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[33] **Netherlands**
[31] **67-16844**

[54] **MANUFACTURE OF CRIMPED YARNS**
13 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **28/1.2,** 28/72.11
[51] **Int. Cl.** **D02g 1/00**
[50] **Field of Search** 28/1.2, 1.3–1.6, 1.8, 72.1, 72.11–72.15

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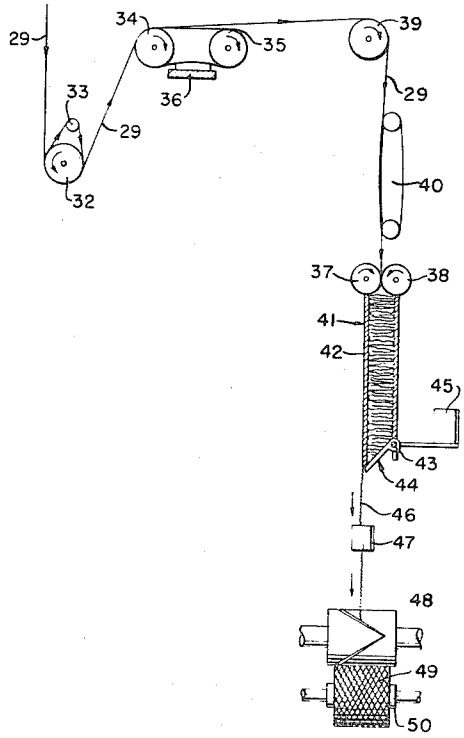
ABSTRACT: A method for the manufacture of a crimped synthetic yarn which comprises introducing two crimps, separately, into a yarn, a latent crimp being introduced into the yarn by heating the yarn asymmetrically while under tension, and a direct crimp being introduced into the yarn by subjecting the yarn to a direct crimping treatment. Also an apparatus for carrying out this method and the yarn obtained by the method are disclosed.



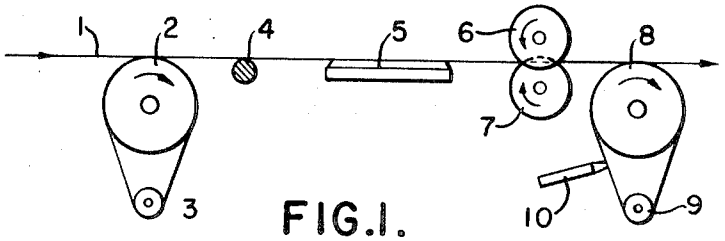


FIG. 1.

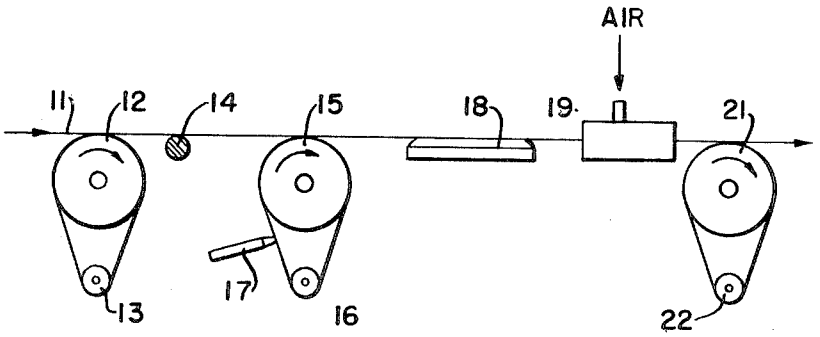


FIG. 2.

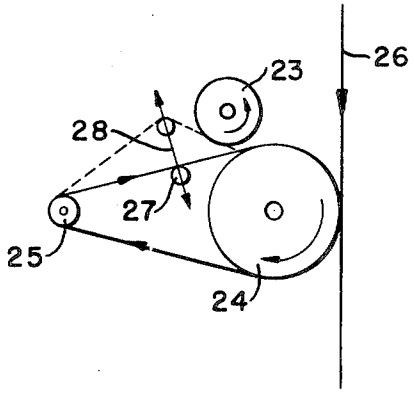


FIG. 3.

