

F. 21216
Singapore



PATENT SPECIFICATION

(11)

1274854

1274854

DRAWINGS ATTACHED

- (21) Application No. 33365/68 (22) Filed 12 July 1968
(23) Complete Specification filed 23 June 1969
(45) Complete Specification published 17 May 1972
(51) International Classification D02G 1/02
(52) Index at acceptance
D1F 40F1CY 40F1Y 42 45Y
(72) Inventors PAUL ROGERS and ROY SPENCER HOLLISS



(54) IMPROVEMENTS IN OR RELATING TO THE DRAWING AND BULKING OF SYNTHETIC FILAMENT YARNS

(71) We, IMPERIAL CHEMICAL INDUSTRIES LIMITED, of Imperial Chemical House, Millbank, London, S.W.1. a British Company, do hereby declare the invention, for we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention concerns improvements in or relating to the drawing and bulking of synthetic filament yarns.

A widely employed method of bulking synthetic filament yarns is the method known as false twist crimping, in which a temporary, or false twist is continuously imparted to a running yarn, the twist is set by heating means, and then the yarn is de-twisted in a sense to remove the temporary twist. However, because the twist has been set, the final de-twisting of the twist-set yarn causes the filaments to crimp and cockle, and it is this operation which imparts bulk to the yarn, although the bulk may only be latent until some process to make it manifest has been performed on the yarn, such as a heat treatment under conditions of controlled relaxation.

False twist crimping may be carried out on synthetic filament yarn supplied on packages in the fully drawn condition, i.e. the yarn has been packaged by the producer after the standard drawing process has been carried out, in which the undrawn yarn as spun from the spinning machines is extended by several times its undrawn length to orient the molecules.

Alternatively, it is known to combine the drawing and the false twist crimping stages on one machine, so that a package of undrawn yarn is first submitted to a standard drawing treatment and then the drawn yarn is immediately fed into the false twist crimping stage.

Yet another alternative is to submit undrawn yarn from a supply thereof to such conditions of tension in a false twist crimping process that the yarn is both drawn and crimped thereby.

This latter method has been found to be the better one of the two methods starting with an undrawn yarn supply from the point of view of the bulking effect at a given throughput. Nevertheless, there is some tendency for filaments to be broken; and also the bulked yarn seems to impart a glittery effect to fabric which may not be desirable. These potential defects are not present in yarn bulked by the former of the two methods starting with an undrawn yarn supply, i.e. the method in which the yarn is normally drawn before being fed into the false twist crimping stage; but, in order to attain a given level of bulk in yarn processed by this method, it is necessary to run the process at a lower throughput. Hence, the machines are not employed to their full capacity.

We have now discovered that the above mentioned potential defects found when undrawn yarn is directly false twist crimped and drawn can be ameliorated if the yarn is first pre-drawn to a less than full extent, and then the final amount of drawing, only, is performed coincidentally with the false twist crimping.

Accordingly, the invention comprises a continuous process for false twist crimping a synthetic filament yarn, in which process the synthetic filament yarn in undrawn condition is firstly submitted to a pre-drawing stage in which the yarn is drawn by less than the full amount, and then the partially-drawn yarn is fed to a false twist crimping stage under such conditions of tension that drawing of the yarn is completed in or on heating means in said false twist crimping stage.

It is presently preferred to operate under conditions such that the total draw ratio achievable is not reduced much below that normally achieved when either of the two known methods are employed, i.e. when the yarn is either fully pre-drawn or is wholly drawn on the false twist crimping heater. This entails operating at either end of the scale, i.e. at the end where the yarn is nearly fully drawn during pre-drawing, or at the

other end when only very slight pre-drawing is performed.

The invention may be illustrated with reference to the attached drawing, which shows diagrammatically the relationship for poly-(hexamethylene adipamide) between fabric weight and the ratio of the draw ratio in the false twist crimping stage to the draw ratio in the pre-drawing stage. This relationship was obtained by processing a 20 filament supply yarn of poly(hexamethylene adipamide) at a throughput speed of 1700 feet/minute, the undrawn denier being 211 to be drawn to a nominal 70 denier. The weight of fabric per square yard, which is a measure of bulk, was determined for two-fold 70 denier yarns knitted in an 18 gauge interlock fabric with a stitch length of 0.144 inches.

