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E. I. RHODEN

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PROCESS FOR MANUFACTURING SLUB YARN

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FIG. 1

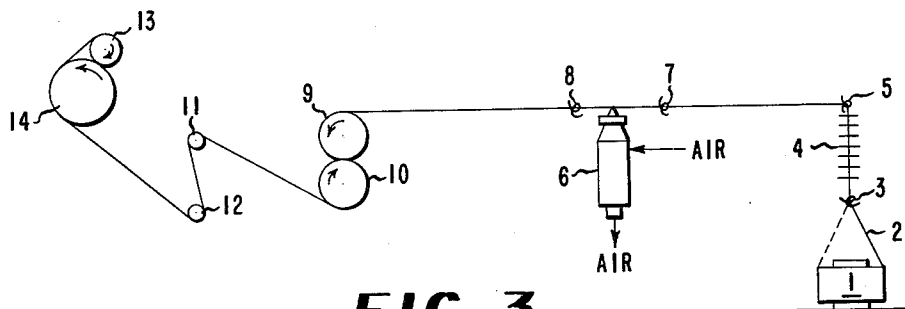


FIG. 3

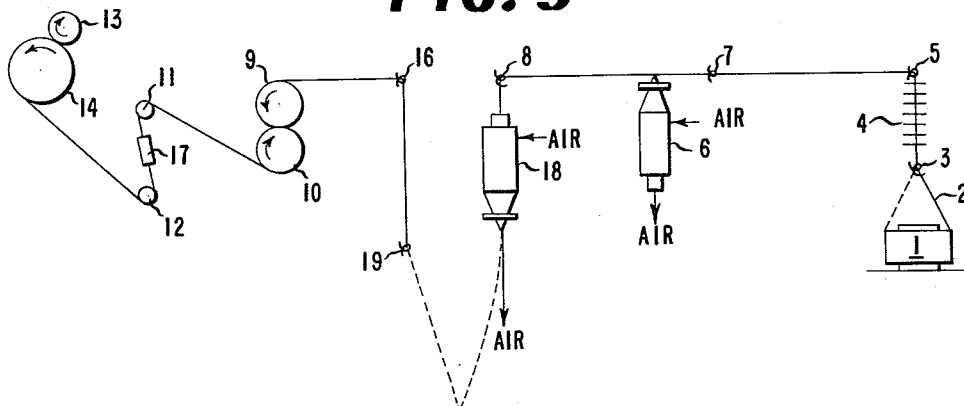
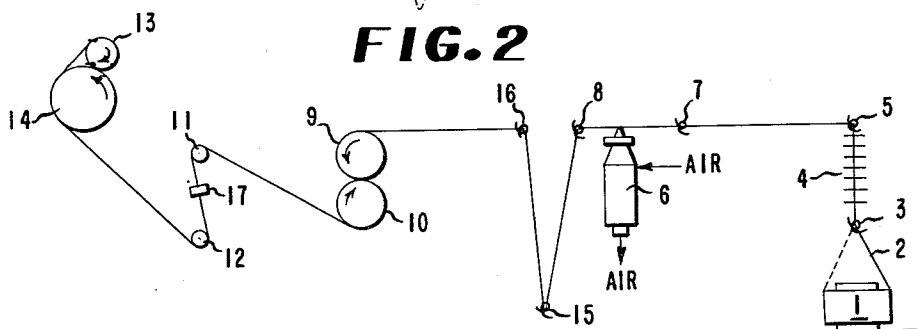


FIG. 2



INVENTOR
EDGAR I. RHODEN

BY *Harold E. Packman*
ATTORNEY

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PROCESS FOR MANUFACTURING SLUB YARN
Edgar I. Rhoden, Newark, Del., assignor to E. I. du Pont de Nemours and Company, Wilmington, Del., a corporation of Delaware

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This invention relates to fluid treatment of yarns composed of continuous filaments and is more particularly concerned with a process for manufacturing slub yarn.

Slub yarns are well known in the art and are characterized by numerous protrusions or other similar variations in cross-sections along the length of the yarn. The slubs may be spaced at equal or unequal distances along the length of the yarn and may vary in width and length depending on the method of manufacture. When made into fabric, such yarns provide a decorative effect of slubs distributed throughout the surface of the fabric.

It is an object of this invention to provide a novel process for producing slub yarn. Another object is to provide such a process which is suitable for treating conventional yarn to introduce slubs, without coalescing the filaments, by means of relatively simple equipment. Other objects of the invention will become apparent from the disclosure and claims.

