METHOD OF PRODUCING CRIMPED CONTINUOUS FILAMENT YARN

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

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10 Claims. (Cl. 20—72)

This invention relates to an apparatus and method for producing crimped continuous filament yarn (mono- or
diifilament) and particularly relates to the production of
crimped continuous filament yarn having zig-zag multi-
planar or uni-planar crimps which are arranged at a rela-
tively low crimp angle. More specifically, this invention
relates to an apparatus and method for producing crimped
continuous filament yarn wherein the filaments of the
yarn are crimped at an angle of about 180° and are then
drawn out to a controllably limited degree in order to
produce a product which retains a lower degree of crimp
so as to afford greater dimensional stability.

In the patent to Rosenstein et al., No. 2,719,309, there
is disclosed a method of making crimped continuous fila-
ment yarn wherein a continuous resin filament yarn is
fed between smooth rolls into a crimping chamber having
a restricted exit. The rotation of the rolls feeds the con-
tinuous filament yarn into the chamber, folding the yarn
over upon itself producing a series of crimps wherein
the yarn is crimped at an angle of approximately 180°
to its longitudinal axis.

Heretofore, in practicing the invention of the afore-
mentioned Rosenstein et al. Patent No. 2,719,309, the
yarn produced by the crimer was desirably subjected to heat
after it crimer, thereby setting the crimer. The heat
setting operation was found to have

many advantages, among which was the high crimp re-
tention of the product, which gave it a very substantial
amount of bulk and loftiness.

It has now been found that, for many purposes, it is
desirable to produce a crimped continuous filament yarn
having a degree of crimp which is less than that produced
in accordance with the aforementioned Rosenstein et al.
patent, but having a degree of crimp which may be
critically limited and controlled. Continuous filament
yarn having a lesser but controlled degree of crimp is
useful in and of itself, and is further useful in combina-
tion with highly crimped yarns of other types, or in
combination with one or more other yarns.

Although the invention is highly advantageous for the
preparation of crimped synthetic polymer continuous fila-
ment yarns such as nylon, "Dacron," "Orlon," "Acrylan,"
rayon, the cellulosic fibers and the like, it is similarly ap-
plicable to a wide variety of other synthetic fibers.

It is accordingly an object of this invention to provide
a novel apparatus and method for preparing crimped con-
tinuous filament yarn which has a lesser degree of crimp
than the yarn produced in accordance with the Rosen-
stein et al. U.S. Patent No. 2,719,309, but which yarns
have a controlled degree of crimp and greater dimensional
stability.

Another object of this invention is to provide a method
and apparatus for producing crimped continuous filament
yarns having a substantially number of crimps per inch,
but having a lesser degree of crimp than yarns which have
been crimped in accordance with the aforementioned U.S.
patent.

Still another object of this invention is to provide a
novel means for manufacturing a crimped continuous fila-
ment yarn which has a series of zig-zag crimps, all ar-
ranged at multi-plane angles to one another, wherein the
degree of such crimp and the magnitude of such angle
is substantially controlled.

Another object and advantage of this invention is to
provide a crimped continuous filament yarn having a
relatively low degree of crimp, which can be dyed more
readily and efficiently.

Other objects and advantages of this invention, includ-
ing the simplicity and economy of the same and the ease
with which the degree of crimp may be accurately con-
trolled will further become apparent hereinafter and in
the drawings whereof:

FIG. 1 is a view in side elevation, with parts shown
in section, of an apparatus for producing crimped con-
tinuous filament yarn in accordance with one form of
this invention.

FIG. 2 is an enlarged schematic view showing a rela-
tively sharply crimped continuous filament yarn produced
in one stage of the process.

FIG. 3 is a schematic view similar to FIG. 2, showing
the crimped continuous filament yarn after it has been
subjected to a uniform tension.

FIG. 4 is a partial-plan view of the apparatus appear-
ing in FIG. 1, illustrating how the crimped web of yarn
is drawn out in accordance with this invention.

FIG. 5 is a schematic view in side elevation showing
an apparatus for combined drawing-out and continuous
dyeing of continuous filament yarn.

FIG. 6 is a view in side elevation, with parts shown
in section, showing an alternate form of the invention and
FIG. 7 is an enlarged view of a portion of the apparatus
shown in FIG. 6.

The specific forms of the invention shown in the draw-
ings are not intended to define or to limit the scope of
the invention, and should be taken as illustrations of pre-
ferred forms thereof. Similarly, the following descrip-
tion relates to the specific forms of the invention as shown
in the drawings, and does not limit the scope of the in-
vention which is defined in the appended claims.

Turning now to FIGS. 1—5, the numbers 16, 17 design-
ate matching rollers, the axes of which are urged to-
ward one another thereby forming a nip. A feeding de-
vice 12 is provided for feeding multiple continuous fila-
ment yarns Y into the nip between the rolls 10, 11.

The number 13 designates a chamber which confines
the yarn Y after it has passed between the rolls 16, 17.
An exit door 14 is provided which is urged by the spring
15 toward a table 16. This maintains the yarn Y com-
pressed when it is within the chamber 13, thereby caus-
ing the yarns to bend upon themselves and to be crimped
at an angle of substantially 180°. The internal pressure
formed within the chamber 13 continuously forces the
resulting crimped yarn out past the door 14 onto the
table 16. At that location, the yarn has a rather high
crimp such as the crimp appearing in FIG. 2.

