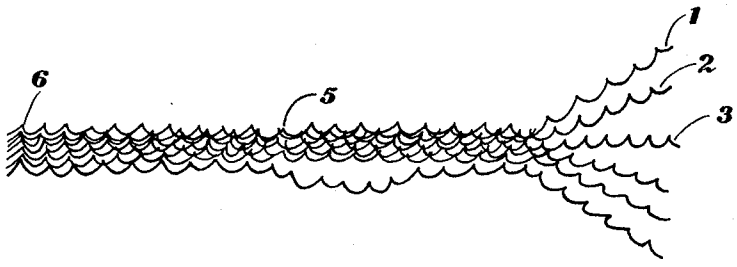
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RUG YARN

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SCHEMATIC ENLARGED SKETCH OF ENTANGLED CRIMPED POLYMERIC YARN

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RUG YARN

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This invention relates to a man-made yarn of novel structure. More particularly, this invention concerns a modacrylic or other polymeric yarn which has been processed in a certain manner to render it especially suited for needle tufting into chenilles and rugs.

This application is a continuation-in-part of my application Serial No. 102,880, filed April 13, 1961, now U.S. Patent No. 3,099,064.

In the prior art tufted rugs have usually been made from staple fiber spun into yarn. Or the rugs have been made from continuous filament yarns which have been treated by a so-called texturizing or bulking process which substantially increases the bulk or volume of the yarn and puts a large number of loops thereon. While the aforementioned types of yarn may be made into rugs of pleasing appearance because of the soft, fluffy nature of such yarn there has been a tendency for rugs made therefrom to catch dirt and mat when heavy objects are placed on the rug. It has also been proposed to make yarns for rugs and the like use by procedures involving hot water shrinkage. However, such method is not readily applicable to certain type yarns as acetate yarns, acrylic yarns and others which exhibit a resistance to water shrinkage.

Therefore, it is apparent that the development of certain new forms of yarn useful for rug manufacture represents a highly desirable result. As known in the rug industry there is a need for a type of yarn which will provide more cover with less weight of yarn and with less tendency to matting than is available in currently produced yarns. After extended investigation I have discovered a new type of yarn together with a simple and economical process and apparatus for its manufacture.

This invention has for a principal object to provide a new yarn product producible by certain processes and apparatuses applied to the treatment of certain continuous filament man-made filaments to render such filaments more useful in the manufacture of rugs and other similar articles of manufacture. Another object is to provide a new yarn product of modacrylic fibers whereby such type of fibers are rendered more useful for rug manufacture and the like purposes. Still a further object is to provide novel type of articles as rugs comprised principally of said new yarn product. Other objects will appear hereinafter.

As indicated above, a number of the prior art fibers while in a processed state exhibiting a soft, pleasing appearance, when made into rugs or for comparable use tend to mat when objects are placed thereon. Prior methods of producing such fluffed and softened fibers have involved the handling of a single end of yarn throughout the process. This handling of a single end of yarn may add to the expense of the yarn production which presents cost problems in the highly competitive field of the manufacture of yarn. In the broader aspects of my invention I have found that several bands of man-made filaments, as distinguished from natural fibers exemplified by wool and cotton, may be processed in a certain controlled manner in a jet. The yarn issuing from the jet as treated by my invention may then be followed by group crimping in a single crimper. Even though the yarn of the present invention is group crimped in a single crimper my yarn may be readily separated into individual ends as it is discharged from the crimper. Since process and apparatus for producing my new yarn product has been described in detail in parent application Serial No. 102,880 referred to above, now Patent No. 3,099,064, only limited reference thereto will be made herein.

For assistance in an understanding of my yarn product invention reference is made to the attached drawing forming a part of the present application.

The figure in the attached drawing is a diagrammatic side elevation view on a considerably enlarged scale illustrating the yarn of the present invention. In this drawing the individual filaments making up the yarn are indicated at **1**, **2** and **3**. The number of filaments making up the yarn may vary considerably as, for example, from 10 to 100. Likewise, the denier of the individual filaments is not limited and may be, for example, between 5 to 80. While the chemical composition of the filaments is preferably cellulose acetate or modacrylic, the composition may be composed of a polyolefin or other polymeric material as will be apparent from the examples which follow.

