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JEAN-MARIE ALIBERT

2,244,281

CELLULOSIC STRUCTURE, APPARATUS AND METHOD FOR PRODUCING SAME

Filed May 4, 1939

2 Sheets-Sheet 1

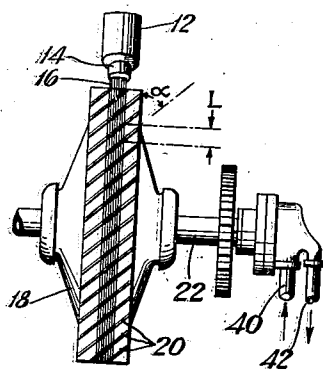


Fig. 2

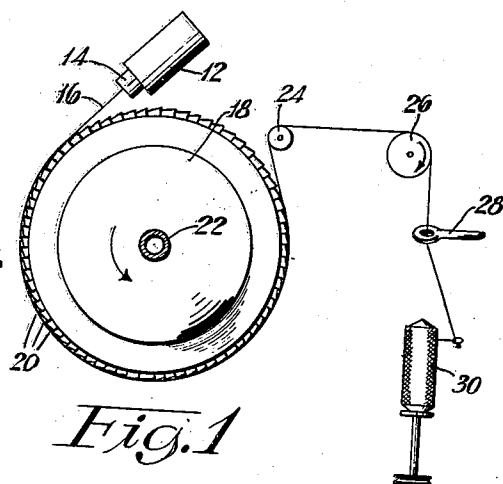


Fig. 1

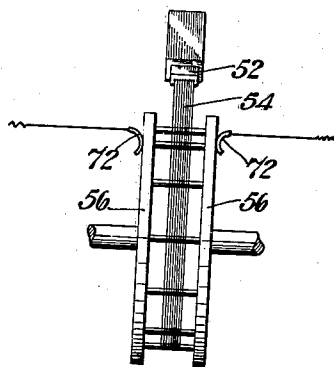


Fig. 4

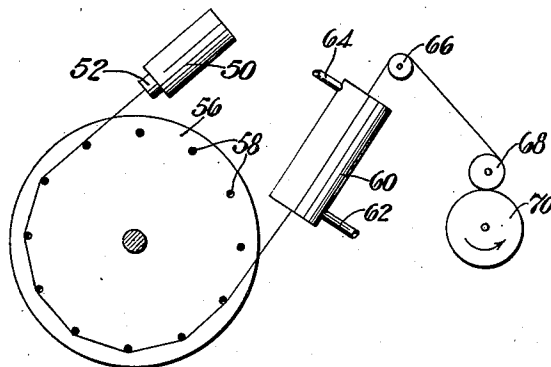


Fig. 3

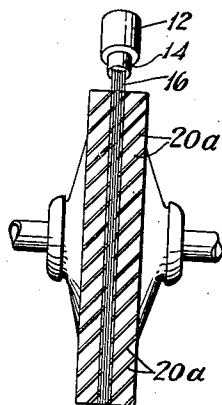


Fig. 7

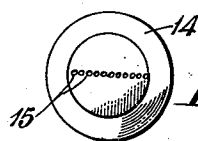


Fig. 5

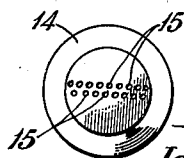


Fig. 6

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CELLULOSIC STRUCTURE, APPARATUS AND METHOD FOR PRODUCING SAME

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2 Sheets-Sheet 2

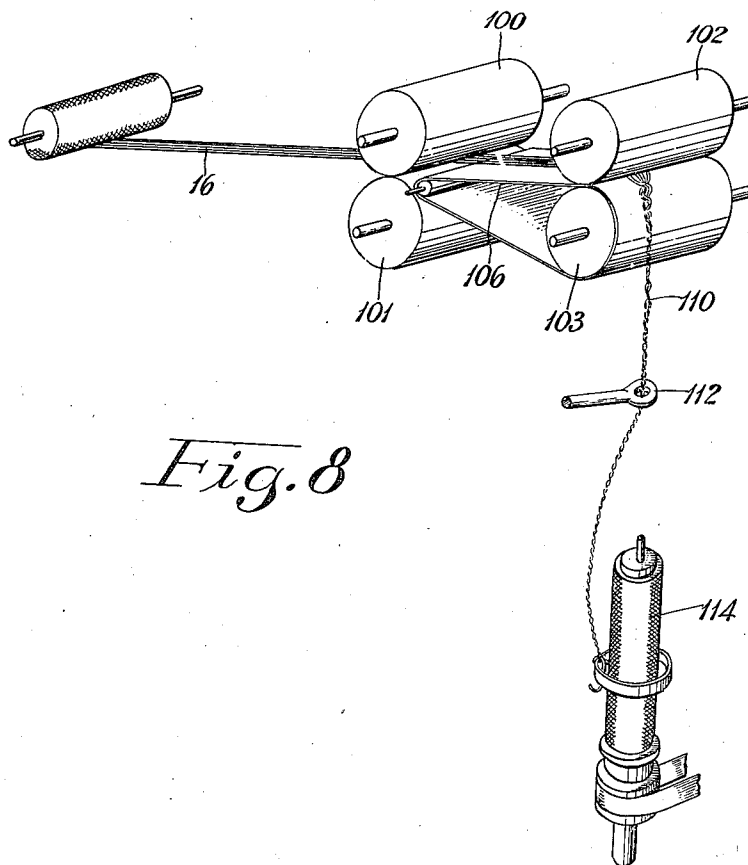


*Fig. 8*

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## UNITED STATES PATENT OFFICE

2,244,281

CELLULOSIC STRUCTURE, APPARATUS AND  
METHOD FOR PRODUCING SAME

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In Great Britain May 6, 1938

9 Claims. (Cl. 18-8)

The present invention relates to the production of artificial filaments, and more particularly it relates to the production of artificial filament bundles in which the several filaments in the bundle have weakened sections, thereby permitting them to be readily divided to staple lengths.

It has been proposed, heretofore, to impart weakened sections to the continuous artificial filaments in a filament bundle and subsequently subject said bundle to tensile stress of sufficient intensity to part the filaments at the weakened sections.

In such previously known methods the weakened sections were imparted to the filaments by mechanical abrasion, by reducing the denier of the filaments while they were still plastic, or by application of a softening agent to spaced sections of the filaments. The first of these known methods is comparatively crude, and it is difficult to control the degree to which the filaments are abraded as well as the selectivity of abrasion of a portion of the filaments in a bundle. The second method necessitates the production of filaments of varying denier and this may under some circumstances be undesirable. The third method must be carried out while the filaments are in a softened or partially dissolved state, and therefore involves certain objections. Furthermore, this method necessitates the after-treatment of a previously finished filament bundle.

