

June 19, 1956

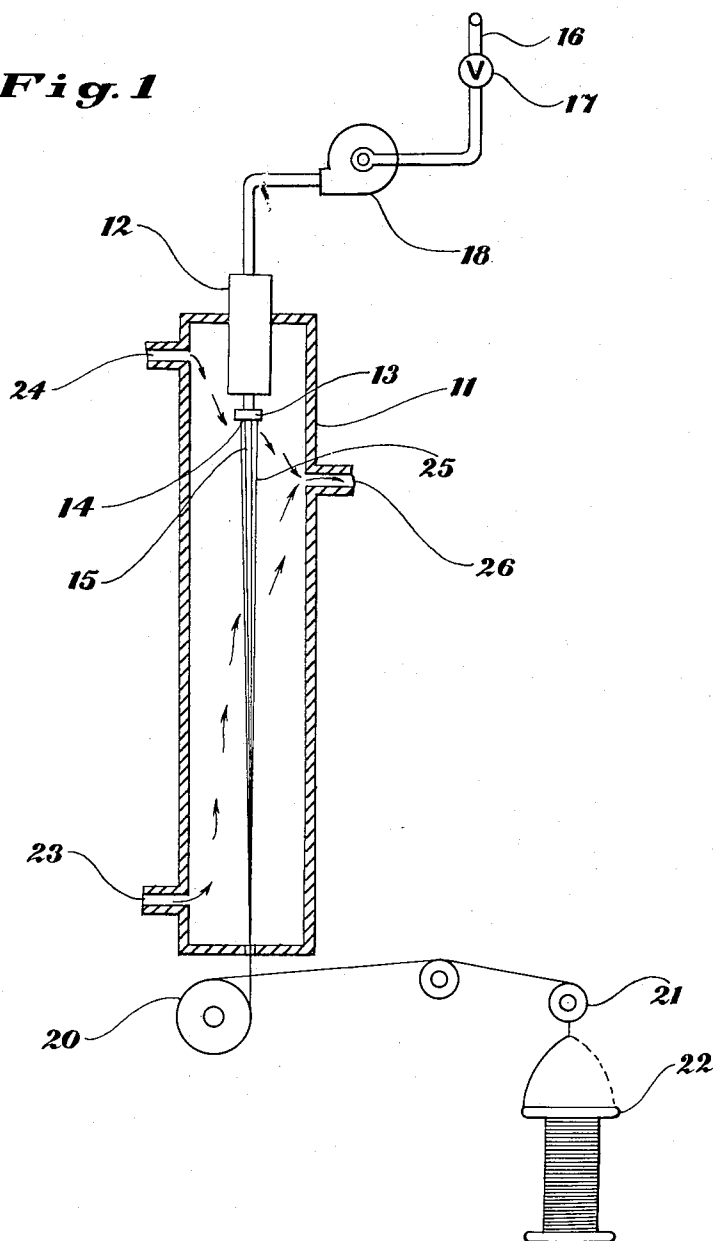
J. C. WHITE
YARN STRUCTURE

2,750,653

Filed Jan. 19, 1955

2 Sheets-Sheet 1

Fig. 1



James C. White
INVENTOR.