The plurality of filaments are internally entangled as indicated at **5** which imparts some coherency to the yarn without need of any or a substantial amount of twist. Also, as apparent from the drawing, the filaments have a saw-tooth crimp as indicated at **6**.

The yarn is made in general by spinning the filaments in a usual manner such as dry spinning or melt spinning. Several yarn ends from several spinning cabinets are passed through separate jets. Then the several ends are gathered together as a single yarn bundle and fed through a single crimper from which the individual ends are separated. The processed ends are then conducted to packaging for rug manufacture. Additional information on details concerning processing the yarn will be had from the examples set forth hereinafter or may be had by reference to my parent application, now Patent 3,099,064 referred to above.

In the present invention it will be noted that the yarn going through the jet is not subjected to action that materially volumizes or loops the yarn. To the contrary the input speed and the output speed are controlled relatively the same so that no or a negligible amount of shortening of the yarn occurs. Any loops that may incidentally form on the yarn are of a versed sine configuration thereby distinguishing the present yarn from prior art looped yarns. It has been found that treating the yarn in the jet at a speed of take-up approximately commensurate to the speed of or slightly lower than the input speed produces yarn which when subsequently crimped may be made into rugs with good results.

A more detailed understanding of my invention will be had from a consideration of the following examples which are set forth to illustrate certain preferred embodiments.

Example I

In accordance with this example the composition spun was a conventional cellulose acetate spinning composition. Details concerning the denier, the rate of feeding to the jet, the air pressure used and the like were as follows:

Yarn denier	4,800 to be processed.
Filaments	400, 12 D/F "C" cross-section.
Agent applied	¼% chemical (shown in head Patent 2,807,864).
Godet roll speed	125 m./m.
Jet air pressure	40 p.s.i.
Output roll speed	100 m./m.
Yarn loops if any	Versed sine type.
Yarn denier after processing	5,000–5,400.
Crimper speed	102 m./m.
Crimps in yarn	9 per inch.
Output speed of crimper	80 m./m.

Eight ends were separated and wound onto a section beam and processed into a cut pile tufted rug having eight stitches per inch and a needle gage of 5/16 inch. The rug sample when finished had superior cover and appearance to rugs of equal construction made from a 1's count acetate staple yarn or a prior art volumized 5,300 uncrimped yarn.

While I do not wish to be bound by a theory of operation, one reason for the improved cover is thought to be as follows: The added feature of crimp in any yarn causes it to be very stretchy or elastic under light loads. As the yarn passes through the needle tufting machine it is placed under considerable tension fluctuation, i.e., cycles of high and low tension. This flexing of the yarn causes the filaments to bloom out from each other and be held apart because the crimps and any versed sine loops in the filaments tend to get out of phase and hold the filaments apart. The crimps are not completely removed in the process and therefore continue to act in the rug imparting resistance to matting.

Example II

In accordance with this example the yarn produced was modacrylic product dry spun in a usual manner. The spinning solution comprised 20–30% of the modified acrylic polymer dissolved in acetone. The yarn spun from the spinning cabinets under various periods of operation was of total denier of 1800, 2200 and 2700 and of a denier per filament of 13–14. The individual yarn ends from the several spinning cabinets were kept separate and were passed over and around the several rolls. Preferably these rolls, or at least two of the rolls are 2–4 feet in diameter. With such larger rolls I have found there is sufficient surface contact and friction to prevent the yarn from slipping so stretching may be accomplished. Also this is aided by positioning the rolls in an offset manner so the filaments go around a large part of the roll circumference. The yarns were drafted to the order of 400–500%. The rolls were maintained at temperatures between approximately 90° and 150° C.

The individual yarn ends were passed through feed rolls, to feed to and through several jets. In this particular example since there were 10 yarn ends, 10 jets were used. The treatment in the jet was carried out so that the withdrawal speed from the jet was only about 3% slower than the input of the yarn to the jet. The air supply to the jets, which were of a non-swirling type, was in the range of 5 to 75 p.s.i.

The yarn emerging from the jet still had an appearance similar to the initially produced yarn but had of the order of 3% internal entanglement. The several ends of yarn were conducted through a crimper to impart about 9 crimps per inch in the yarn. The crimped yarn was discharged onto a conveyor where it went through a heat chamber at approximately 100–140° C. which served to further set the crimp. The resultant yarn which was both jet treated and crimped was packaged in usual manner for rug manufacture.