As illustrated in the drawing high bulk may be obtained when the ratio of the two draw ratios is selected in the range 0.3 to 0.8 or when the ratio is above 1.3. The upper limit for the ratio is determined by the desirability of avoiding the glittery effect imparted to fabric when undrawn yarn is both drawn and crimped in a false twist crimping process. Hence, it is essential that some drawing takes place in a pre-drawing stage. We have found that values for the ratio of the two draw ratios up to about 2.8 are particularly useful.

The invention is applicable to all synthetic filament yarns capable of being heat-set and is particularly applicable to polyamide yarns such as poly(hexamethylene adipamide) yarns.

The polyamide yarn may be derived from a polyamide polymer of a kind which has been nucleated with calcium fluoride in such manner that the mean maximum nucleant separation distance is given by the expression

$$S \leq 2 \int_0^{XC} G(\tau) d\tau.$$

where G is the linear rate of crystallization in microns/second at a temperature $T^\circ\text{C}$,

XC is the distance of the solidification point from the spinneret for an un-nucleated polymer when spun into filaments and

t is the time in seconds for a point in the filaments to travel from the spinneret to a point X where X is any point between XC and the spinneret plate.

The use of a yarn derived from such a nucleated polymer enables higher throughput speeds to be used in the present invention as compared with the use of a yarn derived from an un-nucleated polymer.

The invention is not limited by the means adopted for drawing and for false twist crimping. Nevertheless, it is preferred to pre-draw

the yarn between a feed roll and a faster rotating draw roll whilst localising the point of draw at a ceramic snubbing-pin; and it is preferred to feed the pre-draw yarn directly into the false twist crimping zone by and from said draw roll, with the false twist being imparted directly to the yarn by a rotary friction device. The yarn is then withdrawn from the friction device at a speed greater than that at which it was fed thereto by the draw roll. The false twist is set, and the final drawing is carried out, while the yarn is passing through or over the heater of the false twist crimping zone.

It is, of course, possible to carry out bulk-development or other post-treatments on the false twist crimped yarn, either concurrently or at some later stage in yarn or fabric production. Thus, bulk may be developed by heat treating the false twist crimped yarn under a controlled tension and temperature.

WHAT WE CLAIM IS:—

1. A continuous process for false twist crimping a synthetic filament yarn in which process the synthetic filament yarn in undrawn condition is firstly submitted to a pre-drawing stage in which the yarn is drawn by less than the full amount and then the partially-drawn yarn is fed to a false twist crimping stage under such conditions of tension that drawing of the yarn is completed in or on heating means in said false twist crimping stage.

2. A process according to claim 1 in which the synthetic filament yarn is a polyamide yarn.

3. A process according to claim 2 in which the synthetic filament yarn is poly-(hexamethylene adipamide) yarn and the ratio of the draw ratio in the false twist crimping stage to the draw ratio in the pre-drawing stage lies in the range 0.3 to 0.8 or above 1.3.

4. A process according to any one of the preceding claims in which the false twist is imparted to the yarn by a rotary friction device.

5. A process according to any one of the preceding claims in which the undrawn yarn is partially drawn between a feed roll and a faster rotating draw roll whilst localising the point of draw at a snubbing pin and the partially drawn yarn is fed directly by and from said draw roll into the false twist crimping stage wherein the yarn is passed through or over a heater to a rotary friction device such that false twist is imparted directly to the yarn and the yarn is withdrawn from the friction device at a speed greater than that at which it was fed thereto such that drawing of the yarn is completed in the false twisting stage.

6. A process for producing a false twist crimped synthetic filament yarn substantially as hereinbefore described.

other end when only very slight pre-drawing is performed.

The invention may be illustrated with reference to the attached drawing, which shows diagrammatically the relationship for poly-(hexamethylene adipamide) between fabric weight and the ratio of the draw ratio in the false twist crimping stage to the draw ratio in the pre-drawing stage. This relationship was obtained by processing a 20 filament supply yarn of poly(hexamethylene adipamide) at a throughput speed of 1700 feet/minute, the undrawn denier being 211 to be drawn to a nominal 70 denier. The weight of fabric per square yard, which is a measure of bulk, was determined for two-fold 70 denier yarns knitted in an 18 gauge interlock fabric with a stitch length of 0.144 inches.

