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METHOD OF TEXTURING FILAMENT YARN

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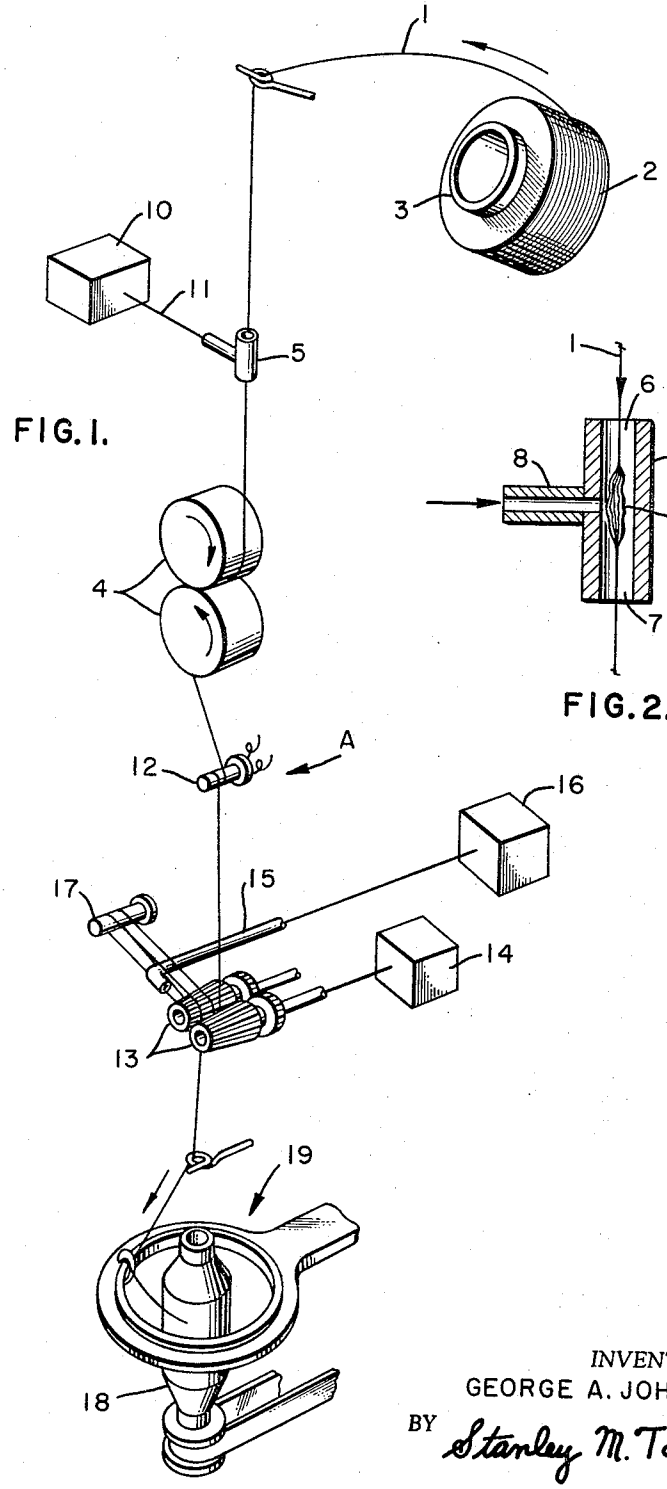


FIG. 1.

FIG. 2.

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METHOD OF TEXTURING FILAMENT YARN

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ABSTRACT OF THE DISCLOSURE

The tufting performance of continuous filament yarn textured by the hot-stretch gear-quench procedure is improved by forwarding the yarn before being stretched through a confined zone in which a stream of fluid moving at relatively low velocity is directed against the yarn. The fluid collides with the yarn therein to discompose the parallelism of the yarn without inducing formation of loops or compacting snarls therein.

The present invention relates to a method of texturing thermoplastic continuous filament yarn. More particularly, the present invention relates to such a method to render the yarn especially suitable for use in the production of tufted fabrics.

Today continuous filament man-made yarns are being used in textile fabrics requiring the yarn to have increased bulk, cover and like properties. The treating of such yarn to obtain the bulkiness is known as texturing or lofting. In accordance with one texturing procedure which has enjoyed considerable commercial success in recent times, substantially untwisted thermoplastic continuous multi-filament yarn showing a low order of molecular orientation is hot stretched and immediately thereafter is simultaneously cooled and deformed by being passed through a pair of cool meshing gear members. The resulting textured yarn has the bulkiness needed in the construction of carpets and upholstery fabrics, a significant part of which is produced today by the use of tufting machines.

It is recognized that the continuous filament yarn textured by the just mentioned hot-stretch and gear-quench procedure exhibits a somewhat lower tufting performance than desired. In using such yarn on standard tufting machines, it is not uncommon for a single filament or a few filaments in the tufting operation to be diverted away from the threadline bundle and to curl into the paths of the tufting needles. The stray filaments are tagged or caught in an adjacent pile loop. As stitching continues, the stray but strong filaments are extended along the backstitching until sufficient force is developed to pull one or more pile loops out of the backing material. These pulled-out loops must be replaced or mended, a costly and undesirable operation; otherwise, a void will be evident on the face of the tufted product. Normally, the mending of tufted carpets is performed as the greige carpeting is inspected on a burling frame located in tandem with the tufting machines, the productivity of which is governed by the time required to mend. Mending results in down time for the tufting machines and obviously is undesirable.

