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J. A. KAY ET AL

3,092,873

SPINNERET

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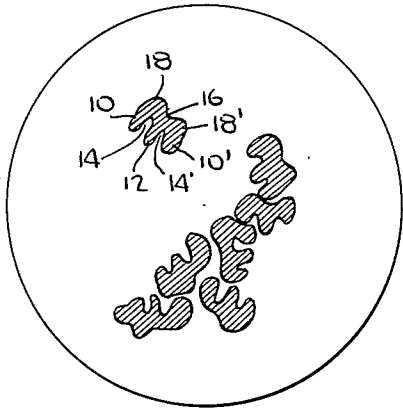


Fig. 1.

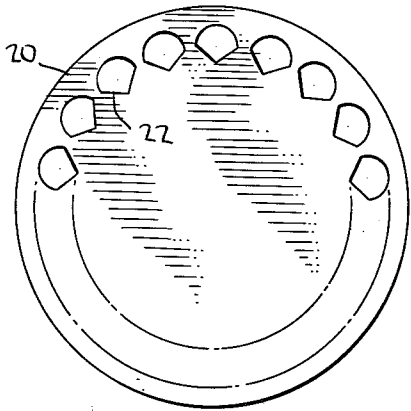


Fig. 2.

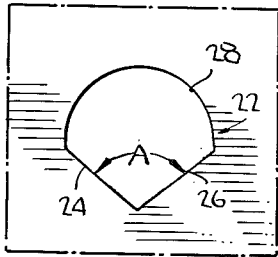


Fig. 3.

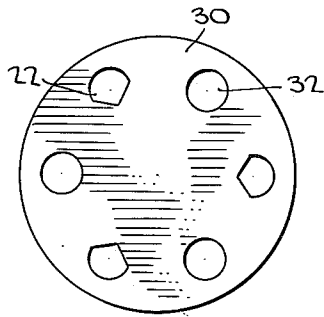


Fig. 4.

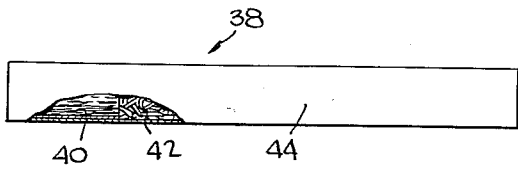


Fig. 5.

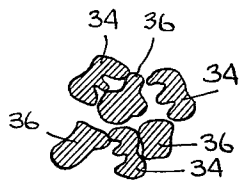


Fig. 6.

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SPINNERET

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4 Claims. (Cl. 18-8)

The invention relates to the manufacture of artificial or synthetic filaments or fibers, and is more particularly directed to filaments of novel cross-section, and methods and means for making such filaments. Also, the invention relates to fabrics and other articles of manufacture, including non-textile products, of yarn or tow including such filaments in either continuous filament or staple form.

An object of the invention is to provide filamentary material affording a comparatively large surface area for the denier thereof.

Another object of the invention is to provide filamentary material which, because of its distinctive shape, has high surface area, cover, bulk and air permeability for its denier as compared with conventional material thereby making the novel filamentary material particularly suitable for use in carpet and upholstery applications, as well as in making cigarette filter, textiles, and non-woven battings.

Another object of the invention is to provide methods and means for the expeditious manufacture of the distinctively shaped filamentary material.

These, and other objects and advantages of the invention will be apparent from the following detailed description, taken in conjunction with the accompanying drawing, in which:

FIG. 1 is a cross-section on an enlarged scale through filamentary material produced in accordance with the invention;

FIG. 2 is a view of the face of a spinnerette having jet openings or orifices therein of a contour designed to furnish filamentary material having the cross-section illustrated in FIG. 1;

FIG. 3 is a greatly enlarged view of a single jet opening;

FIG. 4 is a view of the face of a modified spinnerette; and

FIG. 5 is a cross-section through a yarn dry spun through the spinnerette of FIG. 4; and

FIG. 6 is a view of a cigarette having a filter including the novel filamentary material.

