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A. L. BREEN ET AL
PROCESS FOR MAKING ALTERNATING TWIST SLUB
YARN USING A FLUID VORTEX
Original Filed Dec. 22, 1959

3,043,087

FIG. I



FIG. II

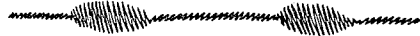


FIG. III

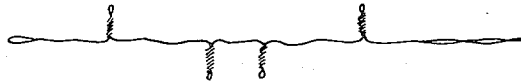


FIG. IV

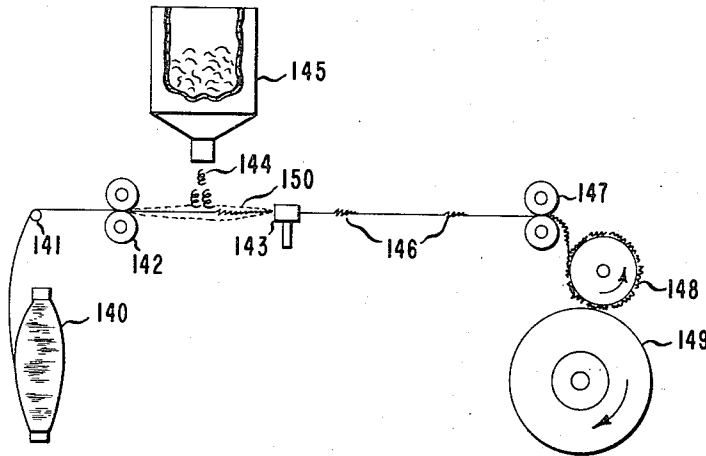


FIG. V

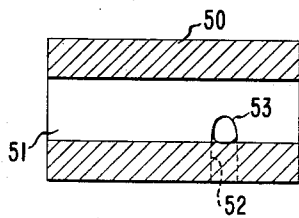
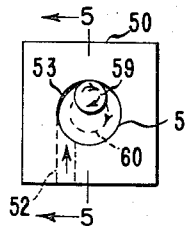


FIG. VI



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3,043,087

PROCESS FOR MAKING ALTERNATING TWIST SLUB YARN USING A FLUID VORTEX

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Original application Dec. 22, 1959, Ser. No. 861,368, now Patent No. 2,997,837, dated Aug. 29, 1961. Divided and this application Jan. 12, 1961, Ser. No. 83,606 4 Claims. (Cl. 57—157)

This invention relates to a novel yarn product and process for preparing it, and more particularly to the process of preparing the slub yarns of application Serial No. 861,368, filed December 22, 1959, and is a division of that application. Said application is now U.S. Patent No. 2,997,837 issued August 29, 1961.

According to this invention there is provided a slub yarn in which each slub contains both S and Z twist. Such a yarn is prepared by passing a continuous running filamentary carrier strand axially through a fluid vortex formed by a jet of fluid with velocity at least $\frac{1}{2}$ sonic, thereby twisting the strand and causing it to balloon immediately upstream of the fluid vortex, feeding a second filamentary material to wrap about the ballooning portion of the continuously running strand to form a slub and permitting the slub to be carried by the carrier strand through the fluid vortex where it is wrapped firmly about the carrier strand with both S and Z twist.

Typical slub yarns produced in accordance with this invention are shown in FIGURES I, II, and III of the attached drawing. FIGURE IV illustrates schematically a preferred embodiment of the process of this invention. FIGURES V and VI illustrate one embodiment of a fluid twister which may be used in the process.

Referring to FIGURE I, it will be apparent that the yarn in slub 1 contains Z twist in area 2 but S twist in area 3. Similarly, the carrier yarn 4 contains Z twist at 5 and S twist at 6.

The slub yarn product illustrated in FIGURE II is particularly unique in that the slub consists of yarn wrapped about the carrier yarn in the direction of twist that exists upstream of the twister, whereas the unslubbed, but plied sections of the yarn are twisted in the twist direction that exists downstream of the twister.

FIGURE III shows a slub yarn which is referred to as a "crepe tail" slub yarn. It is made by processing at low tension of about 3 grams or less. The high twist imparted to the yarn by an efficient fluid twister at this low tension causes the yarn to form branched slubs which pass through the twister. The stability of the branched slubs can be increased by size applied to the yarn before it enters the twister.