As illustrated in the drawing high bulk may be obtained when the ratio of the two draw ratios is selected in the range 0.3 to 0.8 or when the ratio is above 1.3. The upper limit for the ratio is determined by the desirability of avoiding the glittery effect imparted to fabric when undrawn yarn is both drawn and crimped in a false twist crimping process. Hence, it is essential that some drawing takes place in a pre-drawing stage. We have found that values for the ratio of the two draw ratios up to about 2.8 are particularly useful.

The invention is applicable to all synthetic filament yarns capable of being heat-set and is particularly applicable to polyamide yarns such as poly(hexamethylene adipamide) yarns.

The polyamide yarn may be derived from a polyamide polymer of a kind which has been nucleated with calcium fluoride in such manner that the mean maximum nucleant separation distance is given by the expression

$$S \leq 2 \int_0^{XC} G(\tau) d\tau.$$

where G is the linear rate of crystallization in microns/second at a temperature $T^\circ C$,

XC is the distance of the solidification point from the spinneret for an un-nucleated polymer when spun into filaments and

t is the time in seconds for a point in the filaments to travel from the spinneret to a point X where X is any point between XC and the spinneret plate.

The use of a yarn derived from such a nucleated polymer enables higher throughput speeds to be used in the present invention as compared with the use of a yarn derived from an un-nucleated polymer.

The invention is not limited by the means adopted for drawing and for false twist crimping. Nevertheless, it is preferred to pre-draw

the yarn between a feed roll and a faster rotating draw roll whilst localising the point of draw at a ceramic snubbing-pin; and it is preferred to feed the pre-draw yarn directly into the false twist crimping zone by and from said draw roll, with the false twist being imparted directly to the yarn by a rotary friction device. The yarn is then withdrawn from the friction device at a speed greater than that at which it was fed thereto by the draw roll. The false twist is set, and the final drawing is carried out, while the yarn is passing through or over the heater of the false twist crimping zone.

It is, of course, possible to carry out bulk-development or other post-treatments on the false twist crimped yarn, either concurrently or at some later stage in yarn or fabric production. Thus, bulk may be developed by heat treating the false twist crimped yarn under a controlled tension and temperature.

WHAT WE CLAIM IS:—

1. A continuous process for false twist crimping a synthetic filament yarn in which process the synthetic filament yarn in undrawn condition is firstly submitted to a pre-drawing stage in which the yarn is drawn by less than the full amount and then the partially-drawn yarn is fed to a false twist crimping stage under such conditions of tension that drawing of the yarn is completed in or on heating means in said false twist crimping stage.

2. A process according to claim 1 in which the synthetic filament yarn is a polyamide yarn.

3. A process according to claim 2 in which the synthetic filament yarn is poly-(hexamethylene adipamide) yarn and the ratio of the draw ratio in the false twist crimping stage to the draw ratio in the pre-drawing stage lies in the range 0.3 to 0.8 or above 1.3.

4. A process according to any one of the preceding claims in which the false twist is imparted to the yarn by a rotary friction device.

5. A process according to any one of the preceding claims in which the undrawn yarn is partially drawn between a feed roll and a faster rotating draw roll whilst localising the point of draw at a snubbing pin and the partially drawn yarn is fed directly by and from said draw roll into the false twist crimping stage wherein the yarn is passed through or over a heater to a rotary friction device such that false twist is imparted directly to the yarn and the yarn is withdrawn from the friction device at a speed greater than that at which it was fed thereto such that drawing of the yarn is completed in the false twisting stage.

6. A process for producing a false twist crimped synthetic filament yarn substantially as hereinbefore described.



7. False twist crimped synthetic filament yarns whenever produced by a process according to any one of the preceding claims. false twist crimped yarn is heat treated under a controlled tension and temperature.
8. A process for developing bulk in a false twist crimped synthetic filament yarn according to claim 7 in which process the
- 5

D. VINCENT,
Chartered Patent Agent.

Printed for Her Majesty's Stationery Office, by the Courier Press, Leamington Spa, 1972.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from
which copies may be obtained.

