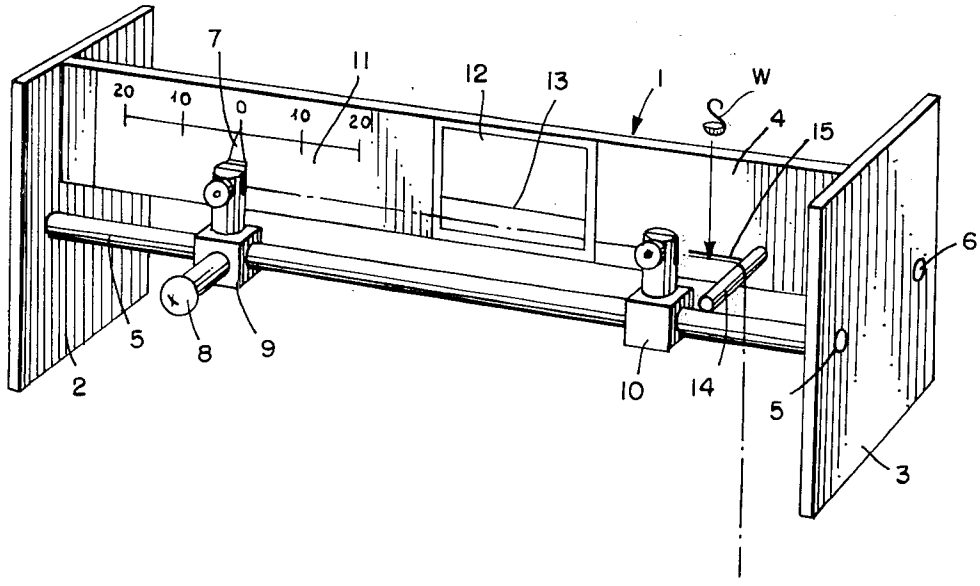


FIG. 1

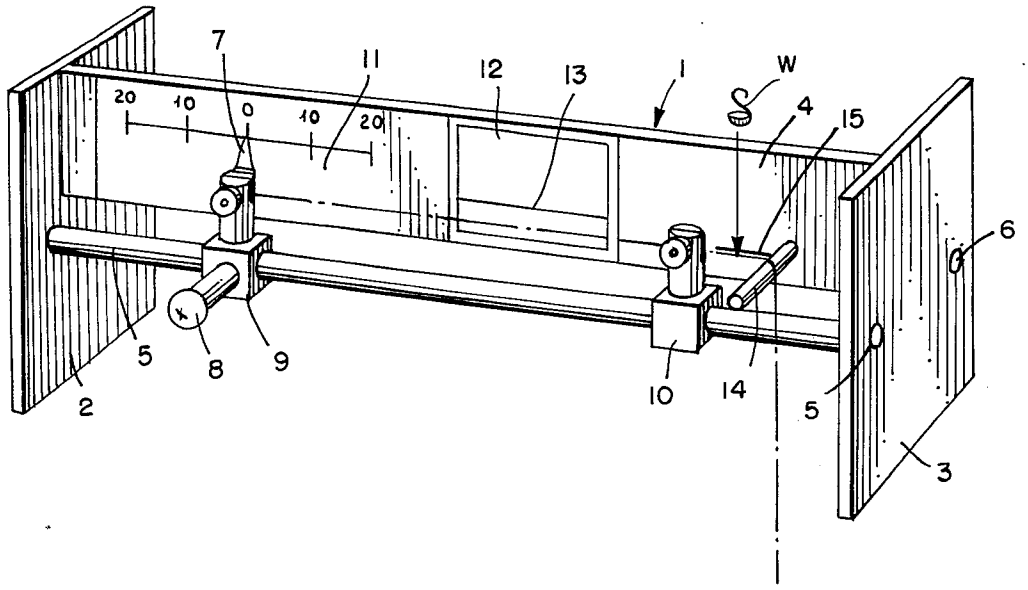

7
11
12
13
1
W
4
15
6
20
10
0
10
20
5
8
9
2
10
14
5
3

FIG. 2

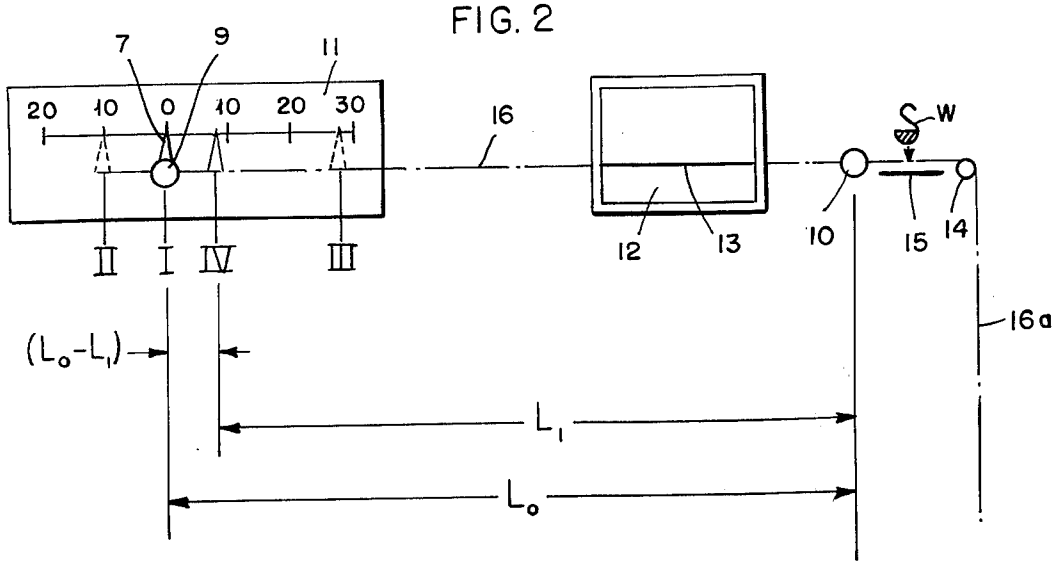

7
9
11
20
10
0
10
20
30
16
W
II
I
IV
III
12
13
10
15
14
16a
(L_o-L_1)
L_1
L_o

FIG. 3

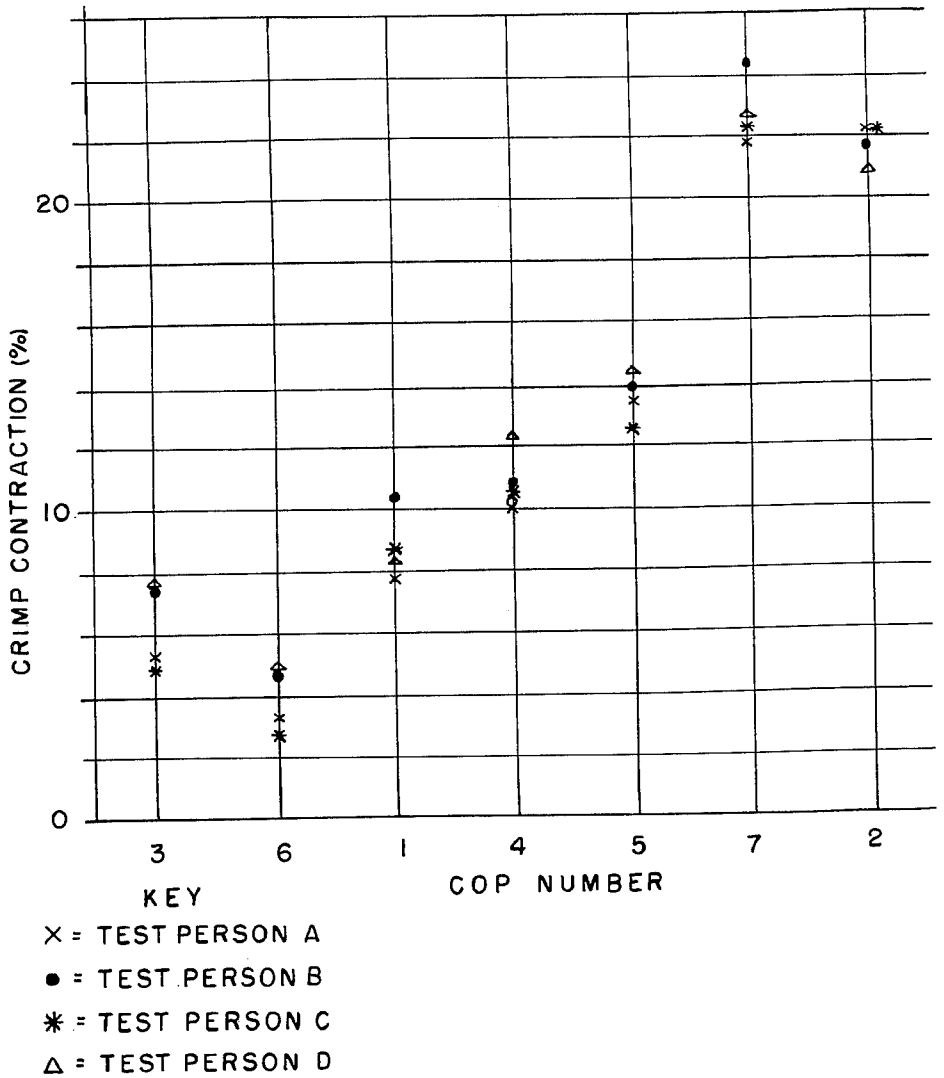