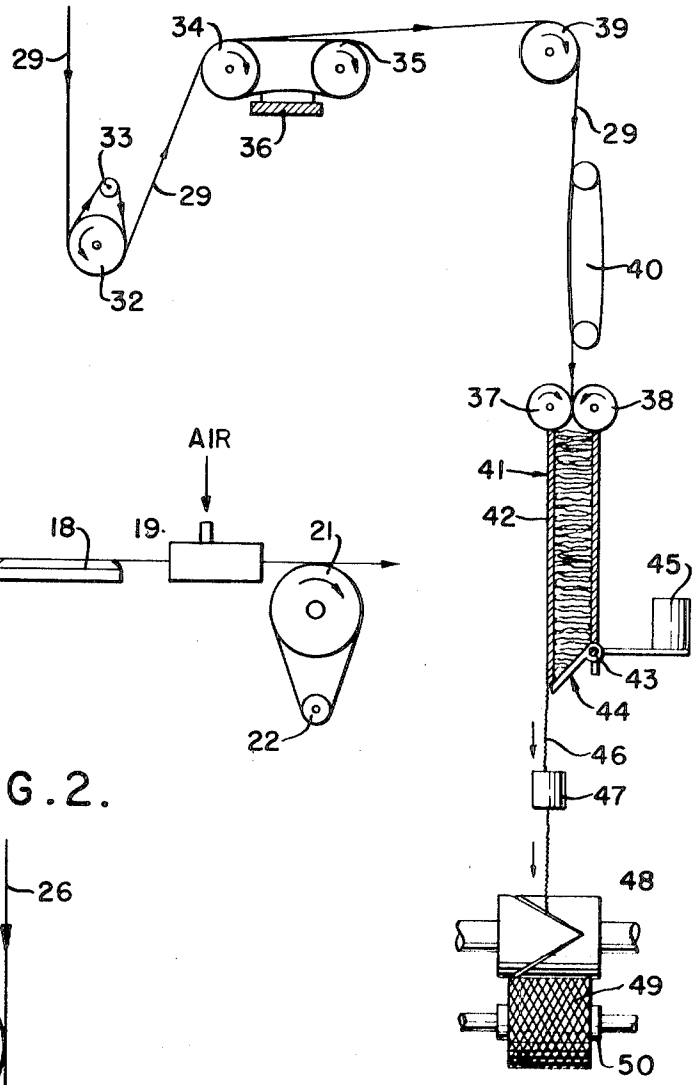


FIG. 4.

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MANUFACTURE OF CRIMPED YARNS

This invention relates to the manufacture of a crimped synthetic yarn, especially a yarn consisting of polyamides or polyesters, and more particularly to a method and apparatus for crimping a yarn wherein two crimps are introduced into the yarn, one being a direct crimp and the other being a latent crimp, and to the double-crimped yarns obtained thereby.

A method of introducing a latent crimp into a yarn is known. With the known method the latent or indirect crimp is developed to a greater or lesser degree, i.e. converted into a palpable and visible crimp, by subjecting the yarn, while in a practically tensionless state, to a heat treatment. However, the yarn manufactured by this known method has been found to be unsuitable for certain applications and insufficiently opened. More particularly, the voluminosity that can be obtained by developing the latent crimp in the yarn is often insufficient to meet the necessary requirements.

This invention advantageously provides a method for crimping yarn which does not show these disadvantages. More particularly, this invention contemplates a method for the manufacture of a crimped synthetic yarn which comprises introducing two crimps separately into a yarn, a latent crimp being introduced into the yarn by heating the yarn on one side or at least asymmetrically while under tension and a direct crimp being introduced into the yarn by subjecting the yarn to a direct crimping treatment such as a gear-crimping, a box-crimping or an air-crimping treatment. The method of this invention is thus characterized in that before or after the introduction of the latent crimp by asymmetrically heating the yarn, the other or second crimp is introduced into the yarn by subjecting it to a direct crimping treatment.

In accordance with this invention, it is preferred that, prior to being subjected to the direct crimping treatment, the yarn should be heated at a temperature in the range of from 70° to 180° C. A very effective embodiment of the method of this invention is characterized in that the direct crimping treatment, and the introduction of the latent crimp by one-sided or asymmetric heating, as well as a drawing treatment are all carried out in a continuous-type operation.

The method according to the invention permits the manufacture in an economically acceptable manner of an attractive double-textured or crimped yarn which has a three-dimensional crimp. This is in contrast with a yarn that is gear-crimped or box-crimped only, and that has a substantially two-dimensional crimp.

