

PATENT SPECIFICATION

NO DRAWINGS

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COMPLETE SPECIFICATION

Improvements in or relating to Crimped Tow

We, EASTMAN KODAK COMPANY, a Company organized under the laws of the State of New Jersey, United States of America, 343 State Street, Rochester, 4, New York, United States of America, (Assignees of ROBERT THOMAS CRAWFORD and JOEL BARTLETT STEVENS), hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a method of manufacturing a uniformly crimped tow of continuous filaments which is especially suitable for the manufacture of cigarette filters.

According to the present invention there is provided a method of manufacturing uniformly crimped tow which comprises spinning continuous thermo-plastic filaments of a denier not greater than 16 denier per filament, gathering the filaments together to form a band of filaments of substantially uniform width and thickness and of a total denier not greater than 160,000, imparting to the band of filaments a crimp not less than 8 crimps per inch and applying to the filaments at a stage prior to the crimping operation a non-toxic lubricant comprising an emulsion containing at least one sorbitan compound.

In carrying the invention into effect according to one form of the invention, continuous filaments are spun from a spinning solution, such as cellulose acetate having an acetyl content of 38 to 41% in acetone or other suitable solvent. The filaments are dry spun from high viscosity cellulose acetate through orifices of 0.030 to 0.045 mm. diameter at low draft. For example, using acetone solvent the high viscosity ester is spun at about 55° at a draft of less than 1.8. The spun filaments, after removal of solvent and setting up in a spinning cabinet are conducted out of the cabinet around a Godet roller.

Prior to or beyond the Godet roller the filaments are treated with a non-toxic lubricant

[Price 4s. 6d.]

comprising an emulsion containing at least one sorbitan compound. Preferably, the sorbitan compound or compounds are applied from a mineral oil environment. A preferred composition comprises mineral oil 50 to 90%, sorbitan monolaurate 25 to 5%, and polyoxyethylene sorbitan monolaurate 25 to 5%, the mineral oil being of a high grade and the sorbitan compounds being of a pharmaceutical or edible grade.

In further detail, the tow may be prepared and the aforementioned sorbitan compounds may be applied to the tow by several methods, such as the following:

A. Cellulose acetate yarn is produced by a suitable spinning process as referred to above. Immediately after the yarn from one spinning cabinet is withdrawn therefrom and before it wraps the Godet roller, it is passed across the surface of a rotating cylindrical applicator roller. The sorbitan composition is picked up on the roller by partial immersion in a trough containing the composition. If desired a doctor blade can be used on the applicator roller to control the film thickness of the sorbitan composition although generally the film thickness is sufficiently uniform to make this unnecessary. The thread of filaments is slightly deflected from a straight line by the roller, preferably no more than 3°. The amount of the sorbitan composition applied can be controlled by varying this arc of contact or preferably by varying the speed of the roller. The roller may be rotated so that the surface in contact with the thread moves in the same direction as the thread or in the opposite direction. In either case the surface speed of the roller is much less than the linear speed of the thread. The roller speed is generally between 0.1 and 3.0% of the yarn speed. The roller is generally a ceramic although metals and other suitable materials may be used. Preferably the surface is roughened to ensure the adherence of a good uniform film of the sorbitan composition.

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tion. If desired, the thread may be guided to run in a suitable groove in the roller, providing better opportunity for all the filaments in the thread to pick up the composition.

5 B. Another method of applying the sorbitan composition is to pass the thread across a wick which picks up composition from a reservoir by capillary action.

10 C. Still another method is to meter the required amount of sorbitan composition to the wick or to a surface from which the thread can pick it up.

15 After the filaments have been suitably treated as just described to apply the sorbitan composition thereto, 5,000 to 40,000 of the filaments are formed into a tow and have imparted thereto the uniform and regular crimp referred to above. This may be accomplished as follows:

20 Generally the number of filaments and the size tow are such that it is not practical to produce the tow from a single large spinnerette and our preferred practice is to combine the threads from a number of spinning cabinets. 1000 to 5000 denier is an advantageous size to produce from a single cabinet so 15 to 100 cabinets are combined to form a composite tow of 20,000 to 70,000 denier. In some instances tow of up to 100,000 total denier may be produced. The spinning capacity of the cabinet and the arrangement of the cabinets will together determine the number which can readily be combined to form the desired tow. Since the linear speed of all cabinet threads should be the same, the Godet rollers are driven from a common power source. In order that each cabinet may produce its proportionate share of the total denier, each spinnerette is supplied with spinning solution from its own metering pump and these are also driven from a common power unit. The Godet rollers and metering pumps may both be driven by the same motor or separate power units may be used in which case they should be inter-connected, electrically, hydraulically, or mechanically.

45 The threads from the required number of cabinets are drawn together to form the tow which is fed to a stuffing-box type crimper. In order to secure uniform crimp in the filaments it is important that the tow should be presented to the crimper as a flat band of uniform width and thickness. It is equally important that the band width as the tow enters the crimper be properly correlated to the width of the rollers since too narrow a band causes low crimp on the edges and too wide a band results in what is termed "crimper harsh." This occurs when a few filaments are trapped between the sides of the rollers and the side plates which form the stuffing box, the filaments being chewed up and pressed into small, flat flakes of the material from which the filaments were spun. 65 In our best product the tow is not only free

of skips, i.e. portions of the tow which have no crimps, but has a uniformity within plus or minus one crimp from the nominal.