It is an object of the present invention to provide a method for the production of bundles of artificial filaments in which the filaments have weakened sections, which method does not have the disadvantages of the previously known processes.

Other objects of the invention will appear hereinafter.

In accordance with the present invention a filament-forming composition, that is, a cellulose ester or cellulose ether filament-forming composition containing a volatile organic solvent, is extruded through a spinneret to form a filament or a bundle of filaments. The filaments thus obtained are subjected, at spaced points along their lengths, to a temperature sufficiently high to insure that the evaporation of the solvent at these points proceeds much faster than the solvent evaporation in the other parts of the filaments.

The drying or coagulation of the filaments can be then completed by any known method, for example, by passing the same through a heated cell or passing into a suitable coagulating bath. The threads obtained in this manner are com-

posed of filaments which, spaced along their lengths, have points where the resistance and the degree of stretching at the breaking point are clearly less than for the rest of the filaments. These weakened points along the length of the filaments are substantially of the same denier as the other portions of the filaments. The points of weakness are due to a difference in molecular structure at these points.

The distance between the points of weakness can be chosen to suit the requirements of the manufacturer. The distance is preferably made constant or approximately constant in order to produce staple fibers of uniform length. By application of tension on the threads manufactured in the above-described manner they will be caused to break at the points of weakness, thus producing staple fibers of the desired length.