This yarn from Example II, while untwisted as produced, after processing was of a suitable character to be used for manufacturing rugs and other articles such as sweaters, blankets and the like. The yarn exhibited good covering power and resisted matting when heavy objects were placed on the products made therefrom; this appeared to be due to the better resiliency imparted to the yarn by the jet treatment followed by crimp which crimp is placed out of register in the manufacturing operations. Also because of the substantial absence of external loops the yarn resisted the entrapment of dirt.

The present invention is particularly useful for the processing of modacrylic yarns of a denier per filament of 2 to 20 and a total denier of 250 to 10,000. However, the present invention may be used on other manufactured fibers such as the continuous filament cellulose ester yarns of Example I, polyester yarns, polyolefin yarns and

polyamide yarns. It may be used on either natural, white or colored yarns. The white yarns are prepared from spinning compositions which contain the filament-forming polymer titanium dioxide and solvent. Colored yarns may be made by dispersing the coloring pigments, such as a black pigment in a small amount of cellulose acetate also containing titanium dioxide and acrylonitrile polymer. This concentrate is milled by three or more rollings on an ordinary two-roll mill. In a similar manner blue pigment may be dispersed in a cellulose acetate base.

A certain amount of titanium dioxide, antimony oxide and modacrylic polymer are mixed together in a solvent as acetone by ball milling. This last mentioned dispersion together with the blue and black dispersions are then mixed with a large amount of a modacrylic dope in solvent. For example, a few percent of the above concentrated dispersion are mixed with 20–30% of the modacrylic polymer, balance solvent, to give a colored spinning composition which contains in addition to the several pigments, the acrylonitrile polymer, modifiers and 4 to 10% cellulose acetate. Other colors may be prepared in a similar manner. I have found that such colored compositions very readily spin into yarns and may be processed by the above process and apparatus with equal facility to uncolored or white yarns.

Illustrations of making yarns of the present invention from other compositions, as polyolefin compositions, will be apparent from the following additional examples.

Example III

Lots 30, 86, and 91 polypropylene were used to produce high heatset samples of polypropylene yarn using the following setup:

(1) Supply yarn from a source of multiple ends
(2) Entanglement of individual filaments in jet
(3) Crimping of multiple ends
(4) Heatsetting of multiple ends
(5) Packaging of individual ends

The operating conditions and physical properties of the yarn were as follows:

Supply yarn Lot #	30	86	91
Supply denier	1,100	1,630	1,640
Percent entanglement	3.25	3.25	3.25
Crimper speed (m./m.)	126	126	126
Final denier	1,730	2,120	2,140
Air pressure (p.s.i.g.)	25	15	15
Tow dryer exposure (minutes)	3	3	3
Tow dryer temperatures:			
First stage (° C.)	110	110	110
Second stage (° C.)	140	140	140
Tenacity (g./d.) processed	1.72	2.73	2.91
Percent elongation processed	39.2	27.7	38.8
Percent hot oven shrinkage (10 minutes at 140° C.)	16.4	17.2	12.0

No lubrication was applied to the yarn during the process of this example. Due to the speed range of the winders used in this example, the desired speed could not be obtained for best winding, thus producing some hard, nonuniform packages. This operation removed a substantial amount of the crimp reducing the cover when tufted into a carpet. However, steaming of the carpet regained some crimp and improved the cover.

Example IV

Lots 25, rose beige, and 46, rose beige of polypropylene composition, were melt spun for Type S polypropylene yarn which was processed. This process consisted of the following operations:

(1) Drafting of yarn
(2) Entanglement of individual filaments
(3) Crimping
(4) Heatsetting
(5) Application of lubricant
(6) Packaging

The operating conditions and physical properties of the yarn were as follows:

Supply yarn Lot #	25	46
Number filaments/end	80	240
Supply spun denier	4,800	9,250
Input roll speed (drafting) (y.p.m.)	28.8	31.7
Output roll speed (drafting) (y.p.m.)	125	125
Draft ratio	4.33:1	3.95:1
Temperature of draft chest (° C.)	145	142
Drafted denier (no relax)	1,210	2,360
Draft tensions	1.3	1.3
Percent entanglement	5	5
Air pressure (p.s.i.g.)	40	51
Crimper speed (y.p.m.)	119	119
Tow dryer temperatures:		
First stage (° C.)	138	137
Second stage (° C.)	141	143
Third stage (° C.)	140	141
Tow dryer exposure (minutes)	2½	2½
Final denier	2,200	4,600
Wind-up speed (y.p.m.)	60	65
Average d./f. (micro. filament)	20.3	14.8
Tenacity (g./d.) processed	1.8	2.18
Crimps/inch	15.5	12.5
Percent hot oven shrinkage (10 min. at 140° C.)	7.6	2.2
Percent Lubricant	5-10	0.36-3.6
Percent elongation	81.5	78.1

