Feb. 20, 1945. J. A. TRUITT 2,370,112

TEXTILE MATERIAL

Filed March 4, 1942

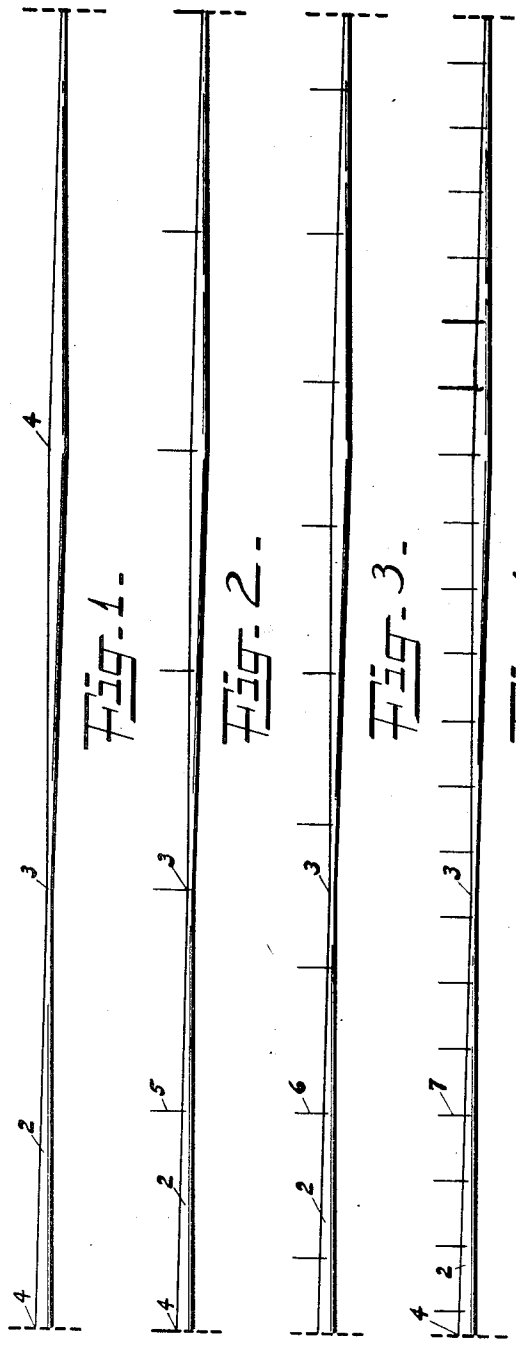

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

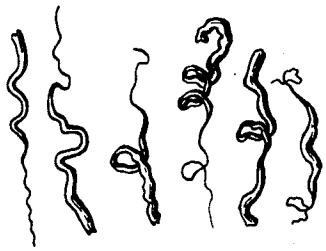

FIG. 7.

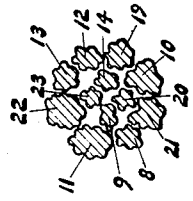

FIG. 6.

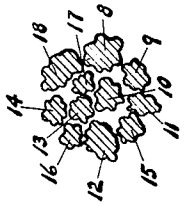

FIG. 5.

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2,370,112

TEXTILE MATERIAL

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3 Claims. (Cl. 28—82)

This invention relates to artificial fibers and to a method of making them.

It is an object of the invention to provide a novel mixture of tapered artificial fibers having the same or different average diameters and which have as a consequence of these characteristics, improved properties adapting said fibers for various textile operations, such as spinning, felting, fulling, and napping or gigging. A further object of the invention is to devise commercially feasible methods for making such artificial fiber mixtures. Further objects of the invention will be apparent from the description hereinafter.

Various procedures and devices for producing filaments and fibers of artificial materials, having innumerable varieties of cross-sectional change at different intervals along the length of the filaments or fibers, have been known and are disclosed in United States Patents Nos. 1,898,085, 1,996,796, 2,038,722, 2,065,124 and 2,142,597. In accordance with this invention, any suitable devices such as those described in the patents just cited are selected and are controlled in such a manner as to taper a filament, or several filaments simultaneously from a maximum to a minimum and then from the minimum to another maximum alternately throughout the length of the filament or filaments. For example, the auxiliary pump diaphragm 14 of Patent 2,065,124 may be continuously operated by a cam having a suitable shape, such as a heart-shaped cam, to effect a gradually increasing displacement of volume alternating with a gradually decreasing displacement of volume in which the increase and decrease of volume extruded respectively are each directly proportional to the time of action. The frequency may be selected as desired by adjusting the speed of rotation of the cam with respect to the speed of extrusion of the filaments thereby determining the length of each tapered section of the filaments. The total displacement of volume depends upon the number of spinnerets and ultimately upon the number of filaments as well as upon the overall maximum variation in filament diameter, and the relation of these factors may be controlled to produce the desired average denier. Alternatively, the teeth of wheel 34 of Patent 2,142,597 may be made of suitable shape to obtain the filaments of tapered cross-section. Similarly, other methods including those described in the several patents cited above may be employed to produce the desired taper and average denier. Preferably, the taper produced is such that the profiles of the tapered sections of the filaments are defined by straight lines, but more or less variation from this desideratum may be permitted and may be desirable in certain cases. The tapered filaments are then cut to produce fibers in a manner hereinafter more particularly described.

