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TECHNIQUE FOR PRODUCING SYNTHETIC BULK YARNS

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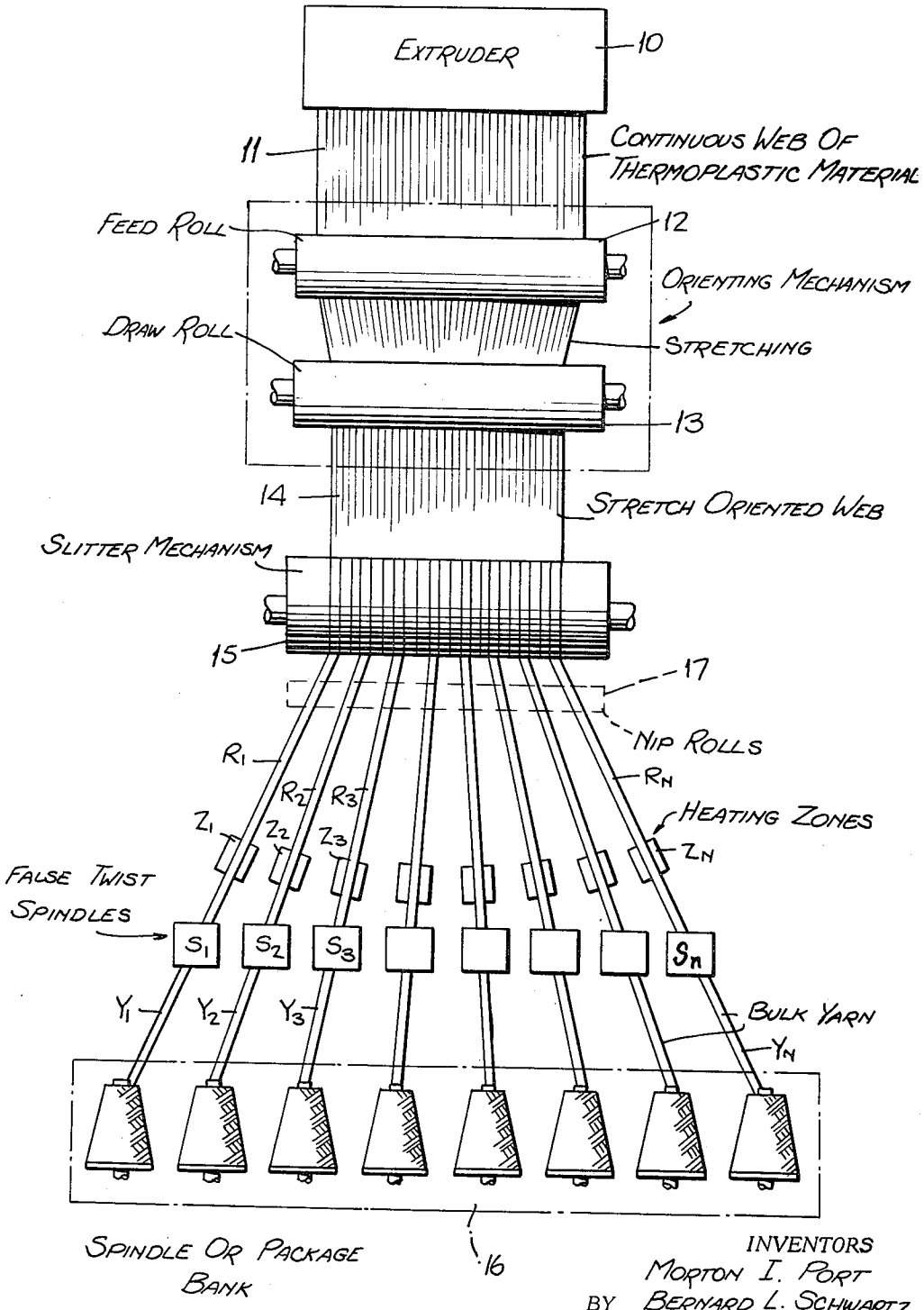