In accordance with this invention slubs are formed in multifilament yarn with an aspirating jet utilizing a high velocity flow of compressible fluid to form a zone of turbulence and to provide an aspirating stream through the yarn inlet sufficient to make the jet self-threading. The jet is of the type used to bulk or texturize yarn by the process disclosed in Breen U.S. Patent No. 2,852,906 issued September 23, 1958. Unlike that process, however, the yarn is not passed through the jet in the treatment of the present invention. The yarn is fed across the yarn inlet to the jet at substantially right-angles to the yarn passageway, and is maintained under sufficient tension to prevent the yarn from being drawn into the jet by the aspirating stream until the process of slub formation is to begin. In this process, yarn tension is reduced, causing the yarn to be sucked into the tip of the aspirating jet. This results in the formation of a loop within the jet. The sides of the loop become combined by twisting and filament entanglement. Filament entanglement may occur before or after the loop folds back on the yarn, or both, resulting in slub initiation. Continuation of this process causes the slub to grow, in random fashion, in length or diameter, or both. This process is discontinued when the tension is increased sufficiently to draw the slub out of the jet. A series of slubs are formed along the yarn by repeating the process at the desired frequency.

The slub yarn formed in the aspirating jet can be passed an interlacing jet of the type disclosed in W. W. Bunting, Jr., et al. U.S. Patent No. 2,985,995, issued May 30, 1961, to increase yarn entanglement and, thereby, increase slub tightness as well as to interlace the yarn between the slubs. Interlacing jets of the type disclosed in U.S. Patent No. 2,985,995, most preferably by FIGURES 15, 16, and 17, are suitable for this purpose. The slubs can also be consolidated using a torque jet of the type disclosed in A. L. Breen et al. U.S. Patent No. 2,997,837, issued August 29, 1961.

The invention will be better understood by reference to the drawings. In these drawings, which illustrate preferred embodiments of the invention,

FIGURE 1 is a schematic representation of the process and suitable equipment for manufacturing slubbed, continuous filament yarn in accordance with the invention;

FIGURES 2 and 3 are schematic views of modified forms of process and equipment for manufacturing slub yarn.

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Referring to FIGURE 1, the continuous filament yarn to be treated may be supplied from any suitable source, such as a yarn package 1. The yarn 2 passes through guide 3 to tension gate 4, through guide 5, and is led across the tip of a conventional aspirating jet 6, which is connected to a suitable compressed air source, by guides 7 and 8 to take-up rolls 9 and 10. The yarn is then led over rollers 11 and 12 to windup package 13, surface-driven by roll 14. The tension gate is adjusted so that the running yarn will be attracted by the jet, but not sucked into the jet. The yarn tension is reduced by suitable manipulation of the tension gate, causing the yarn to be sucked into the jet where the slub is formed by looping and filament entanglement. When tension is restored to the original level, the slubbed section of yarn is withdrawn through the jet inlet. Periodic variation of tension produces a slub yarn. An equivalent method is to maintain a constant low tension on the yarn and vary the aspirating action of the jet, as by pulsing the air supply. When sufficient air is supplied to the jet to overcome the yarn tension, a yarn loop is sucked into the jet and slub formation occurs. Then when the air supply is decreased sufficiently, the slubbed section is withdrawn as above and the operation can then be repeated.

Another method of forming slubs with substantially the same apparatus is illustrated in FIGURE 2. In this embodiment, the yarn is passed from fixed guide 8 through a movable guide 15 and back to a fixed guide 16 in the original line of travel before continuing to the windup section. Guide 15 is arranged for movement perpendicular to this original line of travel so that yarn can be picked up between guides 8 and 16, drawn to one side to form a loop as shown, and then released to provide slack in the yarn. Movement of guide 15 can be accomplished manually or by a mechanical arrangement similar to that long used on sewing machines. When the yarn loop is abruptly released from the position shown, the loose yarn is drawn into the jet and a slub is formed. Continued movement of the yarn to take-up rolls 9 and 10 restores tension in the yarn and removes the slub from the jet. The operation can then be repeated. Further yarn entanglement, to increase slug tightness, is accomplished by running the yarn through a second jet 17 prior to being wound up on package 13.

In FIGURE 3 is illustrated an alternative method in which pneumatic means are provided for altering yarn tension. In this embodiment, the yarn is passed from fixed guide 8 through jet 18 to a fixed guide 19, and back to a fixed guide 16 in the original line of travel for continuing to the windup section. When air is supplied to jet 18, a loop of yarn is formed between the tip of the jet and guide 19. Shutting off the air supply to jet 18 allows the loose yarn to be drawn into the slubbing jet and a slub is formed.