In the drawing, illustrative of the invention,

Figure 1 is a view of a portion of such a filament, greatly enlarged as to thickness,

Figure 2 illustrates one manner of cutting the filament,

Figure 3 illustrates a modified manner of cutting the filament,

Figure 4 illustrates another modified manner of cutting the filament,

Figures 5 and 6 are cross-sectional views of a yarn adapted to be made of the fibers of the invention cut at two positions about one inch apart.

Figure 7 illustrates crimped fibers of the invention.

In accordance with the invention, a filament or bundle of filaments is produced whose diameter or diameters respectively vary substantially continuously and alternately from a minimum to a maximum along its or their lengths, and at any time after their formation, they may be cut to the form of individual tapered fibers. The filaments may be cut at the points of minima and maxima to produce tapered fibers having the same average diameter having a length equal to the distance between the minimum and maximum points in the filament or filaments as produced. The fiber in this case may be made of any length by varying the length between adjacent maximum and minimum points in the filament or filaments as produced. If desired, the filaments may be cut at more frequent intervals than the frequency of occurrence of maximum and minimum points along the lengths thereof. For example, the frequency of the cuts may be from two to two and a half times the frequency of occurrence of maximum and minimum points along the filaments, and in this case the cutting is preferably such as to cause the points of cutting to fall upon at least one end of each tapered interval along the filament. In cases where the frequency of cutting is twice the frequency of occurrence of maximum and minimum points along the filaments, each tapered interval along the filament is neatly severed into two tapered fibers each having a different average diameter. To obtain any desired length of fiber in such a case, the length of the tapered section in the filaments is made larger than the desired fiber length in proportion to the ratio of frequency of

cutting to the frequency of occurrence of maxima and minima along the filaments. Preferably, for commercial application, each tapered interval along the filaments is made of such a length that in order to obtain the desired length of fiber, it may be cut into a number of smaller parts in excess of three. In such cases, no great care need be exerted to see that the points of cutting fall precisely at the points of maxima and minima along the fibers, and still a product will be obtained in which a predominant proportion of the fibers have a single continuous taper along their lengths. For example, filaments having tapered intervals of lengths from about 10 inches to about 24 inches and having a maximum and a minimum measurement of about 10 and about 5 denier respectively may be severed into from five to twelve parts. Thus, if filaments having 10 inch tapered sections are divided into five parts per section, each part will have a length of about 2 inches and there will be at least three out of each five fibers which have a single continuous taper throughout their lengths. The other two fibers out of the five will usually have a point of minimum or a point of maximum diameter somewhat along their lengths. However, where the tapering in the original filaments occurs along a section having relatively long lengths such as to enable a number of individual fibers of 2-inch or greater lengths therefrom, the points of maximum or minimum, occurring more probably than not at points other than the center of the small number of fibers containing them will not greatly alter the essential character of the entire mass of fibers and in some cases, as will be more particularly pointed out hereinbelow, the presence of such double-taper fibers in the mass will yield certain advantages.

The bundle of filaments tapered in accordance with this invention may be arranged with all of their corresponding points of minimum alongside and with all of their corresponding points of maximum similarly arranged. Alternatively, and more practically, the points of minimum and maximum diameters of some of the filaments in the bunch may be offset with respect to the corresponding points of other filaments in the bunch, or the points of minimum and maximum of each filament may be offset haphazardly with respect to the corresponding points of each other filament in the bundle. The latter two types of arrangement may readily be accomplished by employing the domed spinneret having perforations arranged in a spiral or the inclined plate spinneret having aligned holes such as are shown in Figures 3 to 8 of U. S. Patent 2,001,000, in conjunction with the modified pumping or other means suggested hereinabove to produce the tapered filaments. The latter type of arrangement makes it impractical to cut all of the filaments simultaneously and make the cutting coincide with all of the points of minimum and maximum of each filament in the group or bundle. It is therefore preferable that in the latter two types of arrangement the cutting be performed at a frequency of three or more times the frequency of occurrence of maximum and minimum points along any one of the filaments.

