

March 10, 1964

G. B. HUGHEY

3,124,628

METHOD FOR PRODUCING TWISTED FILAMENT YARN

Original Filed Nov. 7, 1960

FIG. 1.

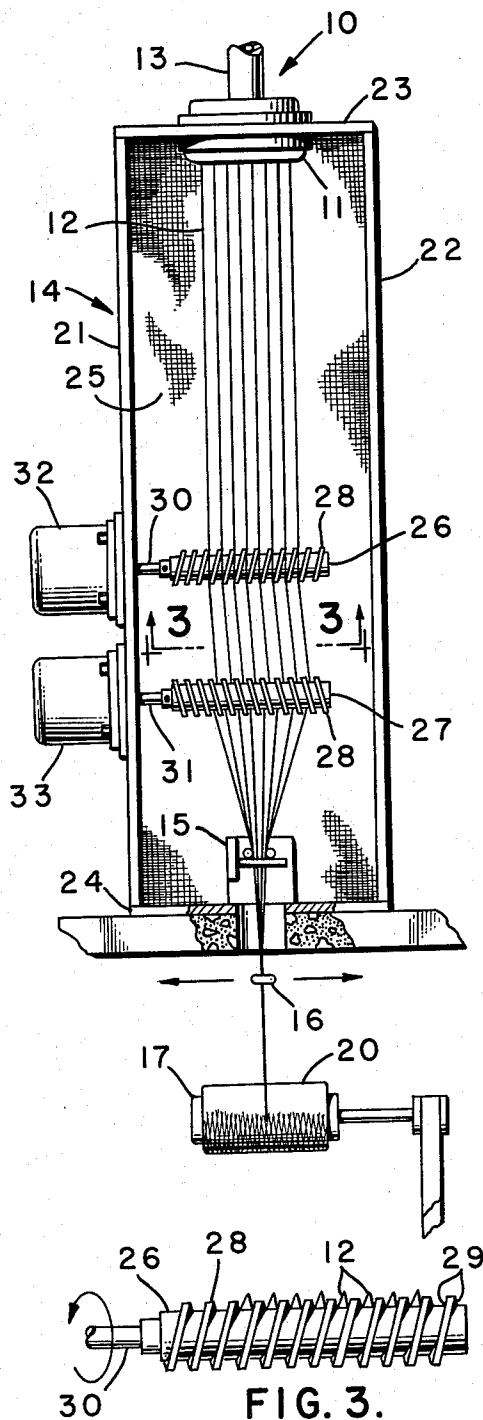
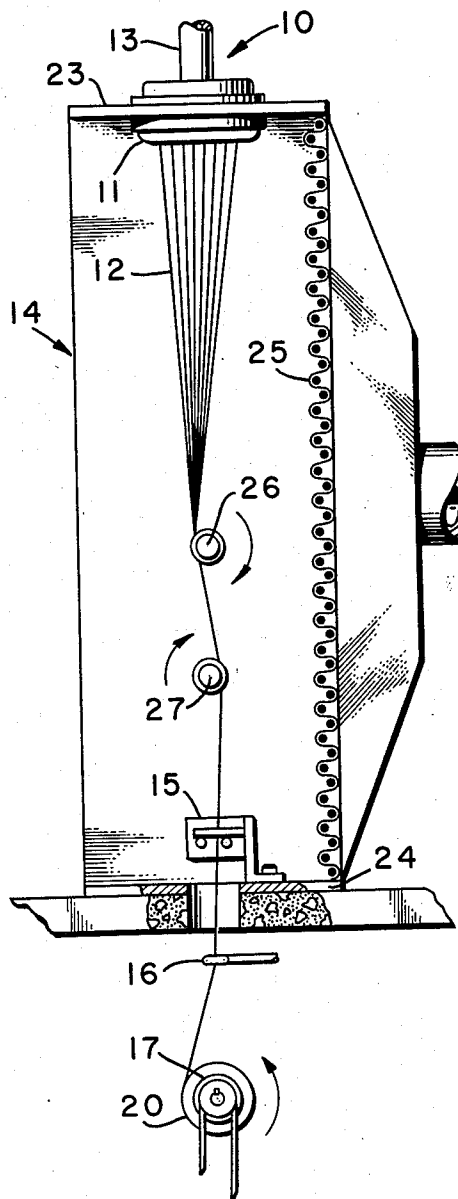


FIG. 2.



INVENTOR.
GEORGE B. HUGHEY

BY

Stanley M. Tarter

ATTORNEY

1

3,124,628

METHOD FOR PRODUCING TWISTED FILAMENT YARN

George B. Hughey, Pensacola, Fla., assignor, by mesne assignments, to Monsanto Chemical Company, a corporation of Delaware

Original application Nov. 7, 1960, Ser. No. 67,658, now Patent No. 3,067,461. Divided and this application Apr. 10, 1962, Ser. No. 186,454

9 Claims. (Cl. 264-103)

This invention relates to the production of filaments by the melt-spinning method. More particularly, the invention relates to a method for producing melt-spun synthetic textile filaments having a twist individually imparted therein.

