Feb. 21, 1933. H. DREYFUS ET AL 1,898,085

PRODUCTION OF ARTIFICIAL FILAMENTS, YARNS, OR THREADS

Filed Aug. 30, 1929 2 Sheets-Sheet 1

FIG_1_

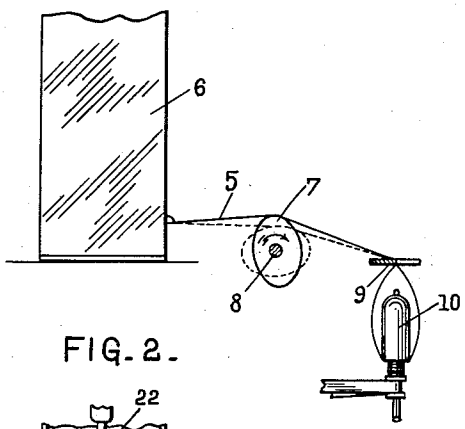


FIG_5_

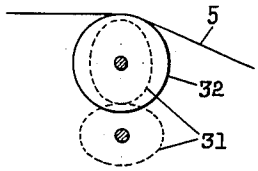


FIG_2_

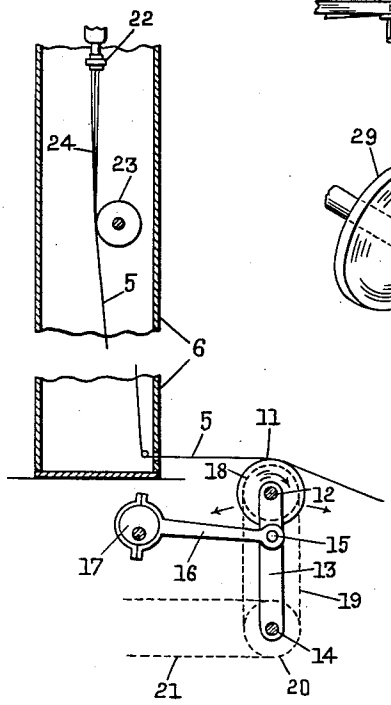


FIG_4_

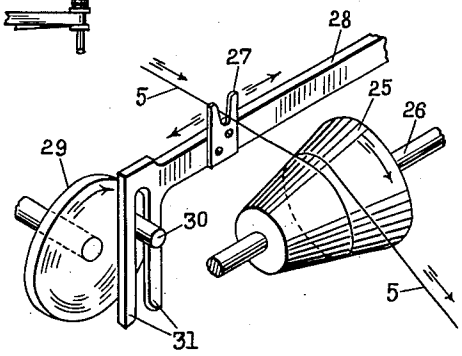
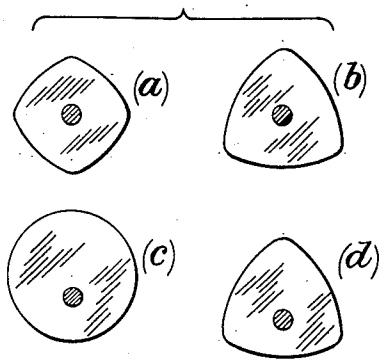


FIG_3_



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PRODUCTION OF ARTIFICIAL FILAMENTS, YARNS, OR THREADS

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FIG_6_

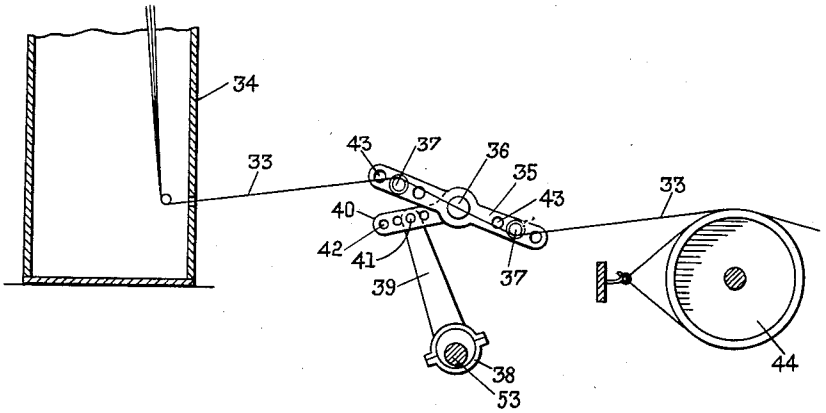


FIG_7_

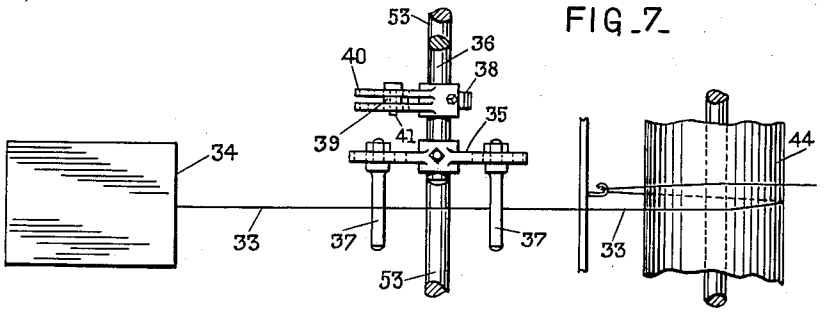


FIG_8_

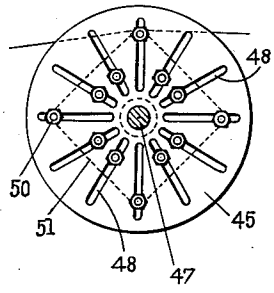


FIG_9_

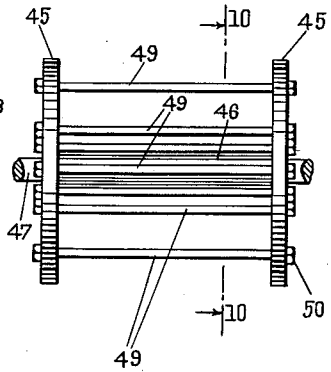
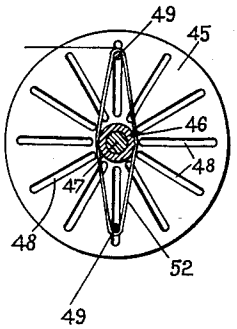