In order to more clearly define the present invention reference is made to the following detailed description taken in connection with the accompanying illustrations, in which:

Figure 1 is a diagrammatic side elevational view of one form of apparatus for producing weakened sections in artificial filaments.

Figure 2 is a front elevational view of a portion of the apparatus shown in Figure 1.

Figure 3 is a diagrammatic side elevational view of a modified form of apparatus for producing weakened sections in artificial filaments.

Figure 4 is a front elevational view of a portion of the apparatus shown in Figure 3.

Figures 5 and 6 are elevational views showing two forms of spinneret suitable for use in accordance with the present invention.

Figure 7 is a front elevational view of a modified form of the apparatus shown in Figure 2.

Figure 8 is a diagrammatic perspective view of apparatus for applying tension to a bundle of filaments having weakened sections.

Referring to Figures 1 and 2 of the drawings, reference numeral 12 designates an extrusion device for a filament-forming composition containing a volatile organic solvent. The extrusion means is provided with a spinneret 14 through which the composition is forced to form filaments 16. The filaments 16 are passed over a heated drum 18. The drum 18 on its cylindrical periphery is provided with a plurality of spaced fins 20. The fins 20 are preferably arranged at an angle of less than 90° with the plane perpendicular to the axis of rotation of the drum 18. The angle  $\alpha$  which the fins make with the plane perpendicular to the axis of the drum is preferably

chosen so that the following equation is satisfied:

$$\tan \alpha = \frac{(n-1)e}{L - \frac{L}{n}}$$

wherein  $n$  is the number of filaments,  $e$  is the distance between any two adjacent filaments, and  $L$  is the distance which separates two points of weakness in the same filament. In this way the points of weakness in the filaments are distributed in an even manner along the thread. The filaments are contacted diagonally across the bundle in such a manner as to present breakage points spaced in echelon formation across the width of the bundle; consequently the bundle can be torn into staple lengths and twisted in the same operation. The drum 18 is rotated at substantially the speed of extrusion of the filaments by any desired rotating means. The drum can be heated by means of inlet conduit 40 and outlet conduit 42 which are connected to hollow shaft 22. The yarn after contact with the heated fins is passed over roller guides 24 and 26, thence through guide 28, and then wound in a conventional manner onto a spool 30. The winding can, if desired, be accompanied by twisting as illustrated.

Referring to Figures 3 and 4 of the drawings, the filament extruding means is designated by reference numeral 50. The extruding means is provided with a spinneret 52 from which a bundle is passed over narrow bars 58 positioned between circular plates 56. The yarn is passed through a solvent recovery device 60. The solvent is recovered by passing a slow stream of gas through inlet 62 and outlet 64. The yarn is then passed over guides 66 and 68 and wound onto a spool 70. The bars 58 are heated by electrical resistance of the bars to an electrical current passing therethrough. The electrical current is passed through bars 58 and plates 56 by brushes 72 contacting with plates 56.

In both of the devices above described the entire heating device and extruding means may be positioned within an enclosure (not shown) which may be utilized for solvent recovery.

In Figures 5 and 6 are shown two forms of spinneret which are particularly useful for carrying out the principles of the present invention. The spinneret 14 in Figure 5 is provided with spinneret orifices 15 positioned along a single line across the face of the spinneret. The filaments issuing from a spinneret of this type will be evenly distributed across the heating elements and thus aid in the production of staple fibers of uniform length. Spinneret 14 shown in Figure 6 has two rows of orifices 15. The orifices in the two rows are preferably arranged in staggered relationship to each other so that the filaments will be separated from each other when they are brought into contact with the heating element.

The heating drum illustrated in Figure 7 is substantially the same as that illustrated in Figure 2 with the exception that the fins 20a do not extend across the entire cylindrical periphery of the drum. The fins 20a extending from the edges of the cylindrical periphery of the drum do not extend to the central peripheral section thereof. By constructing a drum in this manner only the filaments on the extreme edges of the bundle are caused to be heated. The filaments in the center of the bundle will have no weakened sections.