Preferably the second crimping treatment will be a direct box-crimping treatment, in which the crimp is, in general, fully developed immediately. In the box-crimping process a pair of rollers which are pressed together and rotate in opposite directions force the yarn, which may be preheated, or not, at a temperature of, for instance, about 100° C. into a heated or unheated stuffer box at one end thereof against a wad of yarn that has already been crimped. The other end of the stuffer box can be closed with a hingedly attached door, which is loaded with a weight. The box-crimping treatment can be carried out at a high speed (for instance 500–2,000 m./min.). Furthermore, it has surprisingly been found that the latent crimp in the yarn according to the invention is better developed, so that the yarn obtained has a satisfactory voluminosity. This is probably due to the yarn being opened in the direct crimping treatment. Upon opening of a crimped yarn, filaments which are in phase initially may be displaced relative to each other, and when an additional crimp is introduced into the yarn, the voluminosity of the yarn is increased.

Moreover, the yarn manufactured by the method according to the invention has another unexpected advantage. Thus, it has been found that piece-dyed carpets (dyed after manufacture) made from the double-crimped or double-textured yarns of this invention have, more particularly when box-crimped, a very regular appearance compared with carpets manufactured from yarns that have been textured only once. The carpets made from yarns according to the invention also have a soft handle, while they retain such favorable properties as resilience and luster.

If according to the invention direct crimping is carried out by the gear-crimping process, the gear-crimping may with advantage take place in the drawing zone between the feed roll and the draw roll, which is driven at a higher peripheral speed.

In a preferred embodiment of the method according to the invention one-sided heating under tension and after drawing may be carried out with a heating element having a surface temperature adjacent to the point of contact with the yarn that is higher than the softening point of the treated yarn.

This invention also is concerned with a yarn manufactured by the aforedescribed method.

More particularly, this invention is directed to a crimped synthetic multifilament yarn of polyamides or polyesters which is characterized in that in its longitudinal direction each filament has an approximately wavy appearance, and in that in its longitudinal direction each filament extends at least partially along a substantially helical path. It is preferred that this yarn should have a denier in the range of from approximately 1,000 to 1,200, with the number of filaments being in the range of from 60 to 70. Tufted carpets having an upper surface which is made up substantially of the aforedescribed yarn are found to have favorable properties. More particularly, their soft handle and high resilience compare favorably with those of carpets made up of different yarns.

Also spun-dyed yarns manufactured by the method according to the invention may be formed into a carpet which, after it has been subjected to a heat treatment, shows similar favorable properties to those of the above-mentioned piece-dyed carpets.

The crimped yarn according to the invention is also considered particularly suitable to be processed into a filament sheet.

Furthermore, this invention is also directed to an apparatus for carrying out the heretofore-described yarn-crimping method. This apparatus comprises a yarn supply, two different crimping means for introducing two crimps, separately, into the yarn, and means for feeding the yarn from the yarn supply, successively, to said two crimping means, one crimping means comprising means for introducing a latent crimp into the yarn by asymmetrically heating the yarn while the yarn is under tension and the other crimping means comprising means for introducing a direct crimp into the yarn.

The invention will be further elucidated with reference to the accompanying schematic drawings in which:

FIG. 1 illustrates one embodiment of the method for crimping yarn in accordance with this invention (and the apparatus for effecting the method) wherein the yarn is first subjected to gear-crimping and then to latent crimping by one-sided heating;

FIG. 2 illustrates a modified embodiment of the method wherein one-sided heating for the purpose of introducing a latent crimp is followed by direct air-crimping;

FIG. 3 illustrates a modified arrangement for effecting one-sided heating of the yarn; and

FIG. 4 illustrates still another embodiment of the method (and apparatus) of the invention wherein, after the introduction of the latent crimp by one-sided heating, the yarn is subjected to box-crimping.

In the process scheme shownin FIG. 1, an undrawnyarn (e.g.onemadeofnylon-6filaments)issupplied by a feed roll 2, that is driven in the direction indicated by the arrow, and a separator roll 3. The yarn is given a few wraps around these rolls. The yarn then makes one wrap around a draw pin 4 and passes over a hot plate 5 having a temperature of 100° C. After leaving the hot plate, the yarn is subjected to a direct crimping treatment by feeding it between the intermeshing teeth on gear wheels 6 and 7 which are driven at a circumferential speed of 270 meters per minute in the directions indicated by the arrows. The yarn is forwarded by means of a draw roll 8 and separator roll 9, the draw roll being driven in the

clockwisedirection,asfurther indicated by the arrow. The circumferential speed of the draw roll **8** is approximately four times that of the feed roll **2**, so that the yarn is drawn at a ratio of 4:1.