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TECHNIQUE FOR PRODUCING SYNTHETIC BULK YARNS

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The portion of the term of the patent subsequent to Aug. 20, 1985, has been disclaimed

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U.S. Cl. 264—147 6 Claims

ABSTRACT OF THE DISCLOSURE

A technique for converting synthetic polymeric material into a plurality of bulk yarn packages, wherein the material is first extruded into a film-like web which is then stretch-oriented to an orientation point at which the material is susceptible to fibrillation, the web then being slit before or after orientation into individual ribbons, each of which is thereafter conveyed through a heating zone and a false twister, such that the twisting action stresses the ribbon to fibrillate same into multiple filaments which are curled or otherwise distorted as a result of heat-setting, thereby forming a multifilament, bulked yarn which is wound into a package.

Related application

This application is a continuation-in-part of our copending application Ser. No. 378,179, filed June 26, 1964, now Patent No. 3,398,220.

This invention relates generally to the manufacture of bulk yarns, and more particularly to a method for converting a web of thermoplastic polymeric material into multi-filament bulk yarns.

The term "bulk yarns" is generally applied to continuous, multi-filament yarns that have been processed to give greatly increased mass or bulk per unit length. There are three distinct types of bulk yarn, each type depending on the method and conditions used to texturize the filaments. The crimped type, such as Textralized and Spunized yarn, is produced by stuffer-box or gear crimping techniques, and is characterized by the fact that individual fibers, when fully contracted, show very small random undulations along their length.

In the looped type, as for example Taslan yarn, produced by air texturizing techniques, the individual fibers exhibit many complete loops. In the crinkle-type, produced by a knit-heat set and unravel technique, the bulk yarn has a wavy configuration.

The end uses of bulk yarns depend on their inherent characteristics, and while crimp-type yarns in heavy deniers are used in rugs, carpets and for upholstery and industrial fabrics of various types, the loop type is more widely used in apparel items, such as sport jackets, ties and scarves, whereas the crinkle type finds its uses in ladies' seamless hosiery and sweaters. Each type of bulk

yarn has a particular appearance, hand and texture, as well as moisture absorption characteristics, and these properties are taken into account in the selection of a bulk yarn for a specific purpose.

The technique by which the continuous filaments are converted into bulk yarns is known as "texturizing." This technique depends on the ability of thermoplastic filaments to be deformed, heat-set and developed, and it acts permanently to introduce crimps, coils, loops, or crinkles into otherwise continuous filaments. Not only does texturizing make it possible with synthetic yarns to simulate the characteristics of spun yarns, but is provides bulk yarns having improved pill resistance, greater durability, as well as stretch and wash-and-wear qualities.

Conventionally, in making bulk yarns, one begins with a continuous, multi-filament yarn produced by standard fiber-making techniques. The raw material in molten form, which may be, for example, a polyamide, a polyester or an acrylic, is extruded through a pattern of fine holes in a spinneret to yield a multiplicity of fine continuous filaments which are then wound upon a spin bobbin. Thereafter the multi-filament yarn is unwound and stretch-oriented by a drawing process to improve the tensile strength thereof, the multi-filament yarn being again wound on a bobbin. To texturize this yarn, it is again unwound, this time the yarn passing through an appropriate stuffer-box or other form of texturizing mechanism.

Thus the conventional technique for making bulk yarns involves a series of distinct, discontinuous steps, the yarn being unwound at the beginning and rewound at the end of each step. Accordingly, it is the main object of the present invention to provide a novel process for making bulk yarn in a rapid, uninterrupted, sequential operation for transforming molten raw material into bulk yarn.

More specifically, it is an object of this invention to provide a continuous method for manufacturing bulk yarns, wherein the molten thermoplastic, synthetic material is extruded into a film-like web which is oriented and slit before or after orientation into a series of flat monofilament ribbons, each ribbon then being fibrillated and texturized to form a multi-filament bulk yarn, the various steps being interrelated and uninterrupted.