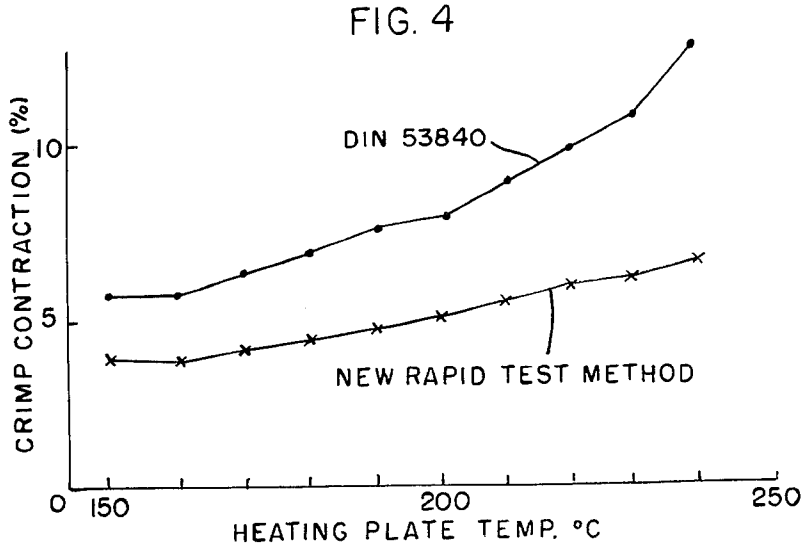

CRIMP CONTRACTION (%)
20
10
0
3
6
1
4
5
7
2
COP NUMBER
KEY
X = TEST PERSON A
● = TEST PERSON B
✱ = TEST PERSON C
△ = TEST PERSON D

FIG. 4


CRIMP CONTRACTION (%)
10
5
0
DIN 53840
NEW RAPID TEST METHOD
150
200
250
HEATING PLATE TEMP. °C

METHOD AND APPARATUS FOR THE MEASUREMENT OF CRIMP CONTRACTION

The crimp contraction (CC) of conventional texturized yarns is usually defined as follows:

$$CC = \frac{L_o - L_1}{L_o} \cdot 100\ \%,$$

wherein L_0 is the stretched or fully elongated length of the yarn and L_1 is its normal crimped or relaxes texturized length.