For a still further understanding of our invention, reference will be made to the following detailed examples which are set forth primarily for illustrating preferred embodiments.

EXAMPLE I

In accordance with this example, a tow having a total denier of 68,000 was passed in contact with an applicator roller rotating in a bath of finishing agent which consisted of a 10% aqueous emulsion of a mixture of 60% sorbitan monopalmitate and 40% polyoxyethylene castor oil derivative. The roller applied about 0.5% of the non-aqueous agent to the tow which was then uniformly crimped to 8.0 crimps per inch using apparatus substantially as described above.

It was found that the mixture of sorbitan monopalmitate and castor oil derivative was superior to mineral oil alone as a filament lubricant. It provided a better ratio of static to kinetic friction between the tow and the surfaces of the crimper stuffing box. This relationship, commonly called "slip-stick", has an effect on crimp uniformity. With a high slip-stick ratio, the tow column in the stuffing box moves intermittently. With a low slip-stick ratio the column of tow moves more uniformly. This more uniform movement of the tow column is easily seen as is the improved uniformity of crimp. In addition, this particular lubricant has a lower fibre-to-fibre friction than mineral oil which makes it easier to separate the crimped filaments, one from another.

EXAMPLE II

A tow was produced in a manner similar to that described above except that the finishing agent applied thereto was a 10% aqueous emulsion comprising 70% N.F. (National Formulary), quality mineral oil, 17% sorbitan monolaurate, and 13% polyoxyethylene sorbitan monolaurate. The tow was crimped as described above. This finish has advantages as follows: In crimping, the water applied to the tow has an antistatic and softening effect, making it easier to control the tow band and to crimp uniformly. It was observed that a lower stuffing box pressure was required for 8.0 crimps per inch than for tow treated with mineral oil alone. Furthermore, the uniform water content obtained by emulsion application resulted in uniform action in the stuffing box and thus, uniform crimp. The higher moisture content in the tow at the time of crimping produced a firm compact ribbon which could be conveyed to and packed in the bale with less disturbance to the ribbon. The compact tow produced a more dense bale. In making cigarette filters from the tow it was found that the compact tow ribbon withdrew better from the

bale and ran smoothly, producing uniform filter rods. In addition, the monolaurates complemented the mineral oil, decreasing the fibre-to-fibre friction, resulting in a better bloomed tow.

EXAMPLE III

In accordance with this example the yarn end from each spinning cabinet was passed in contact with an applicator roller before being conducted around the Godet roller. The applicator roller rotated in a bath comprising a 4% aqueous emulsion of a mixture of 75% N.F. quality mineral oil having a viscosity of 85-95 SSU (Saybolt Seconds Universal at 100°F.), 12.5% sorbitan monolaurate, and 12.5% polyoxyethylene sorbitan monolaurate. The aqueous emulsion was applied in such quantity as to deposit 0.35% of the non-aqueous component to the yarn. The yarn end from each spinning cabinet comprised a number of filaments having an individual size of 2 D/F. A sufficient number of these ends were combined to form a tow containing 32,000 filaments with a total denier of 64,000. The tow was crimped as described above. It was observed that the emulsion finish provided excellent control of the tow band to the crimper, resulting in a crimped tow having uniform crimp and a compact character which permitted packaging in a bale without disarrangement of the crimped tow band. This resulted in a bale of high density. In processing the tow of this example into cigarette filters it was found that the compact tow band withdrew smoothly from the bale with little tendency for loose, stray filaments to entangle filaments from adjoining layers of tow. The reduced fibre-to-fibre friction resulting from the addition of the laurates to the mineral oil finish improved the opening or fluffing of the tow so that essentially no married fibres remained

in the tow. This good opening permitted optimum banding of the tow for uniform application of a plasticizer. The resulting filter rods were characterized by exceptionally good uniformity and appearance. They were uniformly firm due to even plasticizer application and to the absence of uncrimped sections. The ends of the rods had a smooth, square cut and exhibited a uniform, matte finish brought about by the absence of any bundles of unopened filaments. Laboratory tests disclosed an improvement in uniformity of weight, size and pressure drop (resistance to passage of gas at a standard rate).

EXAMPLE IV

In accordance with this example, the spinning solution used was of a somewhat different composition than that used in Example I and comprised the following: cellulose ester—27.00%, titanium dioxide—0.15%, water—1.55%, acetone—71.30%. Reasonable tolerances were permitted on the percentage of each component.

This solution was extruded through a spinnerette containing 0.04 mm openings to obtain a yarn made up of 600 filaments of 2.5 denier per filament. This yarn was treated with a 10% aqueous emulsion of a composition containing 65% of white mineral oil having a viscosity of 125 Saybolt Universal Seconds at 100°F., 20% sorbitan monooleate and 15% polyoxyethylene sorbitan monooleate.

