

Jan. 21, 1969

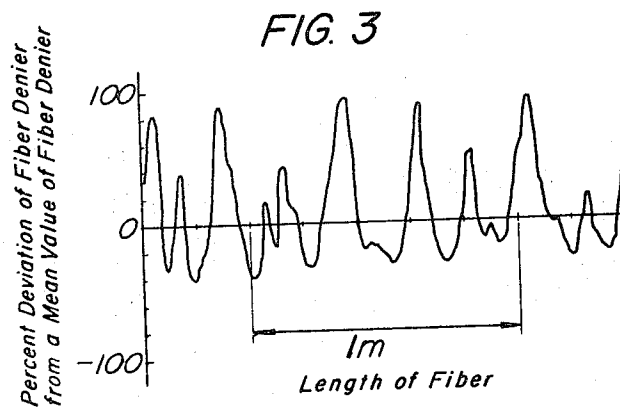
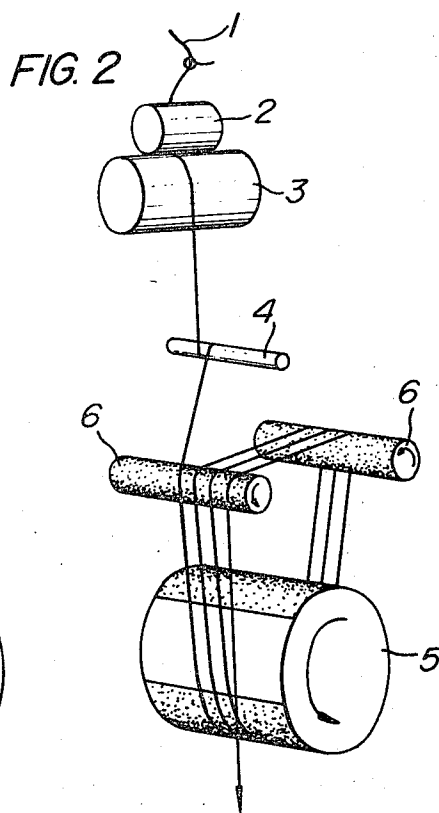
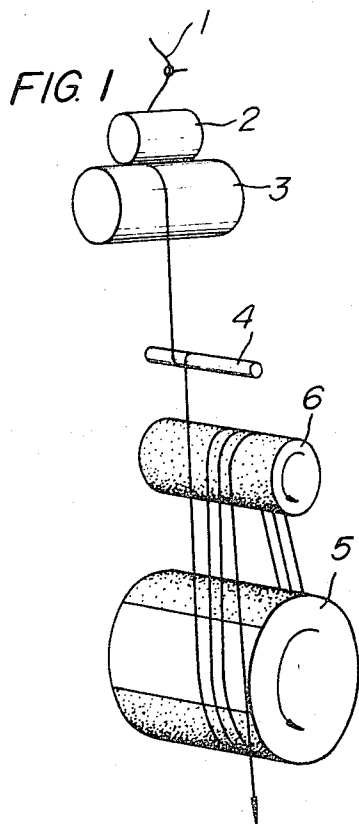
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3,422,491

APPARATUS FOR STRETCHING SYNTHETIC FIBERS

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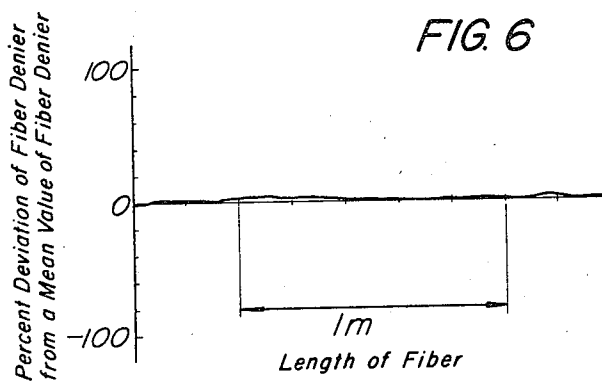
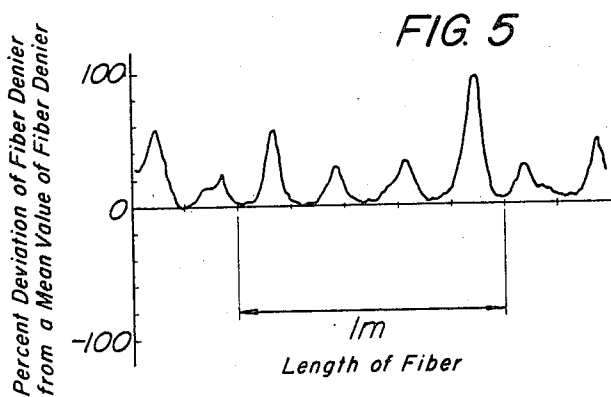
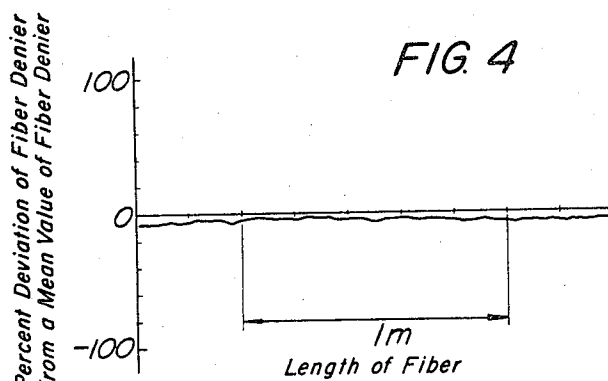
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APPARATUS FOR STRETCHING SYNTHETIC FIBERS