Variations were obtained in lubricant application using the wick-type applicator. Variations in crimp were also noticed which produced a difference in shade in the processed yarns. Lot 25 was two plied with 1 t.p.i. twist and tufted into a carpet. Lot 96 was twisted to 0.5 t.p.i. twist in single end and tufted into a carpet. Both samples were tufted on the 5/32 Cobble Brothers machine with little difficulty. Some streaks were noticed in both lots when tufted into a level loop pile carpet but did not show in a high-low pattern.

It will be noted from the foregoing description that the new yarn product of the present invention results to some extent from processing the filaments in a jet in a manner wherein the overfeed is small as, for example, of the order of only 3%. This is considerably different than many prior art processes wherein 100% or greater overfeed is used. At reduced overfeed a more stable yarn configuration is obtained. Also, in prior art processes the filaments may be distorted into loops and undulations. In contrast, the yarn product of the present invention is characterized by sharp, saw-tooth crimp and is free from any round or looped formations of the prior art type. In addition, it will be observed that the new yarn product of the present invention does not exhibit crunodal loops along the length of the filaments as is the situation in some prior art yarns.

Another distinguishing feature of the yarn of the present invention is that it is not characterized by extreme extensibility under tension and recoverability after removal of then tensioning force. The elongation of the yarn of the present invention is of the order of 27 to 39%. This is substantially the same elongation value which would be found in the unprocessed yarn used to make the present new yarn. In further detail, yarns of the prior art may be extended from 50% to at least 66% of their initial length without loss in recovering and this stretchiness makes them difficult to tuft and obtain good pattern definition. In contrast to the prior art yarns, the yarns of the present invention would be substantially permanently elongated and would not recover to its original condition if subject to extensions of 50% or more. It will be further noted that the yarns of the present invention are preferably made from filaments of non-circular cross-section illustrated by filaments having a C or a Y cross-section.

Although the invention has been described in considerable detail with particular reference to certain preferred embodiments thereof, variations and modifications can be effected within the spirit and scope of the invention as described hereinabove, and as defined in the appended claims.

I claim:

1. As a new article of manufacture a substantially untwisted, crimped, heat-treated textile yarn of a denier per filament of 2–20 and a total denier of 250 to 10,000, said yarn being comprised of a number of filaments of longitudinally oriented heat-treated polymeric compositions, said yarn being characterized by sufficient internal entanglement of the filaments to enable the yarn to be compacted with other yarns without said yarn losing its identity as a separate yarn, the crimped, heat-treated yarn being free of external loops and said yarn being of a dense structure with the crimp having a saw-tooth configuration.

2. The yarn of claim 1 free of loops except loops of a saw-tooth configuration and wherein the elongation at any given load after treatment is not substantially different than its elongation at the same load before treatment.

3. The yarn of claim 1 wherein the saw-tooth crimped configuration requires only 3 to 20% elongation to substantially straighten out the yarn and said heat treated yarn having less than 3% to 5% boiling water shrinkage.

4. The yarn of claim 1 wherein said new crimped yarn product contains a coloring material and also contains cellulose ester for dispersing the coloring material into the yarn polymeric composition.

5. The yarn of claim 1 wherein the filaments are of a non-circular cross-section.

6. As a new article of manufacture a substantially untwisted, multifilament, crimped, heat treated polymeric textile yarn of a denier per filament of 2–20 and a total denier not greated than 10,000, said yarn being comprised of a number of filaments of longitudinally oriented heat-treated polymeric compositions, said yarn being characterized by sufficient internal entanglement of the filaments to enable the yarn to be compacted with other yarns without said yarn losing its identity as a separate yarn, the crimped, heat-treated yarn being free of external loops and said yarn being of a dense structure with the crimp having a saw-tooth configuration.

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