Many methods and devices are known for imparting some of the desirable properties of spun yarn to continuous filament yarn by modifying the texture thereof. Continuous filament yarn which has been modified in some manner to increase its bulk, stretch, or both of these properties has become known as a textured yarn. A well-known procedure for producing textured yarn includes the steps of twisting drawn yarn, then heat-setting the twisted yarn and then detwisting the yarn. In commercial practice the steps of twisting and detwisting most often are accomplished by means of a false twist apparatus. However, by the use of a false twist apparatus the twist is not a true twist and the amount of twist imparted to a bundle of filaments is not uniform from one filament to the next. Often it is desirable to employ textured yarn in the construction of fabrics and the like, the filaments of which are twisted individually and uniformly. Heretofore, prior art procedures for imparting uniform twist to the individual filaments of a bundle of filaments to increase the bulk thereof have been fraught with difficulties and are regarded as being economically unfeasible.

It is an object of this invention to provide a new and useful method for twisting individual filaments during melt-spinning thereof.

It is another object of the present invention to provide a new and useful melt-spinning method for imparting a positive twist to the individual filaments during the melt-spinning thereof.

It is a further object of the present invention to provide a new and useful method for melt-spinning filaments and twisting such filaments up to and just beyond the point of solidification of the filaments in the spinning chamber so as to provide a uniform and positive twist in the individual filaments.

Other objects and many advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawing in which like numbers designate like parts throughout the figures thereof.

In general, the objects of the present invention are accomplished by providing one or more melt-spinning devices adapted to shape and discharge molten or plastic organic filament-forming materials into one or more streams to cool the streams into hardened filaments and thereafter to collect the filaments in an orderly form. Each spinning device includes a plate, such as a spinneret, having a suitable number of small orifices therein. The molten or plastic mass is extruded at a constant rate and under pressure through these small orifices to form molten streams of polymer. The device includes a protective spinning chamber adapted to receive the shaped streams which are directed downwardly therethrough and wherein the extruded streams are cooled and solidified into filaments such as by a non-turbulent flow of gas impelled against the streams. Each spinning device con-

2

tains at least one rotatably mounted twist-imparting member having a thin continuous helical rib projecting therefrom. The member is positioned near the yarn path between the spinneret and means for taking up the yarn in a uniform manner. The member is adapted to produce a rotation moment to individual filaments by a peripheral effort on the filaments. The resulting twist of the filaments extends upwardly toward the point of extrusion and slightly past the point of solidification of the filaments in the spinning chamber so as to obtain a true and permanent twist in the filaments.

With reference now to the drawing, FIGURE 1 is a front elevational view of a melt-spinning apparatus incorporating one embodiment of the invention;

FIGURE 2 is an elevational view taken from the right hand side of FIGURE 1 with a side wall of the apparatus removed for convenience of illustration; and

FIGURE 3 is a view of part of the apparatus on a larger scale taken along line 3-3 of FIGURE 1 and looking in the direction of the indicating arrows which illustrates more fully how the said member imparts a twist to the filaments.

In the drawing, reference numeral 10 generally indicates a spinneret assembly which incorporates a spinneret 11 through whose orifices a molten or plastic filament-forming polymer is extruded into a plurality of filaments 12. The molten polymer is pumped or propelled to the spinneret under pressure through a conduit 13 from a suitable source where the polymer is heated to a molten or plastic condition. The face of the spinneret preferably is horizontally disposed so that the normal extrusion axis extends vertically downward. Upon extrusion the molten polymer assumes the form of a stream or a plurality of streams of polymer. The streams are received immediately after extrusion by and cooled within the confined and protected area provided by the elongated spinning chamber 14. The bundle of filaments 12 pass downwardly through the cooling zone within chamber 14 and thence to and through yarn converging guide 15 where the filaments are gathered together in a more compact bundle. Thereafter, the bundles of filaments are taken up in an orderly manner. As illustrated, the take-up means includes reciprocally mounted traverse guide 16 adapted to lay the melt-spun filaments on a bobbin 17 or the like suitably driven to form a filament package 20. It will be appreciated that the speed of filament take-up on bobbin 18 will be coordinated properly with the extrusion speed of the polymer so that proper melt-spinning is accomplished. Ordinarily the collection rate is considerably higher than the extrusion rate.

The spinning chamber 14 having an open front comprises two solid vertical side walls 21 and 22 in spaced apart relationship, a top panel 23 and a bottom panel 24 provided with an opening therein through which the gathered bundle of filaments passes in operation. The back wall of the chamber 14 bridging said side walls 21 and 22 and extending from panel 23 to panel 24 is made of material pervious to gas, such as gauze fabric, felt material, or as illustrated, a fine mesh wire screen 25. The screen will impart a diffused but substantially straight line flow to the cooling gas impelled therethrough so that the cooling gas contacts laterally the vertically moving streams of polymer to cool same into solid filaments. Often it is desirable to contact the filamentary stream with a force of air sufficient to cause the streams to assume an arcuate path during part of their travel down the spinning chamber.