Several methods are known for the measurement of crimp contraction, all of which generally require a small rope or stranded yarn to be loaded under definite conditions with a specific weight (for measurement of the length L_0) and subsequently to be released from the weight and the length again measured after the crimp has redeveloped (L_1). From these lengths, the crimp contraction is calculated according to the above formula. Attention is directed to the German Industrial Standard (DIN) 53 840 of September 1972 for this determination of the crimp contraction in this manner. No corresponding ASTM or other U.S. Standards could be found for this measurement and calculation of the crimp contraction, and for this reason, a complete translation of DIN 53 840 (draft of September 1972) is included in the record of this patent.

For the rapid testing of yarn samples in commercial operations, especially for sorting or grading cops of texturized yarns, the known methods are much too expensive and, because of the rope sample preparation, heat treatment, drying, climatization, etc. these known methods are much too lengthy and tedious.

It is an object of the present invention to provide a method for measurement of the crimp contraction of texturized yarns, above all one which can be carried out very quickly and which leads to reasonably good reproducible values as well as placing only minimum requirements on the time and skill of operating personnel as the persons conducting the measuring tests. Another object of the invention is to provide an especially suitable apparatus for a simple and rapid determination of the crimp contraction values of texturized yarns. Other objects and advantages of the invention will become more apparent upon consideration of the following detailed specification.

The method or process of the invention includes the following steps:

clamping a length of the texturized yarn in a striaght line path between two points spaced at a predetermined interval while the yarn is under an initial tensional load sufficient to remove slack from the yarn and to draw out at least part of its normal crimp;

briefly extending the yarn longitudinally through movement of a first clamp point thereof by an amount sufficient to ensure the complete drawing out of the normal crimp and to temporarily stress the yarn without imparting any substantial permanent extension thereo;

immediately thereafter completely relaxing the yarn through movement of the first clamped point in the longitudinal direction of the yarn opposite that of the preceding extension step in order to redevelop the normal crimp of the yarn; and

then extending the yarn again only until it is brought back approximately to the straight line path between the two clamping points through another movement of the first clamped point in the same longitudinal direction of the yarn as the preceding extension step, whereby the crimp contraction may be determined directly as a percentage of the predetermined interval between the two clamping points.

The apparatus of the invention preferably includes the following elements in combination:

a supporting frame;

guide rail means mounted horizontally on the supporting frame;

a first and second yarn clamping means with at least the first clamping means being carried slidably on said guide rail means for its adjustable movement in a horizontal reciprocal path with respect to the second clamping means which is adapted to remain in a predetermined fixed position;

a yarn guide pin mounted adjacently to the second clamping means to receive the free end of a yarn passed horizontally through both clamping means and then over the pin;

an indicator means associated for horizontal reciprocal movement together with the first clamping means; and a scale calibrated in percentage of a predetermined initial yarn length between said first and second clamping means and mounted on the frame to extend along the range of the horizontal reciprocal path of the indicator means.

The invention is further illustrated with the aid of the accompanying drawings in which:

FIG. 1 is a perspective view of a particularly useful embodiment of apparatus for carrying out the determination of crimp contraction by the method of the invention;

FIG. 2 is a schematic illustration, including portions of the apparatus of FIG. 1, of the steps followed in directly determining the crimp contraction as a percentage value according to the invention;

FIG. 3 is a graphical illustration of a number of crimp contraction measurements carried out in accordance with the invention by different individual testers to indicate the degree of variation in results;

FIG. 4 is a graphical illustration of crimp contraction measurements made on a particular bicomponent yarn according to the present invention and, for comparison, according to DIN 53 840.