It is an object of the present invention to provide a method of texturing man-made thermoplastic continuous filament yarn.

It is a further object to provide an improved method of hot-stretch and gear-quench texturing.

Other objects may become apparent.

In accordance with the present invention a source of supply of man-made thermoplastic multi-filament yarn is provided. The yarn is undrawn and substantially untwisted. By being undrawn the yarn exhibits a low degree of molecular orientation. The undrawn untwisted yarn is forwarded longitudinally from the source of supply. While

the yarn is traveling, a stream of fluid moving at relatively low velocity is directed at an angle against the yarn. The fluid collides with the yarn in a confined zone to discompose the parallelism of the yarn without inducing formation of loops or compacting snarls therein. Next, the parallelistically discomposed yarn is drawn at an elevated temperature to increase the molecular orientation thereof. Immediately thereafter the drawn yarn is simultaneously deformed and cooled by being passed between relatively cool meshing gear members. The resulting textured yarn is taken up in an orderly manner and has improved tufting performance as compared with yarn textured in the same way but without pre-discomposing the filaments.

The invention is illustrated in the accompanying drawing wherein:

FIGURE 1 is a schematic view illustrating a continuous filament yarn being textured by the process of the present invention; and

FIGURE 2 is a schematic view of a fluid jet in cross section providing a confined zone in which the filaments are brought into disorder.

In FIGURE 1 man-made thermoplastic continuous multi-filament yarn **1** has substantially no twist therein and has not been drawn. Nascent man-made filaments as a rule, do not show a high order of molecular orientation and have a relatively low load-bearing capacity. The source of the yarn is provided in the form of a package **2** wound on a bobbin **3**. Although the yarn is shown as having been packaged, the yarn can be supplied directly from a filament-forming device without the yarn having been packaged provided the yarn is substantally undrawn and twist-free.

The yarn is forwarded from the source by means of a thread advancing device, such as feed rolls **4**, to supply it at a predetermined delivery speed to fluid jet **5**. As shown, the jet is tubular and the yarn passes therethrough. It is important that correct tension be maintained on the yarn as it passes through the jet. For best results the tension should be maintained uniformly low, preferably not exceeding 0.5 gram per denier and usually above 0.01 gram per denier, the exact tension depending upon the type of discomposing fluid used, the mass velocity of the fluid and the yarn count (denier and number of filaments). All these factors are interrelatedly controlled to provide the required disturbing of the parallelism of the filaments without placing snarls of loops therein.

Jets of somewhat similar construction have been used to place crunodal loops in drawn filaments. But, in the present process, the formation of such loops is to be avoided, since their presence adversely interferes with the subsequent drawing and deforming treatment of the present process. Jets of similar construction have also been used to snarl or entangle the filaments of yarn to compact same so that it has some characteristics of highly twisted yarn. Obviously, this snarling is to be avoided in the present process, since the objective herein is to provide a textured or lofted yarn with a coherent thread bundle. A highly twisted yarn or one having a simulated twist due to the presence of snarls cannot acquire the desired bulky character of textured yarn.

In FIGURE 2, one form of jet **5** is shown on an enlarged scale in cross section. Yarn **1** passes therethrough from the entry port **6** to the exit port **7**. A fluid such as compressed air, steam, mist, etc., is flowed through side arm **8** of the jet. The jet of fluid collides with the yarn and deranges the threadline at **9** as seen in the drawing. The impingement of the fluid on the yarn at an angle discomposes same to disturb the parallelism of the filaments and to cause a moderate amount of criss-crossing of the filaments.

A source of supply of fluid is shown at **10** in FIGURE 1.

The fluid flows to the jet via line **11** at a controlled rate. Ordinarily, a mass velocity of 4 to 15 pounds per minute per square inch is quite suitable when compressed air is employed. (The mass velocity is based upon the cross section of the inlet side arm of the jet.) In one aspect of the present invention a measured amount of yarn finish or lubricant in the form of small particles suspended in and moved with air is brought into disturbing contact with the yarn in the jet. This accomplishes the required discomposing of the filaments while at the same time evenly distributing the yarn beneficiating agent throughout the yarn bundle.

From the feed rolls **4** the non-parallelized yarn **1** is led through zone A wherein the yarn is given a hot stretch. That is, the yarn is heated and drawn to change the filaments thereof from their undrawn state to a uniformly drawn, highly oriented state. Heated pin **12** provides the necessary heat and at the same time localizes the point of draw. Obviously, other means of heating the yarn in zone A can be used.