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Filed Sept. 7, 1965, Ser. No. 485,272

Claims priority, application Japan, Sept. 9, 1964,
39/51,834

U.S. Cl. 18—1
Int. Cl. D02j 1/22

1 Claim

ABSTRACT OF THE DISCLOSURE

Apparatus for periodically varying the denier of fiber by stretching the fiber, without slippage, when contacted by the mirror surface of a stretching roll and then stretching the fiber substantially less when contacted by an aventurine surface of the stretching roll. A broad, axially extending segment of the stretching roll is provided with an aventurine finish and the remaining narrower segment has a mirror finish.

This invention relates to an apparatus for stretching synthetic fibers, and more particularly to an apparatus for periodically varying the denier of synthetic fibers.

Synthetic fibers comprising polyamide, polyester, polyolefin, polyacrylonitrile or the like, are industrially produced by wet, dry and melt spinning processes. At the stage of the spinning process, the spinning liquids of the polymers are pressed through a spinneret and are solidified to form fibers. These fibers are not satisfactorily oriented in their internal structure and must subsequently be stretched so as to be oriented to a practically satisfactory mechanical level. The stretching or drawing of such synthetic fibers is performed by passing them through two sets of driven rolls differing in speed.

The methods hitherto known of periodically varying the denier of synthetic fibers include (1) methods of periodically varying the feeding of the starting liquid to the spinneret when spinning, (2) methods of unevenly solidifying the fibers immediately after the spinneret, (3) methods of eccentrically driving the feeding roll or the stretching roll when stretching, (4) methods of periodically varying the rotating rate of the rolls and so on.

Any of these methods requires precise and complicated equipment and subsequently have the disadvantage that the apparatus becomes expensive.

It is an object of the present invention to provide apparatus for stretching synthetic fibers and obtaining periodically varied denier of fibers which does not require any precise, complicated and expensive construction.

It is another object of the present invention to provide apparatus for obtaining uneven fibers which have a unique appearance when dyed and woven.

Other objects and advantages will become apparent from the following description.

We have found that in the cases of stretching synthetic fibers, such as fibers comprising polyamide, polyester, polyolefin, polyacrylonitrile or the like, if the surface of the stretching roll is given an aventurine finish partly in the circumferential direction, for instance, by means of liquid honing with carborundum, the stretching is made uneven and fibers having periodically varied denier are obtained.

Thus, the present invention provides apparatus for stretching synthetic fibers which comprises varying periodically the denier of fiber by use of a stretching roll having the surface thereof partly with an aventurine finish in circumferential direction.

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According to the present invention, fiber with periodically varied denier can be obtained with little modification in the conventional stretching equipment and accordingly the apparatus is inexpensive.

When the thus obtained fiber is dyed, the lesser stretched portions are dyed more deeply and when such a fiber is woven into a fabric, the uneven dyeing produces a unique appearance.

In the following, the present invention will be explained in greater detail with reference to the accompanying drawings in which:

FIG. 1 is a perspective view of one embodiment of the apparatus in accordance with the present invention;

FIG. 2 is a perspective view of another embodiment of the same;

FIGS. 3 and 4 are graphical illustrations respectively showing denier unevenness of the fiber according to the present invention and the method using conventional stretching roll, both obtained in Example 1; and

FIGS. 5 and 6 are similar illustrations of the results obtained in Example 2.

Referring to FIG. 1, unstretched yarn 1, after being held by a holding roll 2, leaves a feeding roll 3 and after being wound on a stretching pin 4, proceeds to a stretching roll 5 and after passing one to three turns on the combination of the stretching roll 5 and a separate roll 6, is wound up.

An angular portion of about 180° to 330° of the surface of stretching roll 5 has an aventurine finish, obtained for instance, by means of liquid honing with carborundum, and the remaining portion has a mirror finish. The entire surface of the separate roll 6 has an aventurine finish. (In FIGS. 1 and 2, the dotted portions represent aventurine surfaces.) In this case, when the running yarn is contacted with the mirror-finished surface of the stretching roll 5, the yarn is stretched normally, without slippage, because the frictional resistance is high, which when contacted with the aventurine surface, the yarn is not stretched as much because the frictional resistance is low.