Among the advantages of the present invention are manufacturing efficiency and economy, the technique making use of low-cost processing equipment. It also enables the manufacture of bulk yarns from lower-grade resins and materials which otherwise do not lend themselves to or justify texturizing.

For a better understanding of the invention, as well as other objects and further features thereof, reference is made to the following detailed description to be read in conjunction with the accompanying drawing, wherein the single figure illustrates schematically a system in accordance with the invention, for making bulk yarns.

Referring now to the drawing, the raw material for forming the bulk yarn is rendered molten and extruded through a suitable extruder **10** to form a film-like sheet or web **11**. The raw material may be of any known form of molecularly orientable, thermoplastic polymeric material, such as polyethylene, polypropylene, polyamide,

polyester, or any other suitable resin having an orientable molecular structure. Polymers are synthetic substances composed of large molecules that have been formed by the union of a group of single molecules with one another. The manner in which the raw material is converted into web form is entirely conventional, and any standard equipment may be used for this purpose.

Web **11** is pulled from extruder **10** by feed roll **12**, the web being cooled before it reaches the roll so that it is below its softening point. Longitudinal orientation is then effected by the process of drawing to irreversibly stretch the web and thereby increase its tensile strength considerably. This is accomplished by a cooled draw roll **13** whose peripheral speed is greater than that of a heated feed roll **12**, the ratio between the two rolls being termed the draw ratio. In the case of polypropylene, the draw ratio is preferably in excess of 5 to 1, so that the material will have a definite tendency to filamentize longitudinally when later stressed or worked. In the case of other materials, the draw ratio is chosen to obtain the same effect.

The stretch-oriented web **14** emerging from draw roll **13** is conveyed into a slitter mechanism **15** where it is divided into a plurality of individual flat ribbons R_1, R_2, R_3 . . . R_n, the ribbons having a width appropriate to the final denier of the yarn. Alternatively, slitting may be effected prior to orientation.

In order to convert the ribbons into multi-filament yarns, each ribbon is then subjected to a working operation which serves to rupture the cross or lateral bonding of the polymeric ribbon and thereby to separate the longitudinally-oriented chain molecules into individual fibers or filaments.

To effect fibrillation of ribbons R_1 to R_n, the ribbons are fed into a bank of false-twist spindles S_1 to S_n one for each ribbon, through respective heating zones Z_1 through Z_n. The combined action of the false-twist spindles and the heating zones acts to both fibrillate and texturize the ribbons, so that emerging from the exit side of the false-twist spindles are multi-filament, bulked yarns Y_1 to Y_n, which are then wound on individual spindles in a bank **16** thereof. In practice, the bulk yarns may be wound on a beam for warp yarns or onto suitable packages for use as filling yarns.

A false-twist spindle consists of a rapidly revolving tube with an eccentrically located guide or hook. The ribbon to be false-twisted is led from slitter **15**, passed around the guide or hook, and passed through the tube to the collection package.

The principle of operation is as follows: If a stationary ribbon is held at both ends and twisted in the center by a hollow false-twist spindle, equal amounts of twist with opposing directions of spirality, will be imparted on each side of the spindle. While each half of the ribbon appears to have a real twist therein, the algebraic sum of twist of the ribbon through the length thereof as a whole, is zero. With the false-twist spindle rotating continuously but with the ribbon passing forward, the system reaches a state of equilibrium wherein no twist exists after the ribbon has passed through the tube. This happens because of the cancelling-out of the twist on the exit side thereof.

In practice, the false-twist spindle is controllable to produce as many as thirty-five turns of twist per inch. This gives rise to a considerable rubbing action which works or stresses the highly oriented ribbon and causes it to fibrillate. Since the twist occurs at the entry side of the false-twist spindle in advance of the heating zone, what actually passes through the heating zone is not a monofilament ribbon, but one composed of a cluster of fine filaments. To prevent the twist at the entry side from running back to the slitter, nip rolls **17** or equivalent means are provided adjacent the exit of the slitter **15**.