FIGURE IV illustrates an assembly and process for producing the slub yarns of this invention. In using the assembly of FIGURE V, a continuous or staple filament yarn is unwound from package 140, passed over pin 141, through nip rollers 142, and subjected to the crank twisting action by fluid twister 143. The cranking action upon the yarn is shown by dotted lines 150. In the specific illustration shown, short lengths of a second filamentary material 144 are dropped from reservoir 145 upon the carrier yarn as it is cranked and twisted with

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the result that the short lengths of filamentary material are wound tightly about the cranking (carrier) yarn and become firmly bound thereto to form slubs. Alternatively, the slubs may be formed on the carrier yarn downstream of the fluid twister but this procedure is less desirable because slubs are even more firmly bound to the carrying yarn as the yarn carrying the slubs passes through fluid twister 143. The slub yarn product is then passed through nip rollers 147 and wound on package roll 148 which is driven by drive roll 149. In operating in accordance with this embodiment, the carrying yarn may be either staple or continuous filament yarn, and the secondary yarn, which is added to form slubs, may be short lengths of fibers or yarns or a staple or continuous filament yarn.

FIGURES V and VI show plane and end views, respectively, of a representative fluid twister useful in this invention. In this twister, axial yarn passageway 51 is substantially cylindrical in form throughout its length. A conduit for fluid 52 intercepts the yarn passageway at 53 at an angle of about 90 degrees to the axis thereof and is positioned so that the longitudinal axis of the fluid conduit 52 does not intersect the longitudinal axis of yarn passageway 51, as shown in FIGURE VI. When gas under pressure is passed through fluid conduit 52 so that it reaches at least $\frac{1}{2}$ sonic velocity upon emerging into the yarn passageway 51, sufficient torque upon any yarn in the yarn passageway is created to produce a high rate of crank twisting if the yarn is maintained at a tension of less than about 15 grams. At relatively high fluid velocities less dense fluids may be employed to obtain substantially the same torque produced by a higher density fluid traveling at lower velocity. Fluid may be supplied to the fluid conduit 52 by any convenient means.

It is an important feature of this invention that during the twisting of the yarn bundle the yarn undergoes a cranking action, that is, the longitudinal axis of the yarn describes a surface similar to the inner surface of the yarn passageway and spaced from the inner surface of the yarn passageway by a distance equal to about the radius of the yarn bundle. This feature of the instant invention is illustrated in FIGURE VI. FIGURE VI illustrates direct twisting of a yarn bundle 59 in yarn passageway 51 and shows, by arrows, that the yarn twists about its axis in the same direction as fluid flow about the inner periphery of the yarn passageway while the axis of the yarn bundle describes a surface spaced from the inner surface of the yarn passageway by a distance at least the radius of the yarn bundle, both surfaces having a common longitudinal axis.

Because the fluid twisting devices utilized in this invention twist yarns at exceedingly high rates (turns per minute) at exceedingly high throughput speeds (yarns per minute), slub yarns of this invention may be produced very efficiently.

The fluid utilized in the fluid twisting device may be any compressible fluid, but inert gaseous materials such as steam, air, nitrogen, carbon dioxide, etc., are preferred. A wide variety of fluid twisters useful in this invention and conditions for operating them are set forth in application Serial No. 598,135 filed July 16, 1956, by Breen and Sussman. The manner in which the process conditions disclosed in that application may be employed to produce a variety of slub yarns of this invention will be appar-

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ent to one skilled in the art. For purposes of this invention it is obviously necessary to use a fluid twister having a yarn passageway sufficiently large to permit smooth passage of both carrier yarn and slubs without undue friction or drag. The process of this invention is particularly advantageous not only because of its efficiency and high production rate, but also because the fluid vortex opens up the carrier yarn bundle sufficiently to insert and intermingle slub yarn fibers between and among fibers of the carrier yarn, thereby producing a slub yarn in which the slubs, in addition to their unique twist, are firmly attached to the carrier yarn.

In operating the process of this invention, yarn tension is generally maintained at less than about half the breaking tension of the yarn being processed and preferably between about 0.1 and about 25 grams. Twisting rates equivalent to between 100,000 and 1,200,000 turns per minute are easily obtained.

The following examples illustrate the invention.

EXAMPLE I

Using the setup shown in FIGURE IV, poly(hexamethylene adipamide) yarn is taken from a package, passed through the feed rolls, through a fluid twister operating on 40 pounds per square inch air to a windup roll, and finally to a backwindable package. Windup speed is 160 y.p.m. Tension in the threadline is maintained at 10 grams.