The roughnesses of the mirror-finished surface and the aventurine surface are arranged to give appropriate respective frictional resistances. Particularly, the mirror-finished surface is arranged to be lower than 0.5s in order to give sufficiently high frictional resistance, and the aventurine surface is arranged to be higher than 1s in order to give appropriate slippage but lower than 12s in respect of preventing yarn breakage by frictional forces between the fiber and too roughened a surface. The character s represents the difference in height, expressed in microns (μ) of the raised portions relative to depressed portions and hence is a measurement of the roughness or unevenness of the surface. However, despite the high relative unevenness of the aventurine surface its high polish sufficiently compensates below values of 12s to make its frictional resistance lower than that of the mirror-finished surface.

Thus, the fiber having periodically varied denier can be obtained as the stretching roll 5 rotates. The period of denier unevenness can be changed as desired by changing the diameter of stretching roll 5. And the amplitude of denier unevenness can be increased as desired by decreasing the number of windings of the fiber on the stretching roll 5 and separate roll 6. Alternatively, by increasing the proportion of the aventurine portion of the surface of stretching roll 5, the amplitude of denier unevenness can be increased and also the proportion of the reduced stretched part can be increased. Again alternatively, by decreasing the surface contacting with running yarn of the stretching roll 5 employing two separate rolls 6 as shown in FIG. 2, the amplitude of denier unevenness can be increased.

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Also in the cases of employing either a metallic fixed pin having an aventurine surface finish, for instance, by means of liquid honing, or a porcelain fixed pin having a surface highly roughened in place of the separate roll 6, similar results can be obtained.

The aventurine segment of the stretching roll 5 must subtend more than 180° , so that the running fiber is exclusively contacted only by the aventurine, so that periodical slippage occurs. The aventurine segment of the stretching roll 5 must not subtend more than 330° , so that the frictional resistance on the running fiber is so low that periodical stretching does not occur.

The following examples merely illustrate the present invention, but do not restrict the same.

Example 1

Unstretched fiber of 60 denier poly-caprolactam monofilament was stretched by the system of FIG. 1. A 240° portion in circumferential direction of the surface of stretching roll 5 has been finished aventurine (roughness $3s$) by liquid honing with carborundum and then chrome plating and the remaining portion is a mirror-finished surface (roughness $0.3s$). The diameter of stretching roll 5 is 100 mm. and the length of running yarn from the stretching pin 4 to the first contacting point with the stretching roll 5 is 70 mm. The yarn was passed with one turn around the combination of stretching roll 5 and separate roll 6 and then was wound up. FIG. 3 shows denier unevenness of thus obtained fiber, and FIG. 4 shows denier unevenness of fiber obtained by stretching the same unstretched yarn using a conventional stretching roll, that is, a stretching roll the entire surface of which is mirror-finished (roughness $0.3s$). These figures were determined using an unevenness tester (Uster). The determination was conducted in such a way that the fiber is passed at a constant speed through a two-plate condenser and the volume change due to denier unevenness is transformed into a current change which is recorded. The abscissa represents the length of fiber, and the ordinate represents the percent deviation of the fiber denier relative to the mean fiber denier (corresponding to 0%). FIG. 4 shows that the fiber denier is substantially constant. On the other hand, FIG. 3 shows that the fiber produced according to the method of the invention has peaks, that is, insufficiently stretched portions at intervals of 250 mm. in the lengthwise direction of the fiber. Further, the birefringence of small fiber denier portions was determined as 5.3×10^{-2} and that of large fiber denier portions was determined as 1.7×10^{-2} which shows insufficient stretching.

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When the thus obtained fiber was woven into a fabric and dyed, uneven dyeing appeared and an interesting appearance was obtained.

Example 2

Unstretched yarn of 245 denier/24 filaments poly-caprolactam was stretched by the system of FIG. 2. The stretching roll is the same as in Example 1. About one-third of the surface of the stretching roll contacts the running fiber. The fiber was wound with three turns on the combination of stretching roll and two separate rolls and then wound up.

The denier unevenness of the thus obtained fiber has a periodical variation as shown in FIG. 5. On the other hand, the denier unevenness of fiber obtained by stretching using a conventional stretching roll in replacement of roll 5 has no variation of fiber denier as shown in FIG. 6.

What is claimed is:

1. Apparatus for periodically varying the denier of synthetic fibers, which comprises a feed roll, a stretching pin, a stretching roll having a cylindrical surface divided into two axially extending segments, one which is wider than the other and subtends an angle greater than 180° and up to 330° , the wider segment having an aventurine finish with a surface roughness value between $1s$ and $12s$ while the narrower segment has a mirror finish with a surface roughness value of less than $0.5s$ whereby the aventurine finish surface has a lower frictional resistance than the mirror finish surface, and at least one separator roll proximate said stretching roll for the winding of fibers around said stretching and separator rolls, each said separator roll having a fiber-engaging surface which has an aventurine finish.

References Cited

UNITED STATES PATENTS

2,038,722	4/1936	Dreyfus et al.	264—167
2,859,472	11/1958	Winckhofer	264—290
2,975,474	3/1961	Smith	264—167
3,137,033	6/1964	Maaskant.	

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28—71.3; 29—121; 264—167, 290

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