The drawn yarn makes a few wraps around the draw roll **8** and the separator roll **9**, one of the wraps being brought into contact with a hot pin **10**. The face of the hot pin **10** has a temperature of 250° C. and is in contact with the yarn over a length of about 10 millimeters. In this manner the yarn is in contact with the hot pin for a very short time, so that the yarn is not heated all over its cross section but only on one side or asymmetrically. As a result of this heat treatment, a latent crimp is introduced into the yarn. After leaving the draw roll **8**, the drawn and crimped yarn is discharged in the direction indicated by the arrow and is, for instance, wound in a known manner into a package (not shown).

The embodiment illustrated in FIG. **2** differs from that of FIG. **1** mainly in that according to this embodiment the one-sided heating of the yarn by a hot pin takes place prior to a direct air-crimping treatment, and air-crimping takes place in an additional zone in which the yarn is already substantially drawn.

An undrawn nylon yarn **11** is supplied by a feed roll **12**, (which is driven in the direction indicated by the arrow,) and by a separator roll **13** at a speed of 100 meters per minute and is passed over a draw pin **14**. The yarn then travels to a first draw roll **15** with a separator roll **16**. The yarn makes a few wraps around these rolls, one of the wraps being brought into contact (in a similar manner as shown in FIG. **1**), with a hot pin **17** at a temperature of approximately 250° C. for the purpose of introducing a latent crimp into the yarn by heating it on one side. The circumferential speed of the first draw roll **15** is higher than that of the feed roll **12** and it is so chosen that a draw ratio of 3.8:1 is obtained. After leaving the first draw roll **15** the yarn travels over a hotplate **18** at a temperature of approximately 100° C. and then passes through air crimper **19**. Finally, the yarn passes over a second draw roll **21** with separator roll **22**. The total draw ratio of the yarn between the second draw roll **21** and the feed roll **12** is 4.0:1.

FIG. **3** illustrates a somewhat modified embodiment of an arrangement for carrying out one-sided heating, the hot pin used in the embodiment of FIGS. **1** and **2** being replaced by a hot roll **23** which is driven in the direction indicated by the arrow and is in contact with one of the wraps of a yarn **26** which passes over a draw roll **24** with separator roll **25**. By displacing an auxiliary pin or roll **27** in the directions indicated by arrows **28** the length over which the yarn travels in contact with the hot roll **23** can be adjusted.

FIG. **4** illustrates a setup for a continuous method of melt spinning, drawing, one-sided heating, box-crimping and winding of nylon-6 yarn.

A bundle **20** which consists of a number of nylon-6 filaments is extruded from a spinneret (not shown), and is passed through a blow box (not shown), after which it is passed in a known way on to a driven feed roll **32** with separator roll **33**. The yarn **29** is given a few wraps round the rolls **32** and **33** in order to ensure a constant feed rate of the yarn. The yarn is forwarded by a pair of draw rolls **34** and **35**, which are driven at equal speeds and around which the yarn is given, for instance, five wraps. In one operation the circumferential speed of the draw rolls **34** and **35** was 1,700 meters per minute, and that of the feed roll 400 meters per minute. The transported yarn was consequently drawn at a ratio of 4.25:1. Between the draw rolls **34** and **35** the yarn is heated on one side by contacting one or more of the wraps for a very short time with a plate **36** which is heated electrically (other means of heating the plate may be used) to a temperature of 300° C., the temperature being measured on the surface of the plate close to the yarn.

In this way there is imparted to the yarn a substantially latent crimp, i.e. a crimp which, without further treatment, is insufficiently developed and is palpable and visible in the yarn to only a slight extent. From the draw rolls **34** and **35** the yarn is passed on by stuffing rolls **37** and **38**, which are driven in opposite directions. The circumferential speed of the stuffing rolls is a few percent, e.g. 2 percent, lower than that of the draw rolls **34** and **35**. Between the stuffing rolls and the draw rolls the yarn **29** is passed over a roller **39** and over an electrically heated hot plate **40** having a temperature of about 100° C. The yarn 29 makes a few wraps round the hot plate **40**.