Immediately upstream of the twister, pieces of staple yarn (1.5 denier per filament, 3 inch viscose) are fed to the cranking, twisting threadline from a hopper. On con-

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layers of the slubbing yarn are wrapped. The tension on the carrier yarn is maintained constant at between 10 and 25 grams, whereas the tension on the slubbing yarn is varied in a rapid and random fashion between 0 and 25 grams. Wrapping occurs when the tension in the slubbing yarn drops below the tension in the carrier yarn. Layered slubs occur when the tension in the slubbing yarn approaches zero grams. The wrapping and carrying functions of each yarn may be reversed by reversing the relative tension levels. Process conditions are shown in Example II of Table I.

A fluid twister is particularly adapted to making of slub yarns, since the twister yarn passage offers little resistance to the passage of a slub, whereas mechanical twisters snub the yarn over pins, wheels, etc., which would offer substantial resistance to the passage of slubs, with the result that the threadline would be subject to frequent breakdowns.

By varying the tension of the carrier yarn as it passes through the fluid twister, in accordance with the disclosure in copending application Serial No. 598,135 filed July 16, 1956, by Breen and Sussman, the carrier yarn is formed into an alternating twist configuration and the slubs are wrapped about this yarn so that the product is a slub yarn in which the carrier portion of the filaments possesses a variable degree of twist or possibly alternating twist. In the yarn of FIGURE II, for example, the carrier filament bundle between slubs has a twist opposite to that of the slubs whereas the carrier filament bundle within the slubs has a twist in the same direction as the slubs.

Table I

	Example I		Example II	
	Carrier	Slub	Carrier	Slub
Yarn material.....	poly(hexamethylene adipamide).	Viscose..	poly(hexamethylene adipamide).	Viscose.
Denier.....	70.....	1.5, 3'.....	70.....	40.
No. Filaments.....	34.....		34.....	13.
Source.....	Pirn.....	Bobbin.....	Supply Package.....	
Type of Yarn.....	continuous.....	staple.....	continuous.....	
Initial Twist.....	1/2 Z.....		1/2 Z.....	
Feed speed (y.p.m.).....	tension gate.....			
Windup speed (y.p.m.).....	160.....		50.....	
Tension (gms.).....	20.....		10-25.....	0-25.
Process twist.....	S.....	S.....		
Fluid twister.....	Figs. V and VI.....		Figs. V and VI.....	
Heat-setting temp. ° C.....				
Type heater.....	None.....		None.....	
Air Pressure (p.s.i.g.).....	40.....		30.....	
Twisting action.....	Direct.....		Direct.....	
Product characterization.....	Slub Yarn.....		Slub Yarn.....	
Air Passage diameter (inches).....			1 hole at .040.....	
Yarn Passage diameter (inches).....			.063.....	

tacting the cranking, twisting threadline, the staple fibers are immediately entrained into the threadline by the rapid cranking rotation, and form randomly spaced slubs along the threadline. An enlarged illustration of the slubbed yarn is shown in FIGURE I. The slub yarn is novel in that the slub is held to the carrier yarn with two directions of twist. One end of the slub is twisted in the S direction, the other end is twisted in the Z direction. The process conditions are shown in Example I of Table I.

EXAMPLE II

A slub yarn comprising slubs of continuous filament on a continuous filament carrier yarn is prepared by substituting a continuous filament package for the reservoir 145 in FIGURE IV. Running at a speed of 50 y.p.m. and using a fluid twister of the type shown in FIGURES V and VI, operated on 30 pounds per square inch air pressure, continuous filament yarn which is to be used for slubbing, is allowed to contact the rotating carrier yarn threadline. The slubbing yarn is immediately wrapped about the carrier yarn and forms slubs which consist of short sections of carrier yarn about which numerous

EXAMPLE III

The procedure of Example I is followed except that the carrier yarn tension is maintained at 3 grams. The high twist imparted to the yarn at this low tension causes the yarn to form branched slubs which pass through the twister. The product is a so-called "crepe tail" slub yarn as illustrated in FIGURE III. The stability of the branched slubs can be improved by application of size to the yarn before it enters the twister.

A similar slub yarn is produced by plucking a threadline passing through the twister so as to create short rapid tension changes. Of course, the over-all tension should be maintained low.

The examples in Table II illustrate the operation of the process of this invention under various conditions and with a variety of yarns, both natural and synthetic. Air was used as the twisting fluid in all examples, and air velocity was at least 1/2 sonic.