As shown in FIG. 1, a filament made in accordance with the invention possesses a cross-section having a substantially 3-shape, or what may be alternatively described as an E- or m-shape, depending upon the orientation of the filament when viewing it in cross-section. The filament has three spaced lobes extending from one side thereof, the outer lobes being designated 10 and 10', and the central lobe 12. Channels or grooves 14, 14' extend between an outer lobe and the central lobe, these channels being open to the side of the filament. The lobes and their intermediate channels extend lengthwise of the filament. The side of the filament remote from the lobes is substantially flat, having only a slight indentation 16 approximately mid-way of its height to afford a pair of bulbous areas 18, 18'. The indentation 16 extends lengthwise of the filament.

The internal sides of the lobes, or the walls of the channels 14, 14', which are open to the exterior of the filament furnish added surface areas so that for a given denier the described filament shape possesses a comparatively large surface area coupled with distinctive channels allowing the passage of air lengthwise of the filament. Such characteristics are particularly useful in cigarette filters, where low pressure drop, large filter

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surface area and good bulk are desired. Also, due to the bulbous contour on one side of the filament and the spaced lobate portions on the other side, filaments of this cross-section do not pack so tightly as materially to impede gas flow when made up into a bundle with filaments of like cross-section, or filaments of other cross-sections, as where yarn is spun of a mixture of filaments having the described cross-section and other cross-sections. The filaments may be crimped in accordance with procedures well-known in the art.

Filament-forming materials which may be employed in the practice of the present invention are organic derivatives of cellulose such as the esters or ethers thereof, for example cellulose organic acid esters such as cellulose acetate, cellulose propionate, cellulose butyrate, cellulose benzoate, cellulose acetate formate, cellulose acetate butyrate and the like, ethyl cellulose, etc. The esters may be ripened and acetone soluble, such as conventional cellulose acetate, or may be substantially fully esterified, that is, contain fewer than 0.29 free hydroxyl groups per anhydroglucose unit, e.g. cellulose triacetate.

The filament-forming material may also comprise other thermoplastic, solvent-soluble polymeric materials such as superpolyamides e.g. nylon; superpolyesters such as polyethylene terephthalate, polyglycolic acid and copolymers thereof; acrylonitrile polymers and copolymers, polymers and copolymers of olefins and vinyl esters such as ethylene, propylene, vinyl chloride, vinylidene chloride, vinyl acetate, and the like.

The filament-forming material is initially in liquid phase, e.g. dissolved in a volatile solvent which is extruded through the jet openings of a spinnerette into an evaporative atmosphere. The resulting filaments are taken up at a linear speed of about 75 to 700 and preferably 200 to 500 meters per minute. The take-up speed may range from about 0.6 to 1.4, and preferably 0.9 to 1.2 times the linear speed at which the solution is extruded through the jet openings. When dry spinning a solution of secondary cellulose acetate in acetone the temperature of the dope as extruded generally ranges from about 40 to 110° C.

In making filaments having the contour shown in FIG. 1 as hereinbefore described of a cellulose organic acid ester, the usual and well-known system for dry spinning filaments of such composition may be used. Such dry spinning system for converting cellulose organic acid ester solutions into filaments is well-known, and need not be illustrated or described in detail here. The spinnerette, however, is formed with openings or orifices as shown in FIG. 2.

In forming filaments of the novel shape as by dry spinning in the manner set forth above, the spinnerette may be formed as shown in FIG. 2. While the spinnerette 20 is provided with six jet openings 22, the number of openings can be as much as 300 or more. The denier per filament may be 55 or more but generally ranges from about 2 to 25 and preferably from about 3 to 16. Large bundles or tows of filaments can be formed directly or preferably by combining several smaller bundles, such large bundles being especially useful for forming cigarette filters, for formation of staple fibers by cutting, etc. Prior to such further processing the bundle of filaments may be subjected to treatment to increase its bulk, as by air jet bulking or crimping, e.g. to impart about 5 to 20 and preferably 7 to 12 crimps per inch.