In Figure 1, a tapered filament 2 is shown with points 3 of minimum diameter and points 4 of maximum diameter. In Figure 2 short solid lines 5 are used to designate the place of cutting which in this particular figure are shown to have a frequency of two cuts per tapered section of the filament. As pointed out above, when such a low frequency of cutting is employed it is preferable that every other cut coincide with either a maximum or a minimum thickness around the filament. In Figure 3, the frequency of cutting is three per tapered section of the filament and as stated previously it is not necessary to make any of the cuts coincide with either the minimum or maximum points of thickness of the filaments in order to obtain a predominant proportion of fibers having a single continuous taper throughout their lengths. Figure 4 illustrates an example in which there are about 6⅔ cut lengths made per tapered section of the continuous filament. Here again, it is not essential that any of the cuts 7 coincide with the points of minimum and maximum thickness of the filaments.

The tapered staple fibers may be spun, or they may be combined in any proportion with any other natural fiber or artificial staple fiber and spun, to the form of a thread, cross-sections of which are shown in Figures 5 and 6, in any conventional manner. The thread or yarn thus produced in which the tapers of the several fibers are heterogeneously disposed, some in opposition and some in corresponding alinement, has improved elasticity and loftiness as a result of the variation of diameter throughout the lengths of the individual fibers in the yarn and also partly because of the mixture of fibers having different average diameters to form the thread or yarn. These qualities account for the improved napping and gigging properties of yarns or fabrics made from the mixed fibers. The tapered nature of the fibers imparts felting properties thereto and provides improved coverage and elasticity in pile fabrics, such as carpets, upholstery, dress goods or the like when these tapered fibers are employed in the making of the pile. The presence of the continuous taper along the lengths of the fibers provides for improved drafting properties of such fibers in the process of spinning threads and yarns therefrom and also greater tensile strength. Figures 5 and 6 illustrate diagrammatically a yarn by showing the difference in cross-sectional structure at two positions spaced a short distance (about one inch) from each other along the yarn. The fibers common to both cross-sections are numbered 8, 9, 10, 11, 12, 13, and 14. Fibers 15, 16, 17, and 18 shown in Figure 5 are not present in Figure 6 while fibers 19, 20, 21, 22 and 23 shown in Figure 6 are not present in Figure 5. The mixture in the yarn of tapered fibers having different diameters at any cross-section results in greater average interstitial areas, thereby providing for greater coverage.

The additional qualities of crimpiness, curliness, or kinkiness may be imparted to the fibers (for example, as shown in Figure 7) made in accordance with this invention by performing the cutting of the tapered filaments shortly after their formation in the spinning process before complete regeneration of cellulose occurs such as in the viscose process, or before complete coagulation occurs in the case of spinning cellulose acetate. By performing the cutting of the filaments at this stage of their production, the mechanical action of the cutter upon the incompletely coagulated or regenerated filaments having varying diameter along their lengths gives rise to irregularities which are accentuated as further completion of the regeneration or coagulation of the fibers occurs especially at the larger diameter ends of the fibers. Furthermore, where crimpiness or kinkiness is desired, the presence of the minimum point or maximum point of thick-

ness of the filament somewhere between the ends of the fiber enhances this effect. If desired, further additions may be made to enhance the crimpability, such as the well known crimping agents which may be added to the spinning solutions and which can be made to exert their effects after the spinning of the filaments. Figure 7 illustrates representative crimped fibers tapered in accordance with the invention.

The combination of the taper of the fibers with their crimpiness lends the fibers improved felting properties, and in the case of fabrics made from yarns thereof, the combination of these properties results in improved fulling properties.

The tapered fibers of this invention may be made from any synthetic artificial filaments, such as those constituted of cellulose regenerated from viscose, cuprammonium cellulose, or the like, or constituted of cellulose acetate or similar organic esters or ethers of cellulose, of vinyl resins, such as the co-polymer of vinyl acetate and vinyl chloride, chlorinated vinyl co-polymers, casein, synthetic linear polyamides, such as nylon, etc.

Various modifications and changes may be made in the specific disclosure hereinabove, which is intended to be illustrative only and the invention is to be limited in scope only by the claims appended.

I claim:

1. Textile material comprising yarns having tapered synthetic fibers with their directions of taper opposed heterogeneously, a predominant proportion of the fibers having a single substantially continuous taper throughout their lengths.

2. Textile material comprising yarns having crimpy tapered synthetic fibers with their directions of taper opposed heterogeneously, a predominant proportion of the fibers having a single substantially continuous taper throughout their lengths.

3. Textile material comprising yarns having crimpy tapered synthetic fibers having various average diameters with their directions of taper opposed heterogeneously, a predominant proportion of the fibers having a single substantially continuous taper throughout their lengths.

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