This application is a continuation-in-part of application Serial No. 598,135 filed July 16, 1956, by Breen and Sussman.

Table II

	Example IV		Example V	
	Carrier	Slub	Carrier	Slub
Yarn Material.....	"Dacron"	Wool.....	Silk.....	"Orlon".
Denier.....	250.....	64's.....	15.....	3.....
No. Filaments.....	50.....	.....	14.....	.....
Source.....	Spin Bobbin.....	.....	Cone.....	.....
Type of Yarn.....	Continuous.....	Staple.....	Continuous.....	Staple.....
Initial Twist.....	0.....	0.....	16/14 Z.....	0.....
Feed Speed (y.p.m.).....	Tension Gate.....	Intermittent.....	Tension Gate.....	Intermittent.....
Windup Speed (y.p.m.).....	100.....	100.....	67.....	67.....
Tension (gms.).....	10-25.....	0-25.....	5-15.....	0-20.....
Process Twist.....	Z.....	Z.....	Z.....	Z.....
Fluid Twister.....	Figs. V and VI.....	Figs. V and VI.....	Figs. V and VI.....	Figs. V and VI.....
Air Pressure (p.s.i.g.).....	60.....	60.....	40.....	40.....
Twisting Action.....	Direct.....	Direct.....	Direct.....	Direct.....
Product Characterization.....	Slub Yarn.....	Slub Yarn.....	Slub Yarn.....	Slub Yarn.....
Air Passage Diameter (inches).....	1 hole at .0625.....	.0625.....	1 hole at .0625.....	.0625.....
Yarn Passage Diameter (inches).....	.1250.....	.1250.....	.1250.....	.1250.....

	Example VI		Example VII	
	Carrier	Slub	Carrier	Slub
Yarn Material.....	Wool.....	Nylon.....	"Orlon".....	"Dacron."
Denier.....	18's cc.....	5.....	100.....	3.....
No. Filaments.....	.....	.....	40.....	.....
Source.....	Cone.....	.....	Tube.....	.....
Type of Yarn.....	Spun.....	Staple.....	Continuous.....	Staple.....
Initial Twist.....	12Z.....	0.....	3Z.....	0.....
Feed Speed (y.p.m.).....	Tension Gate.....	Intermittent.....	Tension Gate.....	Intermittent.....
Windup Speed (y.p.m.).....	67.....	67.....	67.....	67.....
Tension (gms.).....	5-20.....	0-20.....	10-20.....	0-25.....
Process Twist.....	Z.....	Z.....	Z.....	Z.....
Fluid Twister.....	Figs. V and VI.....	Figs. V and VI.....	Figs V and VI.....	Figs. V and VI.....
Air Pressure (p.s.i.g.).....	40.....	40.....	40.....	40.....
Twisting Action.....	Direct.....	Direct.....	Direct.....	Direct.....
Product Characterization.....	Slub Yarn.....	Slub Yarn.....	Slub Yarn.....	Slub Yarn.....
Air Passage Diameter (inches).....	1 hold at .0625.....	.0625.....	1 hold at .0625.....	.0625.....
Yarn Passage Diameter (inches).....	.1250.....	.1250.....	.1250.....	.1250.....

	Example VIII		Example IX	
	Carrier	Slub	Carrier	Slub
Yarn Material.....	"Dacron".....	Acetate.....	Nylon.....	"Orlon".
Denier.....	70.....	300.....	70.....	3.....
No. Filaments.....	34.....	80.....	34.....	.....
Source.....	Spin Bobbin.....	Cake.....	Pirn.....	.....
Type of Yarn.....	Continuous.....	Continuous.....	Continuous.....	Staple.....
Initial Twist.....	0.....	0.....	1/2 Z.....	0.....
Feed Speed (y.p.m.).....	Tension Gate.....	Intermittent.....	Tension Gate.....	Intermittent.....
Windup Speed (y.p.m.).....	67.....	67-100.....	67.....	Pickup.....
Tension (gms.).....	10-20.....	0-20.....	15-25.....	67.....
Process Twist.....	Z.....	Z.....	Z.....	Z.....
Fluid Twister.....	Figs. V and VI.....	Figs. V and VI.....	Figs. V and VI.....	Figs. V and VI.....
Air Pressure (p.s.i.g.).....	40.....	40.....	40.....	40.....
Twisting Action.....	Direct.....	Direct.....	Direct.....	Direct.....
Product Characterization.....	Slub Yarn.....	Slub Yarn.....	Slub Yarn.....	Slub Yarn.....
Air Passage Diameter (inches).....	1 hole at .0625.....	.0625.....	1 hole at .0625.....	.0625.....
Yarn Passage Diameter (inches).....	.1250.....	.1250.....	.1250.....	.1250.....