Figure 8 illustrates a conventional apparatus 75 3 and 4 of the drawings, an electrical current is

for placing tension on a filament bundle to cause the filaments in the bundle to be torn and thereby produce staple fibers therefrom. A bundle of filaments 16 containing weakened sections in accordance with the present invention is passed between two sets of nip rolls, i. e. nip rolls 100, 101 and 102, 103. The nip rolls 102 and 103 are rotated at a speed sufficiently in excess of the speed of rotation of rolls 100 and 101 that the filament bundle will be torn. The filaments of bundle 16 will tear at the weakened sections. If the filaments of the bundle have been weakened in accordance with the apparatus shown in Figures 1 and 2 they will be torn along breakage points at different positions in the bundle so as to present an echelon formation. The bundle of torn fibers can then be directly twisted to form a spun yarn as illustrated in Figure 8. The twisted bundle of fibers 110 will be passed through a guide 112 and wound onto a supporting spool 114.

The heating of the filaments may conveniently be carried out by passing them over spaced heated members of any form or material. The spaced heated members may be heated in any desired manner. It is necessary that the spaced heated members be heated to a temperature above the boiling point of the solvent used in the preparation of the spinning solution. The filaments thus heated at their point of contact will cause the solvent to be evaporated quickly and the filaments at these points will possess a marked fragility. If the heated members are placed perpendicular to the direction of movement of the filaments, the filaments making up the thread will all break under the subsequent stretching action at approximately the same section of the thread. In this case it will be necessary to spin a yarn therefrom in the manner employed in spinning yarns from loose fibers, such as cotton fibers.

The following examples are illustrative of processes which may be employed in carrying out the present invention.

#### Example I

Employing the apparatus shown in Figures 1 and 2 of the drawings, hot water at a temperature of 90° to 95° C. is circulated through the drum 18. The drum is enclosed in a chamber which permits the recovery of solvent from the filament bundle. A solution of 23.5 parts of cellulose acetate, 60 parts of acetone and 16.5 parts of ethyl alcohol is extruded from spinneret 14, the orifices of which are located on a single line across the diameter of the spinneret, which line is parallel to the axis of the drum. The sheet of filaments issuing from the spinning nozzle after coming into contact with the hot fins is carried off by the rotation of the drum, and after passage over suitable guides and rollers, is finally wound on a bobbin. The filaments of the continuous yarn thus obtained exhibit at spaced points, where they have contacted the fins 20, weakened sections. These weakened sections are irregularly spaced from one filament to another. By stretching the thread obtained in this manner, a bundle of staple fibers is obtained which can, without doubling, be transformed into yarn in accordance with ordinary twisting, oiling and/or crimping operations.

#### Example II

Employing the apparatus illustrated in Figures 3 and 4 of the drawings, an electrical current is

passed through the disks 56 and the bars 58 by means of slip brushes 72. The current is regulated to heat the bars 58 to a temperature of about 100° C. The same spinning solution as described in Example I is passed from spinneret 52 and the bundle of filaments 54 is carried from the spinneret by means of the bars 58. The solvent is removed from the bundle of filaments by means of the enclosure 60. The yarn containing weakened sections at the points of contact with the bars 58 is wound onto a bobbin 70. The thread thus obtained may be torn into staple fiber lengths at the weakened sections by passing the same through sets of nip rollers as illustrated in Figure 8.

### Example III

A spinning solution such as is described in Example I is extruded from a spinneret and passed about a drum such as illustrated in Figure 7 of the drawings. Only the filaments at the extreme edges of the bundle are caused to be weakened. The bundle of filaments obtained in this manner, when passed between sets of nip rollers as illustrated in Figure 8 of the drawings, will produce a yarn in which the center filaments remain intact and the filaments at the outer edges of the bundle are severed. Such a bundle of continuous filaments and broken fibers can be directly twisted to form a thread giving the appearance of an abraded yarn.

The present invention can be utilized to produce staple fibers or to directly produce spun yarns from staple fibers in a single operation, including the spinning of the continuous filaments. A yarn produced in this manner does not have the objectionable characteristics above outlined with respect to methods previously known.