The novel jet openings 22 are shown on an enlarged scale in FIG. 3, the periphery of each opening being defined by a pair of substantially straight intersecting portions 24 and 26 and a convex arcuate portion 28 extending across the angle subtended by the straight portions. In effect the form of each opening 22 may be considered as made up of a triangle added to a segment

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of a circle, the bounding chord of the segment constituting the base of the triangle. The angle A defined by the intersecting legs (which are preferably of approximately equal length) ranges from about 90 to 130° and preferably from about 106 to 110°. By varying the angle of intersection between the flat sides the spacing between the lobes, or the widths of the channels, may be varied to produce more or less surface area as desired. In the preferred form of the invention the circular portion is approximately a semi-circle.

FIG. 4 shows a modification in which a spinnerette 30 is provided with openings 22 as well as with circular openings 32 which produce conventional filaments of bulbous cross-section. The cross-section of the resulting yarn, seen in FIG. 5, shows 3-shaped filaments 34 and conventional bulbous filaments 36.

FIG. 6 shows a cigarette 38 including a filter 40 composed of a large bundle of crimped filaments of 3-shaped cross-section, disposed at one end of a tobacco filling 42 and wrapped together therewith by a paper wrapper 44.

The following example is included to illustrate the invention further:

Example

An acetone solution of secondary cellulose acetate, having an acetyl value of 55%, is extruded at a linear speed of 380 meters per minute into a cabinet, downwardly through a spinnerette provided with 190 openings each defined by a semi-circle 0.040 mm. in diameter sharing a common base with an isocles triangle having an apex of 108°. Air at room temperature is passed downwardly through the spinning cabinet. The resulting yarn is taken up at a linear speed of 400 meters per minute and has a denier of 570. 140 such tows are joined into a bundle and are passed through a stuffing box crimper to impart an average of about 8.0 crimps per inch of tensioned filament. The tow is opened in conventional manner, sprayed with 10% of its weight of glycerine triacetate as plasticizer, and formed into a filter rod of 86,000 denier (taking into consideration the increase resulting from crimping). The rod is cured at room temperature for 2 hours to cause adhesion of the filaments at points of contact, in conventional manner, cut into 15 mm. plugs and wrapped with tobacco into filter-tipped cigarettes on conventional cigarette-forming machines. The pressure drop across such plugs is less than across plugs formed of conventional cross-section filaments of the same denier.

Instead of using it in cigarette filters the initial 190 filament yarn is especially suited for use in upholstery or carpet construction, advantageously after bulking as by crimping or with an air jet. For example, fabrics

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formed of the bulked filaments are characterized by good abrasion resistance, resilience, and by more rapid dyeing. The uncrimped filaments and textiles produced therefrom when subjected to relaxation in hot water or swelling agents, assume novel crimped or bulked effects due to the unbalanced cross-section of the filaments. In addition, the filaments may be cut into staple fibers for making non-wovens or spun yarns.

In the jet shown in FIG. 2 the openings 22 are all of substantially the same size. However, if desired the openings may be of different sizes, and of the same general shape, so that a bundle of 3-shaped filaments of different fil. deniers is produced.

It is to be understood that the foregoing detailed description is merely given by way of illustration and that many variations may be made therein without departing from the spirit of our invention.

Having described our invention, what we desire to secure by Letters Patent is:

1. A spinnerette having at least one jet opening with a periphery defined by a pair of substantially straight intersecting portions and a convex arcuate portion extending across the inside of the angle subtended by said straight portions.

2. A spinnerette having at least one jet opening with a periphery defined by a pair of substantially straight portions intersecting at an angle of about 90 to 130°, and a convex arcuate portion extending across the inside of said angle.

3. A spinnerette according to claim 2, wherein said arcuate portion is approximately semi-circular.

4. A spinnerette having at least one jet opening with a periphery defined by a pair of substantially straight portions intersecting at an angle of about 106 to 110° and a semi-circular arcuate portion extending across the inside of said angle.

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