Referring first to FIG. 1, the measuring apparatus suitably includes a supporting frame 1 consisting of two parallel vertical plates or upright struts 2 and 3 and a crossbar or central strut member 4. On the vertical plates 2 and 3, there are mounted two guide rails 5 and 6 extending horizontally one behind the other. These guide rails 5 and 6 or other similar guide means act to carry a first yarn clamp 9 which is equipped with an indicator pointer 7 and a handle 8 and is slidable in a reciprocal horizontal direction one one or preferably both guide rails 5 and 6. A second yarn clamp 10 is similarly mounted on the front guide rail 5, preferably so as to be slidably adjustable to various fixed positions along the face of the apparatus toward the right end as viewed in FIG. 1.

The crossbar 4 is provided with a percentage scale 11 mounted thereon in the reciprocating range of horizontal movement of the first yarn clamp 9 with its coacting pointer 7 as an indicator means. This scale 11 is calibrated in percentage units up to 30% toward the right and up to about 20% to the left, preferably to indicate

the closest one-half percent. These percentages are taken with reference to the initial length L_0 which is predetermined at the beginning of a test, e.g. 10% on the scale represents an actual distance of $0.1 \times L_0$. (Note FIG. 2). The scale is preferably one which is easily replaced with other percentage values to accommodate various standard initial lengths L_0.

Between the two clamps **9** and **10**, a mirror **12** is preferably mounted on the crossbar **4** in order to provide a marking or comparison line **13** etched or painted onto the surface mirror in a horizontal position at the same height as the horizontal path of the yarn **16** held tautly between the two clamps. This line **13** is of substantial help in bringing the tested yarn into its desired horizontal position. To the right of the clamp **10** is a cylindrical guide rod or pin **14** for the yarn, preferably in a closely adjacent position on the order of 7.5 cm., ideally about 7 to 8 cm., away from the clamp **10.** This yarn guide pin **14** may be fixed in place or may also be mounted adjustably together with or separate from the clamp **10.** In all cases, the pin **14** is at about the same height as the clamp **9** and clamp **10** so that the yarn extends horizontally over this pin and is received in running contact thereon.

Another horizontal marking line **15** is placed on the crossbar **4** a short distance below the clamp **10** and pin **14,** ideally at a distance of approximately 15 mm. below the horizontal yarn path connecting clamp **10** and pin **14.** An S-shaped weight W is placed on the yarn as indicated by the arrow in FIGS. **1** and **2.** The line **15** permits a more accurate positioning of this weight W as it is adjusted in its height between clamp **10** and pin **14.**

To measure the crimp contraction with this particular apparatus of the invention, the clamps **9** and **10** are first set for example at a distance L_0 of 50 cm. from each other with the pointer **7** of the left clamp **9** resting on the "**0**" (zero) point of the percent scale **11** (where the percentages in this case are calibrated for 50 cm = 100%, i.e. such that 10% is a line spaced 5 cm. from the zero point). This also corresponds to position I as shown in FIG. **2.** A single length of texturized yarn **16** is then taken off from a cop or bobbin to be tested and is placed horizontally in the clamps **9** and **10** as well as over the pin **14.** The clamp **9** is then tightened to hold the left end of the yarn **16.** The tester holds firmly to the right end **16***a* of the yarn and simultaneously loads the S-shaped weight W onto the yarn, e.g. midway between the clamp **10** and pin **14** to provide an initial tension on the yarn of preferably about 0.005 grams/dtex. This weight W is lifted or adjusted by pulling the yarn over the pin **14** until the hook or upper part of the weight comes up to the height of the marking line **15.** The clamp **10** is then also tightened so that a definite tensional load is applied to the yarn while it is clamped over the predetermined interval L_0 of 50 cm.

This initial load, e.g. on the order of 0.005 grams/dtex is sufficient to take up the sag or slack of the yarn caused by its own weight and is also sufficient to at least partly draw out the normal crimp of the yarn, for example so as to stretch the initial texturized yarn for crimp extension by at least about 30% and preferably more than 50% of the total extension required to completely draw out the crimp. Smaller crimp extensions at L_0 (position I) may be used but with less reliable results. Preferably, the yarn **16** is almost completely extended with reference to drawing out the crimp at the initial clamped length L_0, e.g. 85 up to 100% of the available crimp extension or drawing out of the normal crimp.