Daniel I. Mayne
BY *Walter O. Haddon*
ATTORNEYS

June 19, 1956

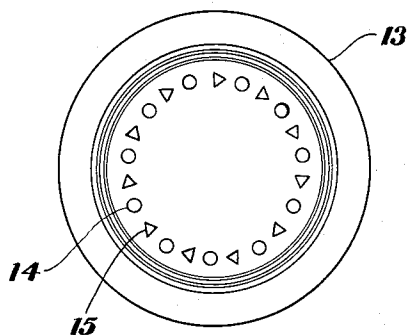
J. C. WHITE
YARN STRUCTURE

2,750,653

Filed Jan. 19, 1955

2 Sheets-Sheet 2

Fig. 2



SECTION OF SPINNERETTE
SHOWING
TWO ORIFICE

Fig. 3

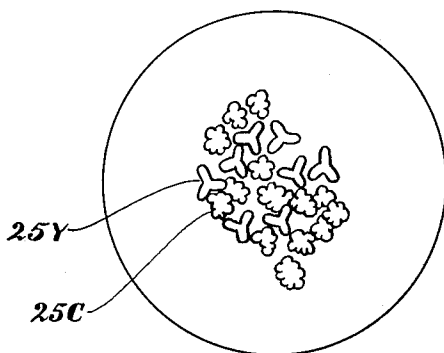
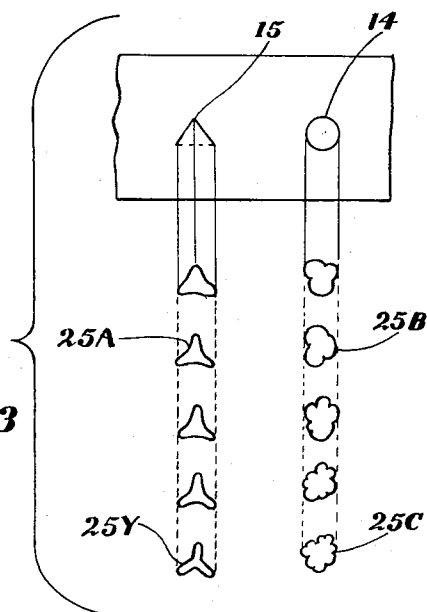
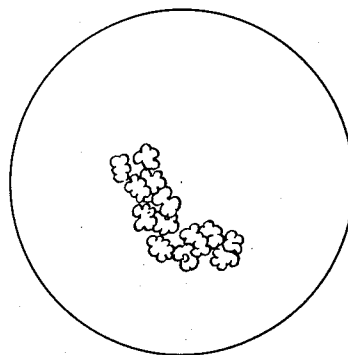


Fig. 4

Fig. 5
PRIOR ART



James C. White
INVENTOR.

BY *Daniel I. Mayne*
Walter O. Hodgeson
ATTORNEYS

1

2,750,653

YARN STRUCTURE

James C. White, Kingsport, Tenn., assignor to Eastman Kodak Company, Rochester, N. Y., a corporation of New Jersey

Application January 19, 1955, Serial No. 482,753

2 Claims. (Cl. 28—81)

This invention relates to the preparation of synthetic yarns of predetermined stiffness and bulk. More particularly, this invention relates to improved dry spinning methods and apparatus for producing simultaneously from the same cellulose organic acid ester spinning solutions, yarns consisting of Y-shaped cross-section filaments and normal cross-section filaments. Furthermore, this invention also relates to fabrics and other articles of manufacture made of, or containing such novel yarns.

Heretofore, various processes and apparatus have been provided for the production of synthetic filaments and fibers of various cross-sections. Typical methods and apparatus for dry spinning cellulose acetate solutions into synthetic fibers are disclosed in H. G. Stone U. S. Patents 2,000,047 and 2,000,048 of May 7, 1935. These patents describe methods including the extrusion of a heated cellulose acetate spinning solution through a spinnerette having a plurality of round orifices and into a drying chamber containing an evaporative atmosphere maintained at suitable drying temperatures. By such controlled conditions, filaments can be consistently formed of approximately round or clover-leaf cross-section. Such filaments are shown in Fig. 5 of the instant drawings and are identified hereinafter as regular cross-section filaments. It appears that synthetic filaments and fibers having greater stiffness and bulk are required for certain novel uses and I have discovered that the simultaneous production of filaments of certain different cross-sections will satisfy this requirement.

An object, therefore, of the present invention is to provide a novel type of yarn made up of fibers having regular and Y-shaped cross-sections.

A further object of this invention is to provide a method whereby the bulk and stiffness of yarn can be regulated as it is spun.

Another object of this invention is to provide spinnerettes each having round and triangular orifices therein.

Another object is to provide staple fibers from yarns consisting of a plurality of Y-shaped cross-section and regular cross-section filaments.

Still another object is to provide yarns adaptable for use in manufacturing cigarette filters.

Other objects will appear hereinafter.

In accordance with the present invention, these and other objects are attained by forcing a suitable spinning solution through a specially constructed spinnerette having a plurality of filament-forming orifices therein and drying the resulting filaments in a spinning cabinet under carefully controlled conditions of temperature while subjecting the filaments to predetermined drafting. The temperature of the solution and its rate of extrusion may also be controlled for optimum results. On leaving the spinning cabinet, the filaments are then twisted into a strand of yarn. A particular feature of the present invention is that some of the orifices in the spinnerette are round whereas other orifices in the same spinnerette are of equilateral triangular shape. I have found by varying the ratio between the round and triangular orifices that the

2

bulk and stiffness of the yarn made from such different filaments can be regulated and predetermined.