The heating zones which precede the false-twist spindles can be heated by electrical resistance coils, air, steam, or other heat-exchange fluids. The temperature of the heated area must be constantly and carefully controlled, and is adjusted to the speed of ribbon travel. Heat can be transferred by direct contact or by radiation.

Thus when equilibrium is reached, there are constantly twisted ribbons on the intake side of the rotating spindle, causing the ribbons to fibrillate, the resultant multi-filament ribbons passing through the heating zone. Twisting occurs, therefore, while the filaments are being heated, while de-twisting takes place while the filaments are cooling. Thus the successive steps of twisting, heat-setting and untwisting, are carried out simultaneously to cause the treated filaments to curl or loop, whereby the yarns emerging from the false-twist spindles are bulked or texturized. It is not necessary, therefore, as in the above-noted, co-pending application, to separately texturize the fibrillated ribbons in a subsequent stage.

It is important to note that the use of the false-twist spindles to effect efficient fibrillation need not be accompanied by heat-setting to simultaneously bulk the yarn, for in some instances, one may wish to produce fibrillated ribbons in which the filaments are unmodified. In such instances, before winding on packages, the fibrillated yarns may have finishing agents or lubricants applied thereto to facilitate subsequent processing, such as weaving. Such fibrillated ribbons are useful, for example, as face yarns for tufted rugs.

The advantage of the false-twist spindle technique for fibrillation, as against the use of rotating brushes or needles of the type heretofore used, is that one can attain better control of fibrillation, for by varying the degree of twist and the speed of advance, one may obtain uniform fibrillation to the extent desired.

Thus the process for producing bulk yarns in accordance with the invention involves the production of a broad, thermoplastic, film-like web by extrusion, followed by stretch-drawing to form an oriented web of narrower width, which web is slit before or after orientation into flat ribbons appropriate to the denier of the final yarn, the oriented ribbons being individually worked in a false-twist spindle operating in conjunction with a heater serving to fibrillate the ribbon into multiple filaments which are curled to produce a bulk yarn.

While there has been shown and described a preferred technique for producing synthetic bulk yarns in accordance with the invention, it will be appreciated that many changes and modifications may be made therein without departing from the essential spirit of the invention.

What we claim is:

1. A process for continuously producing a plurality of packages of bulk yarns from polymeric material capable of being molecularly oriented, said process comprising the continuous steps of:

(A) extruding the polymeric material into a relatively broad film-like web,

(B) longitudinally drawing said web to irreversibly stretch same to an orientation point at which filamentization by stressing is possible,

(C) slitting said web in a slitting zone into a plurality of individual monofilament flat ribbons,

(D) false-twisting each of said ribbons at a false-twisting station to fibrillate the structure thereof to form a yarn composed of twist-free continuous filaments, said false twisting imparting a twist to the ribbon in advance of said station whereby the ribbon entering the station is fibrillated, the fibrillated ribbon leaving the station in a detwisting state,

(E) arresting the twist in the ribbon at a point adjacent the slitting zone to prevent the twist from interfering with said slitting, and

(F) heating the fibrillated and twisted ribbon before it enters said false-twisting station and subsequently cooling the fibrillated ribbon in the course of detwisting whereby curling of the filaments takes place to produce a bulk yarn.

2. A process as set forth in claim 1, wherein the web is slit before orientation.

3. A process as set forth in claim 1, wherein the web is slit after orientation.

4. A process as set forth in claim 1, wherein said polymeric material is selected from the class consisting of polyethylene, polypropylene, polyamide and polyester.

5. A process as set forth in claim 1, wherein said false-twisting is controllable to vary the degree of fibrillation.

6. A process as set forth in claim 1, wherein said ribbons are formed of polypropylene and are stretched in a draw ratio exceeding 5 to 1.

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