The yarn is forwarded through the zone at the required speed by crimping gears **13** driven by means **14** at a peripheral speed greater than the delivery speed of feed rolls **4** to provide the required attenuation of the filaments. As the teeth of the gears mesh, the yarn is subjected to laterally applied stresses increasing and decreasing in intensity as the yarn approaches and leaves the horizontal plane in which the axes of the crimping gears lie. While subjected to the action of the gear teeth the hot drawn yarn is deformed at the same time it is cooled. To provide this cooling or quenching which is of importance to obtain the texture, gears **13** can be positively cooled. As illustrated nozzle **15** supplies the coolant from source **16**. Usually, it is advantageous to pass the yarn through the mesh of the gears a plurality of times, particularly where the total denier of filaments is high. To do this, a separator roll **17** can be positioned adjacent to one of the gears.

After being cooled and deformed by the gears, the yarn is ordinarily taken up in an orderly manner. As shown the yarn is wound in form of a package **18** employing a conventional ring twister mechanism **19**.

The invention can advantageously use as a starting material, undrawn filament yarn prepared from a variety of polymers, including polyamides, polyesters, polyurethanes, polyureas, polyacrylonitriles, polyhydrocarbons (polyethylene, polypropylene, etc.), polyvinyl chlorides, cellulose esters and cellulose ethers, as well as many other materials. The yarn can have a round cross-section as well as a non-round cross-section such as X and Y configurations. In addition, the yarn can be tubular or have discontinuous voids. It is preferred that the yarn be made of polymeric ethylene terephthalate or of nylon which is a class of polyamides. In particular nylon 6 (polymeric 6-aminocaproic acid) and nylon 66 (polyhexamethylene adipamide), as well as various copolymers of nylon can be advantageously processed. When these specific nylons are employed, best results are obtained by maintaining the heating zone in the range of about 150–250° C.

The following example is illustrative of the invention; but, the same obviously is not limited thereto.

Example

The filaments used as a yarn source were prepared by melt spinning nylon 66. The filament had a Y-shaped cross section. A yarn with no twist and composed of 68 of these undrawn filaments, each of which had a denier of about 60, was wound onto a bobbin from a spinning machine. Apparatus of FIGURE 1 was used to treat the yarn except that fluid jet **5** was not part of the equipment. At a speed of 350 yards per minute the yarn was forwarded to the hot stretch zone A. The temperature of pin **12** was 170° C. The yarn was fed between gears **13** driven so that a stretch of 350 percent was accomplished. The yarn was passed through the gears for an additional two times. Then, the yarn was packaged. Several packages were used to tuft a carpet using a conventional tufting machine. During tufting it was noted that errant filaments resulted in pulled-out tufts and in residual deformed tufts on the face side of the carpeting. To mend the carpeting lowered the productivity of the tufting machine to about 30%.

Similarly spun yarn was treated in accordance with the present invention. The yarn under a tension of 0.05 gram per denier was passed through the jet **5** in which the diameter of the inlet arm was 0.0625". Air with a mass velocity of 8 pounds of air per minute per square inch of inlet jet cross section was directed at right angles to the yarn within the jet. (This rate is equivalent to an average linear air velocity of about 260 ft. per second.) The action of the air disturbed the parallelism of the filaments resulting in moderate cross-crossing thereof without formation of loops and snarls. The yarn was hot-stretched and gear-quenched as above in this example. The yarn was used to tuft a carpet. During tufting it was noted that only rarely did errant filaments occur. Productivity of the tufting machine using these filaments increased to about 90%. This is a highly favorable improvement in tufting productivity compared with the productivity when tufting yarn whose filament parallelism was not disturbed in accordance with the invention.

The process herein affords many advantages. Discomposed yarns textured by the hot-stretch gear-crimp procedure have enhanced tufting performance. The process requires no complex apparatus and is quite economical. In addition, the over-all properties of the texture of the yarn show significant improvement.

Discomposition of the parallelism of the yarn permits better heat transfer during drawing. More uniform texture and cohesion of thread bundle and more uniform distribution of residual finish is apparent.

It is evident that many different embodiments of the above can be made without departing from the spirit and scope of the present invention. Therefore, it is not intended that the invention be limited except as indicated in the following claims.

What I claim is:

1. A method of texturing man-made thermoplastic continuous multifilament yarn comprising:

(a) forwarding substantially untwisted undrawn thermoplastic continuous filament yarn longitudinally from a source of supply;

(b) directing a stream of fluid moving at a low velocity against the forwarded yarn in a confined zone to discompose the parallelism of the yarn such that same is substantially free of loops and compacting snarls;

(c) drawing the discomposed yarn at an elevated temperature to increase the molecular orientation thereof;

(d) simultaneously deforming and cooling the drawn yarn by passing same between cool toothed meshing gear members; and

(e) taking up the yarn in an orderly manner.

2. The method of claim **1** wherein the fluid is air moving at a mass velocity of about 4 to 15 pounds of air per minute per square inch of cross section of the inlet to the jet.

3. The method of claim **1** wherein the yarn is made from a nylon polymer.

4. The method of claim **3** wherein the yarn is made from nylon 66.

5. The method of claim **3** wherein the yarn is made from nylon 6.

6. The method of claim **3** wherein the yarn is made from a co-polymer nylon yarn.

7. The method of claim **1** wherein the yarn is made from a polymeric ethylene terephthalate.

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