Under the optimum conditions of solution temperature and composition, and of extrusion, drying and drafting, the wet filaments which are extruded through the equilateral triangular orifices will temporarily assume a similar triangular cross-sectional shape. By employing optimum conditions of drying and of drafting, these triangular filaments are caused to change in filament cross-section from triangular to a Y-shaped cross section with the legs of the Y being substantially equal in length and the angles between adjacent legs of the Y being substantially equal.

Simultaneously under the same conditions of solution temperature and composition and of extrusion, drying and drafting, the filaments which are extruded through the adjacent round orifices in the same spinnerette assume the regular or cloverleaf cross-sectional shape.

The filaments of both types progress downwardly in the spinning cabinet and merge to form a single strand of yarn which can be given a suitable twist. The presence of more or less of the Y-shaped cross-section filaments determines the bulk and stiffness of the yarn.

The present invention is further illustrated in the following detailed description in which several examples of my invention are given and to the related drawings in which:

Fig. 1 is a schematic elevational view, partly in section, showing a spinnerette which has a plurality of round and equilateral triangular orifices positioned in a suitable dry spinning cabinet which is equipped with suitable auxiliary apparatus.

Fig. 2 is a view of the face of a spinnerette, greatly enlarged, having a plurality of filament-forming orifices, some of which are of round and others of which are of equilateral triangular shape.

Fig. 3 is a greatly enlarged representation of the spinning solution coming out of both a round orifice and an equilateral triangular orifice and forming respectively into a cloverleaf cross-section filament and into a Y-shaped cross-section filament.

Fig. 4 is a reproduction of an actual photomicrograph showing the cross-section of a mixture of filaments of both round and Y-shaped cross-section as they are associated in a strand of yarn.

Fig. 5 is a reproduction of an actual photomicrograph showing in cross-section several filaments made by employing a spinnerette having only round orifices in accordance with a prior art method.

The similar parts in the several figures are identified by the same numerals.

Referring to Fig. 1, there is shown schematically a side elevation view, partly in section, of a spinning cabinet 11 and its associated apparatus by which the novel yarns of the instant invention may be manufactured. Mounted at the top of the cabinet is a candle filter unit 12 to which is connected a spinnerette 13 which in accordance with this invention has a plurality of round orifices 14 and a plurality of equilateral triangular orifices 15 therein. The face of this novel type of spinnerette with the round and triangular orifices 14 and 15 therein is shown in the magnified view of Fig. 2. The candle filter may be uniformly heated by means of heating coils, not shown, which are positioned so as to surround candle filter 12, and through which coils may be circulated any appropriate heat exchange medium such as water maintained at the desired temperature.

Spinning solution of the composition described herein-after is supplied from conduit 16 through valve 17 to pump 18 which forces the solution at the desired rate to the candle filter unit 12 thence to spinnerette 13 from which it is simultaneously extruded through the round and equilateral triangular orifices 14 and 15 respectively into the

form of round and triangular filaments shown generally by numeral 25.

The filaments 25 pass downwardly in the cabinet 11 while progressively losing solvent by evaporation until, in a substantially solidified and dried condition, they leave the cabinet 11 and pass around godet roll 20, which is positioned below the lower end of the spinning cabinet 11. Godet roll 20 is driven at a uniform speed by means, not shown, to give the desired draft to the filaments 25. From godet roll 20 the filaments pass over the usual guide rolls 21 and are finally wound onto a bobbin 22 after an appropriate twist has been imparted thereto, by means not shown.

To facilitate drying of solvent from the filaments during their travel through the cabinet, heated air is supplied to the cabinet 11 by means of inlet conduits 23 and 24 positioned respectively adjacent the lower and upper ends thereof, the air passing through the cabinet and emerging through outlet conduit 26 positioned at a substantial distance below spinnerette 13, as illustrated.

The change of the cross-section of the respective filaments while in the cabinet from an initial round or triangular cross-section to a clover-leaf and Y-shaped cross-section filaments is schematically illustrated in Fig. 3. As shown at 25A the filament has just been formed by the equilateral triangular orifice and is substantially of a triangular cross-section. Further on, in the downward progress of the filament under the controlled condition of drafting and drying it has changed to the desired Y-shaped cross-section filament 25Y.

Similarly the filament issuing from the round orifice first assumes a round cross-section as shown at 25B and then changes to a clover-leaf cross-section as shown at 25C. Such Y-shaped and regular or clover-leaf cross-section filaments are shown greatly magnified in Fig. 4.