The numbers 20, 21 designate further rolls which are
urged against one another and which form a nip for the
crimped yarn coming from the table 16. Spaced apart
from the rolls 20, 21 is another set of rolls 22, 23, be-
tween which the fibers also pass. As will be apparent
in FIG. 1, a motor 24 operates through chains and
sprockets to drive the rolls 11 and 21 and also through
a slip clutch 24(a) to drive the roll 23. The gear ratios
of the sprockets are such that the roll 23 is rotated at a
greater peripheral velocity than the roll 21, thereby caus-
ing a limited but controlled uniform tension to be applied
to the fibers which are between the rolls 21 and 23. This
tension draws out the fibers F, producing a crimp of
lesser angle, such as the crimp appearing in FIG. 3.

The rolls 22, 23 are preferably mounted on a slotted
support so that they are adjustable toward and away from
the rolls 20, 21.
The product from rolls 22, 23 is led to any suitable device such as a quiller, twister, skeiner or coner, for example, or even a continuous dye machine as hereinafter described.

Fig. 4 shows how the limited degree of tension modifies the crimped web to advantage. After crimping, the web consists of filaments that are interlocked, providing a mass (a) wherein the individual filaments are attached to adjacent filaments. After limited tension has been applied, the individual filaments are separated as indicated at (b) in Fig. 4.

Fig. 5 shows a novel and advantageous apparatus and process wherein the web, crimped and drawn out as in Fig. 1, is passed directly from the rolls 22, 23 into a continuous dyeing machine generally designated 35. The details of the continuous dyeing machine are themselves not a part of this invention, and may be widely varied. The dyeing machine as shown has, for example, two dyeing sections 26, wherein the drawn-out filaments are concurrently dyed and heat-set, and two wash sections 28. Other treating sections may be used if desired. The dye 29 for the dyeing machine 35 is preferably interconnected with or at least driven in timed relation with the drive motor 24 of the crimpler and the rolls 22, 23. Preferably all the rolls of the dyeing machine, and the roll or rolls ahead of it, are independently driven in order to avoid additional tensioning of the yarn. One or both of the rolls 22, 23 may themselves be incorporated into the dye bath so that the dye bath itself provides the tension to draw out the crimp.

Turning to Figs. 6 and 7, table 16 has an extension 30 having a rounded end over which the crimped yarn continuously passes. Located at a predetermined distance D beneath the end of the extension 30 is a substantially horizontal plate 31 which is suspended from a pair of side bars 32 by means of cables 33, 34. The number 34 designates a container having slots 35, 35 through which the plate 31 can extend. Accordingly, the plate 31 has capacity to move up and down in the container 34. The cables 33, 34 are wound around a capstan 36 which is selectively reversibly driven from power source 24 through a change gear mechanism 37, in order to cause the plate 31 to move downwardly at a controlled speed, which is related definitely to the bulk of the fiber, and both such factors are related in a manner to provide a yarn length which draws itself out by the action of gravity alone.

In operation, the apparatus of Figs. 6 and 7 produces a highly crimped yarn as in Fig. 1, before it passes between rolls 20 and 21, and the yarn is put under substantially constant tension in order to draw out the crimp by applying tension which is caused by gravity alone. The distance D in Fig. 6 is maintained substantially constant by the capstan 36 which gradually lowers the plate 31 as the container 34 is gradually filled with crimped yarn. When the plate 31 is on the bottom of the container 34, the container itself is full of crimped yarn having a carefully controlled degree of crimp, at a much lesser crimp angle that the crimp angle of the fibers produced at the crimping chamber itself. In order to remove the container full of crimped yarn, the entire container 34 together with the plate 31 at the bottom thereof is removed.

Preferably, the crimped continuous filament yarn as produced in accordance with Figs. 1–6 and 7 is subjected to a heat-setting operation for the purpose of retaining the residual crimp. The heat-setting may be accomplished in a variety of ways, as for example, by subjecting the yarn continuously to infrared or other heat, or by heat-setting in batch style in a steam chest, or the like. However it is highly preferred in accordance with this invention to set the residual crimp by subjecting the yarn to a simultaneous dyeing and heat-setting operation, wherein heat is provided, and wherein the yarn is maintained immersed in such hot dye for a predetermined period of time and at a heat-setting temperature.
yarn produced in the crimping step, thereby drawing out the crimp under a substantially constant tension.

7. In a method for forming cramped continuous filament yarn, the steps which comprise bending at least one of said filaments through an angle of approximately 180° and exerting pressure on said filament while so bent, thereby crimping said filament without heat-setting, and thereafter, subjecting the cramped yarn to a controlled degree of tension, thereby partially drawing out crimp initially produced which retaining a predetermined crimp in the yarn of substantially uniform value.

8. In a method of forming cramped continuous filament yarn, the steps which comprise bending said yarn through an angle of approximately 180° and exerting pressure on said yarn while so bent, thereby crimping said yarn without heat-setting, thereafter subjecting the cramped yarn to a controlled degree of tension, thereby partially drawing out the crimp initially produced while retaining a predetermined crimp in the yarn of substantially uniform value, and then immersing the resulting yarn in a hot aqueous dye solution maintained at a temperature sufficient to heat-set said yarn.

9. In a method of forming cramped continuous filament yarn, the steps which comprise bending a plurality of said yarns through an angle of approximately 180° to the longitudinal axis thereof without heat-setting, thereby forming a weblike mass of yarns, thereafter subjecting said cramped yarn to a controlled degree of tension, thereby separating said yarns and partially drawing out the crimp initially produced therein while retaining a predetermined crimp in the yarn of substantially uniform value.

10. The method defined in claim 9 wherein is included a further step of immersing the resulting yarn in a hot aqueous dye solution maintained at a temperature sufficient to heat-set said yarn.

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