As soon as the yarn **16** is clamped at position I, the clamp **9** is moved to the left in order to ensure complete crimp extension up to a preferably predetermined extension to position II of about 5 to 20% greater than the length L_0. This extension lasts only a few seconds, e.g. 2 seconds generally being sufficient and seldom more than 5 or 6 seconds. It is preferable to set a definite extension to the position II based upon the stress-strain diagram of the fibrous material of the yarn. Such materials can be elongated without breaking and often have sufficient elasticity to return to their original length without any substantial permanent extension. This particularly true where the extension is very temporary and lasts only a few seconds. By referring to the stress-strain diagram of the fibrous material, one can select a percentage extension for position II which is reasonably within the elastic limits of the material iteself so as to permit the same percentage extension on each sample of a similar group of yarns differing only in their texturization or crimping values but being composed of the same fibrous material.

Surprisingly, the exact percentage of extension in the movement to position II does not have any great significance in the same series of tests provided it is kept constant and ensures a completely crimp free yarn without exceeding elastic limits of the material iteself.

Immediately after this extension to position II, the yarn is released and completely relaxed by movement of clamp **9** toward the right to position III. The length of this movement is of little importance so long as it permits a recovery or redevelopment of the yarn crimp substantially free of tension. This relaxation and crimp contraction also requires only a few seconds, seldom more than 10 seconds, at position III.

Then, after the crimp contraction is substantially complete, the clamp **9** is moved again to the left away from clamp **10** and is extended only up to the point that it reaches the original horizontal path of the yarn, preferably by comparing or aligning the yarn at this point with the horizontal marking **13** on mirror **12.** The pointer **7** is then in position IV and the percentage crimp contraction can be read directly off the scale **11.**

There is no substantial tension on the yarn at position IV which essentially measures the distance L_1 which represents the amount of crimp contraction from the more extended original clamped position I corresponding to L_0. It is particularly advantageous to be able to read the percentage value of this crimp contraction from the calibrated scale **11** because this avoids the tedious measurement of actual yarn lengths followed by a computation or calculation of the percentage crimp contraction.

In order to obtain a greater differentiation of the measured values of different cops or bobbins, it is sometimes helpful to return the yarn to position IV without completely reaching the horizontal linear path but instead to a point where the yarn still exhibits a slight sag in the middle of a few millimeters, e.g. up to 5 mm. In this case, it is desirable to provide another marking line (not shown) on the mirror **12** just below the illustrated marking line **13.** For a more exact result, the percentage value shown on the scale must be corrected by a small amount to compensate for the error introduced by the sag in the yarn.

FIG. 3 illustrates a testing of a number of different cops of texturized yarn as randomly selected by each of four testers A, B, C and D. The yarn in this case was a bicomponent yarn of two polyethylene terephthalates of different molecular weight melt spun side by side for each individual filament in a ratio of 50:50. These filaments were stretched on a heated plate at various temperatures of 150° to 240°C. to achieve increasingly higher crimping values.

FIG. 4 compares the crimp contraction values for these same yarns at each 10°C. increment from 150° to 240°C. According to the rapid test method of the invention (using an extension to position II of 15%) and also according to the much more time-consuming standard method of required by DIN 53 840. Although a larger crimp contraction in percent is obtained by DIN 53 840, very distinctive lower percentages of crimp contraction are achieved by the present invention so as to provide an accurate method of sorting or grading the cop yarns which are otherwise very similar in appearance and vary only within about 8 percentage values even when measured by DIN 53 840.

As will further be apparent from FIG. 3, these different bicomponent yarn samples will exhibit some variation in the mesurement of the crimp contraction values, depending upon the particular test person taking the measurements. However, these variations are not a serious problem, especially if all tests are carried out by the same person who tends to make all measurements in the same manner. Also, it has been found that testing each sample twice and using the average value of the two tests is usually sufficient to give an accurate result.