One of the major variables for controlling product characteristics is the overfeed. It will be apparent that the intermittent action of the tension changes will result in the yarn being fed to the jet in an irregular manner, so the feed rate will be expressed as an average value. The range can be varied within wide limits, primarily to change slub size and frequency. Generally speaking, this overfeed can vary from 5% to 100% or more. As used herein,

Percent overfeed

$$= \frac{(\text{average feed rate} - \text{withdrawal rate})}{\text{withdrawal rate}} \times 100$$

where the withdrawal rate is the rate at which the yarn is withdrawn from the slubbing jet.

Since slub growth is a random process, both slub size and the interval between slubs will vary. However, slub frequency will primarily be determined by the frequency

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of the tension changes while the slub size will primarily be determined by the duration of the tension change.

It will be obvious that when an additional jet 17 is used to improve the slubbed yarn, as shown in FIGURE 2, one or more yarns can be passed to this second jet at the same or different rate of speed. Thus, a carrier-effect yarn may be obtained, which is useful for specialized applications. This is particularly useful for plying slub yarn with a carrier yarn to strengthen any weak spots which might cause difficulty in weaving.

Any synthetic or natural fiber yarns can be used in the novel process described previously. Suitable materials include all the fiber-forming polyamides such as 6 nylon and 66-nylon. The polyester yarns are all useful and include polyesters of terephthalic acid or isophthalic acid and a lower glycol, for example, polyethylene terephthalate, poly(hexahydro-p-xylene terephthalate). Other conventional classes of fiber-forming materials include regenerated cellulose, cellulose esters, and the acrylic polymers, as well as the many suitable fiber-forming copolymers. Preferably, the yarn to be treated is a continuous multifilament yarn at 0 twist. It may be desirable, however, for special effects or specific end uses, to use a pretwisted yarn or, perhaps, to add a pretwisted yarn as a carrier yarn after the slubbing jet.

These yarns can also include monofil or twist lively yarns. These are difficult to handle and slub effectively but can be included for unusual results.

Almost any jet is suitable to slub the yarn provided that the jet has an aspirating action. If desirable, a jet fluid flow pattern that induces a twisting action can be used. Other jets similar to those described under the section on supply jets can be used to consolidate the slub; torque jets are a preferred species for consolidating the slub.

The fluid used in either jet may be room temperature or heated. Suitable compressible fluids include air, steam, gases, vapors, and the like, to twist, loop, slub, or consolidate the slub yarn. The only upper limit to the treating temperature is the yarn melting or degradation point. The preferred temperature is that of room temperature with air as a preferred fluid.

Obviously, the type, temperature, and pressure of the gas can be varied over a very wide range. The gas conditions in each jet may be the same or different, depending upon the characteristics of the slub yarn product desired so as to permit one to greatly augment the types of novel yarns produced by this new process.

Example I

Apparatus equivalent to that in FIGURE 1, using a jet of the type described in U.S. Patent No. 2,852,906, is used to process 70 denier, 34 filament, 0 twist dull 66-nylon yarn at a windup speed of 400 yards per minute. The jet is supplied with 100 p.s.i.g. air. The tension gate is adjusted so that the running yarn is attracted by the jet, but not sucked into the jet. The yarn tension is reduced by manual manipulation of the tension gate, and this results in suction of yarn into the jet, where a slub is formed in the yarn by twisting and filament entanglement. When tension is restored to the original level, the slub section of yarn is withdrawn from the jet inlet. Periodic variation of tension produces a slub yarn.

The interval between slubs ranges from $\frac{1}{8}$ to 80 in. or more. The length of the slubs ranges from $\frac{1}{8}$ to 10 in. The contrast between slubs and the base yarns is substantial to provide desirable effects in the ultimate fabric, i.e., the denier of the slubs is 3 to 8 times the denier of the base yarn. The slubs are characteristically tight and are not readily pulled apart, even though the individual filaments are not stuck together.

Example II

Apparatus of the type shown in FIGURE 2 is used to process 70 denier, 34 filament, 0 twist, dull 66-nylon yarn.

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In this example the tension is varied by increasing the length of yarn between guides 8 and 16 by downward movement of guide 15. Release of the extended loop permits entry of yarn into the aspirating jet where the slub is formed in the yarn strand by twisting and filament entanglement. The slubbing jet is supplied with 100 p.s.i.g. air at room temperature. Periodic variation of the yarn tension as described above produces a slubbed yarn. Further yarn entanglement to increase slub tightness is accomplished by running the yarn through an interlacing jet 17 of the type described in U.S. Patent No. 2,985,995.