Instead of using the hot plate 40, it is also possible to heat the yarn only in the stuffer box by electrically heating the wall thereof or by blowing steam into it. The stuffing rolls **37** and **38** force the yarn **29** at one end of the stuffer box **41** against a wad **42** of yarn that has already been crimped. At its other end the stuffer box may be closed with the aid of a door **44**, which is hingedly attached at **43** and is loaded with a weight **45**. The crimped yarn **46** is, via a tensioner **47**, withdrawn from the stuffer box **41** by a winding device which consists of a driven slotted drum **48** for traversing the yarn along a yarn package **49**, which is formed on a bobbin **50**.

The following specific examples further illustrate the invention.

EXAMPLE I

In this example a nylon-6 carpet yarn is produced by following the procedure disclosed with reference to FIG. **1**. The draw ratio, the roll speeds and the temperatures disclosed in the description of this embodiment were used in the production of a nylon-6 carpet yarn having a denier of 1,140 and consisting of 64 filaments. The teeth of the gear wheels **6** and **7** were involute, the module being m=0.5. From the resulting yarn, tufted carpets were made which after piece-dyeing in a warm dye-bath were found to have the favorable properties heretofore described, i.e., regular appearance, soft handle, and good resilience and luster.

EXAMPLE II

Additional yarns are produced in accordance with procedures described for the embodiments of the invention disclosed in FIGS. **2** and **4** (in the embodiment of FIG. **2** the air-crimper was replaced with a pair of gear-crimper wheels which rotate at a circumferential speed of 250 meters per minute). The draw ratios, roll speeds and temperatures of the heated surfaces heretofore disclosed with reference to each of these embodiments are employed to produce double-crimped yarns having increased voluminosity, particularly suitable for carpet applications.

It will be appreciated that various changes and modifications may be made to the specific embodiments illustrated that are within the scope of the invention.

What is claimed is:

1. A method of manufacturing crimped synthetic yarn having two separate and distinct crimps which comprises, in any order, introducing a latent crimp into a synthetic yarn by heating a portion of the cross section of said yarn while under tension to a temperature higher than the softening point of the yarn for a relatively short period of time whereby said yarn is asymmetrically heated to localize the heating to said portion and to thereby form a latent crimp therein, and introducing a direct crimp into the yarn by separately heating the yarn to a temperature lower than the softening point of the yarn and bending the heated yarn to form a direct crimp therein.

2. The method of claim **1** in which the latent crimp is introduced into the yarn prior to the direct crimp.

3. The method of claim **1** in which the direct crimp is introduced into the yarn prior to the latent crimp.

4. The method of claim **1** in which the direct crimp is introduced into the yarn by a gear crimping, a box crimping, or an air crimping treatment.

5. The method of claim **4** in which the direct crimp is introduced into the yarn by gear-crimping the yarn, and the gear-crimping is carried out in a drawing zone between a feed roll and a draw roll, said draw roll being driven at a higher circumferential speed than the feed roll.

6. The method of claim 1, in which prior to being bent, the yarn is heated at a temperature in the range of from 70° to 180° C.

7. The method of claim 1 in which the introduction of the direct crimp and the introduction of the latent crimp by asymmetrical heating are carried out in a continuous operation.

8. The method of claim 7, in which the yarn is subjected to the two crimping treatments and drawn.

9. The method in a continuous-type operation of claim 8 in which the drawing operation and the two crimping treatments are carried out immediately after melt-spinning of the yarn.

10. The method of claim 1 in which the asymmetrical heating of the tensioned yarn takes place after drawing of said yarn.

11. The method of claim 1 in which the yarn is a multifilament yarn having a denier which is higher than 500.

12. An apparatus for manufacturing crimped synthetic yarn having two separate and distinct crimps comprising a yarn supply, a yarn tensioning means, means for supplying the yarn from said yarn supply via said tensioning means to two crimping means, one of said crimping means comprising heating means adjacent and in contact with a portion of the cross section of the tensioned yarn for a relatively short period of time to heat that portion of yarn asymmetrically to a temperature higher than the softening point of the yarn and thereby form a latent crimp therein, and the other crimping means comprising a separate means for heating the yarn to a temperature lower than the softening point of the yarn and means adjacent to said separate heating means for bending the yarn to introduce a direct crimp into said yarn.

13. The apparatus of claim 12 in which said other crimping means, comprises means for gear-crimping, box-crimping, or air-crimping of the yarn.