Since it is obvious that many changes and modifications of the present invention can be made without departing from the nature and spirit of the invention, it is to be understood that the invention is not to be limited except as set forth in the appended claims.

#### I claim:

1. The process which comprises spinning a plurality of artificial filaments from a filament-forming composition containing a volatile organic solvent, evaporating volatile solvent from said filaments and before the volatile solvent has entirely evaporated therefrom, contacting some of said filaments at spaced points with elements having an elevated temperature above the boiling point of said solvent thereby imparting to said filaments, at the point of contact, sections which are weaker in tensile strength than the remaining sections of said filaments.

2. The process which comprises spinning a plurality of artificial filaments from a cellulose derivative filament-forming composition containing a volatile organic solvent, evaporating volatile solvent from said filaments, and passing said filaments, before the volatile solvent has entirely evaporated therefrom, into contact with spaced elements having an elevated temperature above the boiling point of said solvent thereby imparting to said filaments, at the point of contact, sections which are weaker in tensile strength than the remaining sections of said filaments.

3. The process which comprises spinning a plurality of artificial filaments from a cellulose derivative filament-forming composition containing a volatile organic solvent, evaporating volatile solvent from said filaments, and passing said filaments, before the volatile solvent has en-

tirely evaporated therefrom, into contact with spaced elements having an elevated temperature above the boiling point of said solvent thereby imparting to said filaments, at the point of contact, sections which are weaker in tensile strength than the remaining sections of said filaments, removing the remaining volatile solvent from said filaments, and winding the same onto a supporting element.

4. The process which comprises spinning a plurality of artificial filaments from a cellulose derivative filament-forming composition containing a volatile organic solvent, evaporating volatile solvent from said filaments, and passing said filaments, before the volatile solvent has entirely evaporated therefrom, into contact with spaced elements having an elevated temperature above the boiling point of said solvent thereby imparting to said filaments, at the point of contact, sections which are weaker in tensile strength than the remaining sections of said filaments, removing the remaining volatile solvent from said filaments, twisting said filaments into a thread, and winding the same onto a supporting element.

5. The process which comprises spinning a plurality of artificial filaments from a cellulose derivative filament-forming composition containing a volatile organic solvent, evaporating volatile solvent from said filaments, and passing said filaments, before the volatile solvent has entirely evaporated therefrom, into contact with spaced elements having an elevated temperature above the boiling point of said solvent thereby imparting to said filaments, at the point of contact, sections which are weaker in tensile strength than the remaining sections of said filaments, subjecting said filaments to a tensile stress sufficient to tear said filaments at said weaker sections, and twisting said torn filaments into a thread.

6. Artificial threads comprising filaments having spaced along their lengths predetermined points where the strength and the degree of stretching at the breaking point is less than for the rest of the filaments, the filaments at said predetermined points having substantially the same denier as the rest of said filaments.

7. An apparatus for the production of artificial filaments of uniform denier having weakened sections at predetermined points throughout their length, which comprises means for extruding the filaments and a rotating drum having at its periphery a plurality of spaced members for contacting filaments passing from said extruding means, said spaced members being diagonally inclined across the periphery of said drum at an angle to the axis of rotation thereof, and means for heating said diagonally inclined spaced members.

8. An apparatus for the production of artificial filaments of uniform denier having weakened sections at predetermined points throughout their length, which comprises means for extruding the filaments and a rotating drum having at its periphery a plurality of spaced members for contacting filaments passing from said extruding means, said spaced members extending on said periphery from adjacent each edge of said drum to a point short of the central peripheral section thereof forming a circumferential groove therein, and means for heating said spaced members.

9. An apparatus for the production of artificial filaments of uniform denier having weakened

sections at predetermined points throughout their length, which comprises means for extruding the filaments and a rotating drum having at its periphery a plurality of spaced members for contacting filaments passing from said extruding means, said spaced members being diagonally inclined at an angle to the axis of rota-

tion of said drum and extending on said periphery from adjacent each edge of said drum to a point short of the central peripheral section thereof forming a circumferential groove therein, and means for heating said diagonally inclined spaced members.

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