In this example the interval between slubs varies from 20 to 200 inches with the slubs having a length between 4 and 15 inches and a range of denier ratio from 1:3 to 1:6.

Example III

Apparatus for producing slub yarn is set up as in Example II except that the yarn used is 40 denier, 27 filament, 0 twist, semidull polyethylene terephthalate yarn. In this example the interval between slubs is 20 to 200 inches or more. The slub length ranges from $\frac{1}{2}$ to 7 inches with a range of denier ratio from 1:3 to 1:6.

Example IV

Apparatus for producing slub yarn is set up as in Example II except that a yarn of 70 denier, 50 filament, 0 twist polyethylene terephthalate copolymer with 2 mol percent of the sodium salt of poly(sulfisophthalate) having a trilobal cross-section is used. In this example the frequency of the tension changes is varied to produce an interval between slubs of 2 to 200 inches or more. The slub length ranges from $\frac{1}{8}$ to 12 inches with a range of denier ratio from 1:3 to 1:10.

Example V

Apparatus is set up as in Example I for producing a slub yarn from 70 denier, 50-filament, zero twist, trilobal semi-dull polyethylene terephthalate yarn. The air supply is turned off and the yarn tension adjusted to give 5 grams total tension. The air supply to the jet is then turned on, and the aspirating action of the jet sucks the yarn into the jet where a slub is formed by twisting and filament entanglement. When the air is turned off, the slub section is withdrawn from the jet inlet. Periodic operation of the jet produces a slub yarn.

The interval between slubs ranges from $\frac{1}{2}$ inch to 100 inches or more. The slub length ranges from 1 inch to 10 inches with a range of denier ratio from 1:3 to 1:6.

Example VI

Apparatus of the type shown in FIGURE 3 is used to process 100 denier, 34 filament, zero twist, semidull polyethylene terephthalate yarn. In this example the tension is varied by increasing the length of yarn between guides 8 and 16 by operation of jet 13. The air supply to jet 6 is turned on and the yarn tension adjusted at tension gate 4, so that the yarn is attracted by but not sucked into jet 6. The air supply to jet 13 is then turned on and the force on the yarn created by jet 13 is high enough to overcome the tension set at gate 4. When jet 13 is in operation, yarn is removed from the supply package at a faster rate than it is wound up and it accumulates as a loop of loose yarn. When air flow to jet 13 is stopped the low yarn tension of the loop permits entry of yarn into the aspirating jet where a slub is formed. Periodic variation of the yarn tension by intermittent operation of jet 13 produces a slub yarn.

In this example, the interval between slubs varies from 20 to 200 inches or more. The slub length ranges from $\frac{1}{2}$ to 36 inches, and the denier ratio ranges from 1:3 to 1:6.

The intermittently bulked yarn prepared by the subject invention has many of the desirable properties associated with slub yarns in the past. They are particu-

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larly useful for novel and decorative effects for wearing apparel, upholstery and draperies.

Since many different embodiments of the invention may be made without departing from the spirit and scope thereof, it is to be understood that the invention is not limited by the specific illustrations except to the extent defined in the following claims.

I claim:

1. In the treatment of multifilament yarn with an aspirating jet utilizing a high velocity flow of compressible fluid to form a zone of turbulence and to provide an aspirating stream through the yarn inlet into the jet, the process for forming slubs in the yarn which comprises feeding and forwarding the yarn along a path leading across the jet inlet without passing through the jet, flowing compressible fluid through the jet at sufficiently high velocity to draw a loop of yarn into said jet at said jet inlet and form the loop into a slub by fluid action in the turbulent zone, then forwarding the yarn under sufficient tension to withdraw the slub from the jet, repeating the process along the yarn to form a series of slubs, and collecting the slubbed yarn.

2. A process as defined in claim 1 wherein the yarn is fed through the aspirating stream to take-up rolls which forward the yarn at constant speed and the speed at which

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the yarn is fed to the aspirating stream is varied to provide the slubbing action.

3. A process as defined in claim 2 wherein the speed variation is accomplished by varying the feed tension.

4. A process as defined in claim 2 wherein the speed variation is accomplished by varying the aspirating action of the jet.

5. A process as defined in claim 2 wherein the speed variation is accomplished by pulling a loop in the yarn adjacent to the jet and releasing the loop to provide slack in the yarn.

6. A process as defined in claim 1 wherein the yarn tension is varied by intermittently pulling the yarn aside and releasing the yarn to provide slack in the yarn passing through the aspirating stream.

7. A process as defined in claim 6 wherein the slack is provided by forwarding the yarn in a stream of a second aspirating jet which is operated intermittently.

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