The yarn thus treated was formed into a tow of 90,000 total denier, uniformly crimped as described above and formed into filters. The improved efficiency of the filters made from tow treated with sorbitan compounds of the present invention as compared with mineral oil treated tow is shown in the following table:

COMPARATIVE PROCESSING

	Mineral Oil Lubricant	Emulsion Lubricant
Processing Strength	Fair	Good
Banding	Good	Good
Cross-Overs	Few	Very Few
Blooming	Good	Excellent
Appearance of Crimp	Some skips, alternating crimp level	Few skips, less crimp variation

EXAMPLE V

In accordance with this example relatively small denier per filament and small total denier tow was prepared. This tow was dry spun from an acetone solution of high viscosity cellulose acetate. The tow was treated with approximately 5% of sorbitan composition as described above. In more detail, this composition contained approximately 75% mineral oil and approximately 12.5% each of sorbitan monolaurate and polyoxyethylene

sorbitan monolaurate.

Also, this tow was more highly crimped than that previously described. For example, in the preferred embodiment of operation of the present invention the 2.1 D/F, 44,400 T/D was crimped to 16 crimps per inch. The tow was formed into cigarette filters using air opening of the tow in making the elements. The elements were tested.

The following table summarizes the results of this example:

D/F	2.1	1.2	0.6
Tow Denier	44,400	31,000	28,000
Acetate Textile Viscosity	110	200	1,000
Spinning Viscosity at 55° C., poises	350—400	350—400	350—400
Orifice Diameter, mm.	0.04	0.035	0.03
Tow Processing (to make filter)	Air	Air	Air
Tip Pressure Drop	1.8	1.8	1.8
Tar Removal, %	35	40	43

In the above table, the tar removal figures are the percentage reduction in tars in the main-stream smoke for a king-size cigarette consisting of a 70 mm. tobacco portion and a 15 mm. filter as compared to an 85 mm. unfiltered cigarette. The control and the filtered cigarettes were all smoked to the same butt length using apparatus and procedures known to the cigarette industry. The total denier of each filter tow was adjusted so that the draw of each type of tip was essentially constant as indicated.

The foregoing data clearly indicates that tow of less than 3 D/F, 30,000—50,000 T/D and 16 CPI represents a particularly useful tow for making tobacco smoke filter elements.

While in the above examples we have shown the use of compositions in the amount of 0.35%, our sorbitan composition may be applied in amounts ranging from 0.1% to 2.0%. The sorbitan compounds while preferably laurates may be other long chain acid derivatives such as polyethylene sorbitan monooleate or polyoxyethylene sorbitan tri-stearate.

In the above examples we have shown the application of our new treating agent to tows of various total denier and denier per filament. Thus practically we can by our invention produce tows within the range of 0.6 to 16. D/F and a T/D of 15,000—160,000.

While the tow is preferably made from dry

spun cellulose acetate having an acetyl content of 38 to 41%, the benefits of this invention may also be obtained on higher acetyl contents, so to about 44% acetyl and on tow made by other methods. Our new treating agent appears to improve all ranges of tow having a total denier up to 160,000 rendering the tow more easily packaged into bales and the like. However, in the preferred embodiment of this invention we prefer a tow which is made up of finer filaments, for example, 0.6—3 denier per filament and of a total denier of 20,000—70,000. Such tow is preferably crimped not less than 12 crimps per inch. Such preferred tow is treated with the sorbitan composition in the amount of from .1 to 2%.

WHAT WE CLAIM IS:—

1. A method of manufacturing uniformly crimped tow which comprises spinning continuous thermo-plastic filaments of a denier not greater than 16 denier per filament, gathering the filaments together to form a band of filaments of substantially uniform width and thickness and of a total denier not greater than 160,000, imparting to the band of filaments a crimp not less than 8 crimps per inch and applying to the filaments at a stage prior to the crimping operation a non-toxic lubricant comprising an emulsion containing at least one sorbitan compound.

2. Method according to claim 1, wherein the lubricant comprises a composition consist-

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filter elements

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ing of sorbitan monopalmitate and polyoxyethylene castor oil derivative.

5 3. Method according to claim 1, wherein the lubricant comprises a composition consisting of mineral oil, sorbitan monolaurate and polyoxyethylene sorbitan monolaurate

10 4. Method according to claim 1, wherein the lubricant comprises white mineral oil, sorbitan monooleate and polyoxyethylene sorbitan monooleate.

15 5. Method according to any of the preceding claims, wherein the filaments have a denier of 0.6 to 3 denier per filament and are gathered together into a band of filaments of a total denier of 20,000—70,000.

6. Method according to any of the preceding claims wherein the filaments are spun

from a solution of cellulose acetate.

7. Method according to claim 6, wherein the cellulose acetate has an acetyl content of 38 to 41%. 20

8. Method of manufacturing uniformly crimped tow substantially as hereinbefore described.

9. Uniformly crimped tow manufactured by the method according to any of the preceding claims. 25

10. Cigarette filters constructed from uniformly crimped tow manufactured by the method according to any of the preceding claims. 30

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