In the yarn path between the spinneret and the take-up means there are positioned rotatably mounted members 26 and 27 each having a continuous helical rib 28 projecting therefrom and extending longitudinally thereof. The said members are adapted to impart a rotational

movement to the filaments coming into contact therewith. Preferably, the members are circular in cross section and are mounted to be normal with respect to the extrusion axis. The sides 29 of rib 28 preferably are substantially parallel. The twist-imparting members 26 and 27 are mounted on drive shafts 30 and 31 respectively driven by electric motors 32 and 33. The motors are energized by suitable electrical connections, not shown. As indicated above, the long axes of members 26 and 27 are perpendicular with respect to the extrusion axis. Instead of employing two members, as illustrated, one or more than two such members may be employed, although the use of two members gives quite satisfactory results. The members are positioned near the bottom of the spinning chamber 14 where the filamentary streams are solid. The members cause the individual filaments to become twisted with the twist running back unimpeded toward the spinneret where the streams are still plastic. By maintaining the twist in the filaments, during the metastasis of the filaments from a molten condition to a hardened state, the resulting twist is permanent.

For best results the number of grooves between the ribs 28 approximates the number of filaments being produced and the height of the ribs is less than half the distance across the cross section of the filaments. Where two twist-imparting members are employed, the filaments for best results contact opposite sides of the peripheries of the members. Drawing attention to FIGURE 2, it is noted that the filaments 12 contact the left side of the periphery of member 26 and then the right side of the periphery of member 27.

The invention is generally applicable to any substance that can be suitably melt spun. Specific polymeric materials capable of being melt spun include: nylon 66, nylon 6, nylon 4, nylon 610, nylon 11, and their filament-forming copolymers, e.g., 6/66, 6/610/66, etc.; polyesters derived from terephthalic acid and ethylene glycol and from terephthalic acid and bis-1,4-(hydroxymethyl) cyclohexane; polyethylene and polypropylene; and other substances.

The present process is most suitable for twisting yarn whose filaments have a non-circular cross section such as that produced where a spinneret having non-circular shaped orifices is employed during the manufacture thereof. Yarns of X- or Y-shaped cross section are examples of yarns having a non-circular cross section. The yarns may have a triangular cross section as shown in FIGURE 3 or may have a square cross section or other polygonal or multilobal shape.

There has just been described above a simple, inexpensive and effective method for imparting a persistent twist in the individual filaments of melt-spun yarn as they are being produced. The resulting yarn is bulky, that is, it has greater covering power and warmth due to enhanced lateral spacing of the filaments. Among other advantages of the present invention is the fact that the device may be run at high speed and requires little operator attention. The construction and arrangement of the device make it possible to convert at moderate expense existing melt-spinning equipment into a machine of the type disclosed and claimed herein. The inherent properties of the yarn

twisted in accordance with this invention are such that they impart numerous and desirable effects in woven, non-woven, and knitted fabrics made therefrom.

Obviously, many modifications and variations of the present invention are possible in the light of the above teaching. It should be understood, therefore, that the foregoing disclosure relates to only preferred embodiments of the invention and that numerous modifications may be made therein without departing from the spirit and scope of the invention as set forth in the appended claims.

This application is a divisional application of application Serial No. 67,658, filed November 7, 1960, and now Patent No. 3,067,461.

What is claimed is:

1. A method of producing twisted continuous filament yarn having enhanced bulk comprising the steps of extruding molten thermoplastic filament-forming polymer into plastic filaments, passing said filaments through a cooling zone to effect metastasis of the polymer from a plastic state to a more rigid state, collecting the resulting filaments at a speed sufficient to impart a substantial attenuation thereof while same are being cooled, rotating each individual filament about its longitudinal axis by applying a positive peripheral rotational effort below where metastasis occurs as same is being attenuated thereby imparting a twist running along each filament to a point above where metastasis occurs to effect permanently twisted filaments.
2. The method of claim 1 where the polymer is nylon.
3. The method of claim 2 where the polymer is nylon-66.
4. The method of claim 2 where the polymer is nylon-6.
5. The method of claim 1 where the cross sections of the filaments are non-circular.
6. The method of claim 1 where the polymer is a polyester having fiber-forming properties.
7. The method of claim 1 where the polymer is polypropylene.
8. The method of claim 1, wherein all of said filaments are rotated in the same direction.
9. A method of producing twisted continuous filament yarn having enhanced bulk comprising the steps of extruding molten thermoplastic filament-forming polymer into plastic filaments, passing said filaments through a cooling zone to effect metastasis of the polymer from a plastic state to a more rigid state, collecting the resulting filaments at a speed sufficient to impart a substantial attenuation thereof while same are being cooled, rotating each individual filament about its longitudinal axis by applying a plurality of positive filament rotating efforts to each individual filament below where metastasis occurs as same is being attenuated thereby imparting a twist running along each filament to a point above where metastasis occurs to effect permanently twisted filaments.

References Cited in the file of this patent

UNITED STATES PATENTS

2,509,845	Slayter	May 30, 1950
2,708,813	Bourgeaux	May 24, 1955