The method and apparatus of the invention works especially well with the well-known bicomponent texturized yarns wherein the extension or stretch to position II is preferably set at about 10 to 15% for optimum results. However, the method and apparatus have also been used successfully with false-twist texturized yarns and may also be applied to stuffing box crimped yarns, edge crimped yarns, deknit crimped yarns and the like. In general, it is preferable to employ synthetic thermoplastic melt-spun fiber forming polymers, especially the linear polyesters such as polyethylene terephthalate and the linear polyamides such as the nylons. However, other texturized synthetic or artificial yarns are also capable of being measured by the invention, for example, polyacrylonitrile, polyolefine, acetate and the like. For additional details concerning such texturized or crimped yarns and their preparation, attention is directed to such references as "Woven Stretch and Textured Fabrics," by Hathorne, Interscience Publishers, John Wiley & Sons, New York (1964).

Both the method and the apparatus of the invention may be readily adapted to a wide variety of texturized yarns, commercial operating conditions and test personnel. The advantage of the invention resides not only in the rapid and simple performance of the method on an economical test device but also in the fact that only a very short length of yarn is required for each test sample by comparison with the so-called "small rope" method of DIN 53 840. Moreover, no special pretreatment of the yarn is required and only a very small amount of preliminary information is required to set up the apparatus and the test method. Accordingly, the invention is ideally suited for large scale commercial operations where one must constantly sort, grade or size texturized yarns to maintain uniform results and good compatibility of various texturized yarns in composite threads, fabrics and other textile products.

The invention is hereby claimed as follows:

1. A method for the rapid measurement of the crimp contraction of a texturized yarn which comprises:

clamping a length of said texturized yarn in a straight line path between two points spaced at a predetermined interval while said yarn is under an initial tensional load sufficient to remove slack from the yarn and to draw out at least part of its normal crimp;

briefly extending the yarn longitudinally through movement of a first clamped point thereof by an amount of about 5 to 20% and sufficient to ensure the complete drawing out of the normal crimp and to temporarily stress said yarn without imparting any substantial permanent extension thereto;

immediately thereafter completely relaxing said yarn through movement of said first clamped point in the longitudinal direction of the yarn opposite that of the preceding extension step in order to redevelop the normal crimp of the yarn; and

then extending the yarn again only until it is brought back approximately to said straight line path between the two clamping points through another movement of said first clamped point in the same longitudinal direction of the yarn as said preceding extension step,

whereby the crimp contraction may be determined directly as a percentage of said predetermined interval between said two clamping points.

2. A method as claimed in claim 1 wherein said length of yarn is clamped in a horizontal straight line path between the clamping points and said first clamping point is moved horizontally for said extension, relaxation and reextension of the yarn.

3. A method as claimed in claim 2 wherein said first clamped point is initially set at the zero point of a fixed scale extending longitudinally of the yarn and being calibrated in units of percentage of the initial predetermined interval between the two clamped points, the crimp contraction being read from said scale as indicated by the final position of said first clamped point after its movement to bring the yarn back approximately to said straight line path.

4. A method as claimed in claim 2 wherein said length of yarn is initially clamped at a first clamping point while running freely through the second clamping point to an adjacent guide pin, a weight for applying said initial load is hung on the yarn between said second clamping point and said guide pin and is placed in a predetermined position a short distance below the horizontal straight line path of the yarn by pulling on the free end of the yarn, and then the second clamping point is clamped on the yarn.

5. A method as claimed in claim 4 wherein said weight hung on said yarn is on the order of 0.005 grams/dtex.

6. A method as claimed in claim 1 wherein the initial tensional load on the yarn is on the order of 0.005 grams/dtex.

7. A method as claimed in claim 1 applied to a bicomponent texturized yarn.

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