My process is described in further detail in the following examples.

Example 1

A spinning solution consisting of 26.5% cellulose acetate, 1.25% titanium dioxide, based on the weight of the cellulose acetate, 1.75% water and the remainder being the solvent, acetone, was spun into filaments having the regular and Y-shaped cross-sections of 150 denier per strand using the apparatus and its general operation as described above in connection with Figure 1. The spinnerette had 19 equilateral triangular and 19 circular orifices therein.

Spinning was carried out so that the resultant strand contained 19 filaments spun from a triangular-shaped orifice to give a Y-shaped cross-section together with 19 filaments spun from a circular orifice to give the regular, clover-leaf cross-section. Thus, the total filaments per strand was 38 and the total denier per strand was 150 denier. Extrusion was carried out at a speed of 500 meters per minute using a candle filter temperature of 65° C., top and bottom air feeds to the cabinet of 800 cubic feet per minute each per 100 cabinets, top inlet air temperature of 70° C., and bottom inlet air temperature of 85° C. The draft ratio was 1.20 and the size of the spinnerette orifices was 0.067 mm. for the length of the side of the triangular orifice and 0.05 mm. for the diameter of the circular orifice. The specific volume of the resultant yarn, as determined by filling a calibrated, grooved pulley, was 35.4 cubic inches per pound as compared with 32.4 cubic inches per pound for yarn containing all normal filaments and 44.3 cubic inches per pound for yarn containing all

Y filaments. Cloth made from the yarn strands described in this example had greater stiffness than similar fabric woven from strands having filaments of regular cross-section but had a lesser degree of stiffness than cloth made from strands containing filaments all of which possessed a Y-shaped cross-section.

Example 2

A cellulose acetate dope was spun under conditions described in Example 1 through a spinnerette having 25 equilateral triangular-shaped orifices and 13 circular orifices. The triangular orifices were equilateral triangles of 0.067 mm. and the circular orifices had a diameter of 0.05 mm. The resultant yarn strand contained 25 filaments with a Y-shaped cross-section and 13 filaments with a normal, clover-leaf shaped cross-section. The specific volume of this strand was 38.0 cubic inches per pound. Cloth made from this yarn was stiffer than similar cloth made from strands composed of regular filaments but not so stiff as cloth made from strands containing all Y-shaped cross-section filaments.

Draft ratio which term is mentioned in Example 1 may be defined rather broadly as the ratio of the linear velocity of wind-up of the filaments to the linear velocity of extrusion of the spinning solution. More specifically, draft ratio may be defined as the ratio of the linear velocity at which the filaments are wound onto and off the godet roll of a dry spinning cabinet to the calculated average linear velocity at which the quantity of spinning solution necessary to the formation of any one of the plurality of filaments comprising the bundle of filaments wound onto and off the godet roll is extruded through any one of the plurality of orifices in the spinnerette employed in the spinning operation, the velocities being expressed in the same units of distance per unit time. For example, if the filaments are wound up at the godet roll at the same linear velocity that the spinning solution is extruded from the spinnerette, the draft is 1.0, thus signifying that the linear speed of wind-up is 100% of the extrusion speed. Similarly, if the filaments are wound up or withdrawn from the cabinet at the godet roll at a linear speed 50% greater than the speed of extrusion, the draft is 1.5, and so on.

Satisfactory Y-shaped cross-section and regular cross-section filaments can be simultaneously produced over a range of spinning and solution conditions. It is desirable that the draft be above 1.0 and preferably above 1.2. A satisfactory range is 1.0 to 1.4. The temperatures in the drying chamber may range from 60° to 90° C.

My invention is further defined in the following claims. I claim:

1. Cellulose organic acid ester yarn consisting of a plurality of filaments of clover-leaf cross-section and a plurality of filaments of Y-shaped cross-section.
2. Cellulose acetate yarn consisting of a plurality of filaments of clover-leaf cross-section and a plurality of filaments of Y-shaped cross-section.

References Cited in the file of this patent

UNITED STATES PATENTS

2,313,296	Lamesch	Mar. 9, 1943
2,434,533	Wurtzbarger	Jan. 13, 1948
2,588,583	Small et al.	Mar. 11, 1952
2,588,584	Small	Mar. 11, 1952
2,673,368	Denyes	Mar. 30, 1954
2,677,184	Webb	May 4, 1954