	Example X		Example XI	
	Carrier	Slub	Carrier	Slub
Yarn Material.....	Nylon (Bulk).....	Cotton Middling.....	Egyptian Cotton.....	Middling Cotton.....
Denier.....	70.....	.....	28's cc.....	.....
No. Filaments.....	34.....	.....	.....	.....
Source.....	Pirn.....	.....	Cone.....	.....
Type of Yarn.....	Continuous.....	Staple.....	Spun.....	Staple.....
Initial Twist.....	1/2Z.....	0.....	24+Z.....	0.....
Feed Speed (y.p.m.).....	Tension Gate.....	Intermittent.....	Tension Gate.....	Intermittent.....
Windup Speed (y.p.m.).....	67.....	67.....	67.....	67.....
Tension (gms.).....	10-20.....	0-25.....	15-20.....	0-20.....
Process Twist.....	Z.....	Z.....	Z.....	Z.....
Fluid Twister.....	Figs. V and VI.....	Figs. V and VI.....	Figs. V and VI.....	Figs. V and VI.....
Air Pressure (p.s.i.g.).....	30.....	30.....	40.....	40.....
Twisting Action.....	Direct.....	Direct.....	Direct.....	Direct.....
Product Characterization.....	Slub Yarn.....	Slub Yarn.....	Slub Yarn.....	Slub Yarn.....
Air Passage Diameter (inches).....	1 hole at .0625.....	.0625.....	1 hole at .0625.....	.0625.....
Yarn Passage Diameter (inches).....	.1250.....	.1250.....	.1250.....	.1250.....

Table II—Continued

	Example XII		Example XIII	
	Carrier	Slub	Carrier	Slub
Yarn Material.....	"Dacron".....	Nylon.....	Nylon.....	"Dacron".....
Denier.....	.....	10.....	70.....	4.75.....
No. Filaments.....	.....	34.....	34.....	.....
Source.....	Cone.....	Pirn.....	Pirn.....	.....
Type of Yarn.....	Spun.....	Continuous.....	Continuous.....	Staple.....
Initial Twist.....	32.5.....	1/2Z.....	1/2Z.....	.....
Feed Speed (y.p.m.).....	Tension Gate.....	67-100.....	Tension.....	Intermittent.....
Windup Speed (y.p.m.).....	61.....	67.....	40.....	40.....
Tension (gms.).....	5-10.....	0-10.....	10-20.....	0-20.....
Process Twist.....	Z.....	Z.....	Z.....	Z.....
Fluid Twister.....	Figs. V and VI.....	Figs. V and VI.....	Figs. V and VI.....	Figs. V and VI.....
Air Pressure (p.s.i.g.).....	40.....	40.....	40.....	40.....
Twisting Action.....	Direct.....	Direct.....	Direct.....	Direct.....
Product Characterization.....	Slub Yarn.....	Slub Yarn.....	Slub Yarn.....	Slub Yarn.....
Air Passage Diameter.....	1 hole at .0625.....	.0625.....	1 hole at .0625.....	.0625.....
(inches).....	.....	.....	.....	.....
Yarn Passage Diameter.....	.1250.....	.1250.....	.1250.....	.1250.....
(inches).....	.....	.....	.....	.....

¹ 2 ply.

We claim:

1. A process comprising passing a continuous running filamentary carrier strand axially through a fluid vortex formed by a jet of fluid with velocity at least $\frac{1}{2}$ sonic, thereby twisting the strand and causing it to balloon immediately upstream of the fluid vortex, feeding a second filamentary material to wrap about the ballooning portion of the continuously running strand to form a slub and permitting the slub to be carried by the carrier strand through the fluid vortex where it is wrapped firmly about the carrier strand.

2. The process of claim 1 in which the second filamentary material is in the form of individual staple fibers.

3. The process of claim 1 in which the second filamentary material is in the form of staple yarn.

4. The process of claim 1 in which the second filamentary material is a yarn of continuous filaments.

References Cited in the file of this patent

UNITED STATES PATENTS

2,751,747 Burleson June 26, 1956

FOREIGN PATENTS

355,447 Great Britain Aug. 27, 1931