FIG_10_



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UNITED STATES PATENT OFFICE

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PRODUCTION OF ARTIFICIAL FILAMENTS, YARNS, OR THREADS

Application filed August 30, 1929, Serial No. 389,412, and in Great Britain September 13, 1928.

This invention relates to artificial filaments, yarns, or threads, and to their production by the extrusion of spinning solutions through jets, nozzles, or other spinning orifices.

According to the invention, filaments or threads of artificial silk or the like are given a regular or systematic irregularity in denier by drawing them at varying linear speeds in the course of their production so as to stretch them at any desired intervals. The varying stretch imparted to the filaments or threads results in a correspondingly varying denier, the variations occurring at any desired intervals and to any desired degree, while extending any desired amount along the length of the filaments or threads (hereafter referred to as "filaments").

Numerous methods may be employed for stretching or drawing or variably stretching or drawing the filaments to impart the desired alternating or periodically recurring irregularities. For instance, the filaments may be caused to pass to a roller of circular cross-section whose speed, which may normally be the same or greater than the speed of extrusion of the filaments, is varied at intervals and to amounts and for periods corresponding to the frequency and degree and length of the predetermined irregularity required to be imparted to the filaments.

According to a further method of imparting the stretch, the filaments may be caused to pass round a roller or the like so mounted and/or of such cross-section as to vary the linear speed of the filaments. For example, rollers of elliptical or other non-circular cross-section may be employed, or rollers of circular or other cross-section may be eccentrically mounted. Further, such rollers may be arranged to rotate at a constant speed, or by varying their speed of rotation, further irregularities may be imparted to the filaments over and above those imparted owing to the form or mounting of the roller.

A roller of irregular cross-section for use according to the invention may be constituted by a pair of flanges each having a number of radial or other slots adapted to receive bars which extend between the flanges, adjustment of the bars along the length of the slots or removal of some of the bars enabling a variety of cross-sections to be obtained.

Moreover, a roller having any of the forms described above, and rotating with either constant or varying peripheral speeds, may be caused to move bodily e. g. to and fro, while rotating, either continuously or intermittently, the movement causing the filaments to be stretched irregularly and thus to receive a reduced denier at desired intervals.

A still further method of carrying out the invention consists in leading the filaments over or round a rotating roller or drum whose diameter varies along its length, the filaments being engaged at successive parts of their length by parts of the roller or drum of different diameters. As the linear speed imparted to the filaments varies in accordance with the diameter of the drawing roller or drum, the length of the filaments between the spinning orifices and the roller or drum is stretched to varying extents, with the production of corresponding variations in denier.

The filaments may be caused to be engaged by the different diameters by traversing the filaments along the roller or drum or by traversing the drum itself, as by moving a guide for the filaments or mounting the drum on an axially slidable shaft. Any predetermined frequency of variation may be obtained by adjusting the rate of traverse of the filaments relative to the roller or drum, and, of course, by varying the length of the traverse, the effect of the roller or drum on the filaments may be modified.

The roller or drum may have any suitable form, depending on the nature of the variations to be produced, for instance, it may be arranged as a truncated cone by means of which a maximum variation in denier may be obtained corresponding to the difference between the diameters of the two ends of the cone. The roller or drum may, moreover, have a non-circular cross-section and be driven at varying speeds.

The filaments may be wound, or twisted and wound, after passing round the stretch-

ing roller or the like, or they may be collected on the roller or the like itself.

Yet a further method consists in drawing the filaments at varying linear speeds by periodically lengthening the path followed by the filaments to a winding or twisting and winding device, the lengthening being effected by one or more bars or rollers (driven or idle) which are moved across the path of the filaments at a frequency and to an extent adjusted in accordance with the variations in denier to be imparted. For instance, the filaments may pass over and under a pair of bars or rollers arranged for oscillation across the direction of feed of the filaments.

Any suitable means may be employed for controlling the speed of operation of the stretching devices, and the devices may be arranged to give a gradual or more or less abrupt change from one denier to another, as desired. The driving of the devices may be by means of electric motors whose speed is controlled in accordance with the variations in denier required. Further, elliptical or other irregular gears may be employed for driving the elements of the stretching devices.

All the jets or nozzles whether in a single metier or machine or in a series of such which are required to produce the same quality of filament have associated therewith devices which are driven or controlled in such a manner as to exert the same stretching action on all the filaments extruded from the jets or nozzles.

The variations in denier produced according to the invention may appear at regular short or regular long intervals of length or at regularly varying intervals, and variations of different degree or extent, or both, may appear at any desired intervals. Or one or more groups of irregularities may appear in regular sequence or in any desired order or at any desired intervals. Thus, for example, one or more short variations may alternate with one or more longer variations, or groups of short and long variations may alternate with short or long variations or with other groups of short and long variations, always with the object of producing a regular or systematic effect from the alternating or periodically recurring irregularities of denier of the filaments, yarns, or threads. Or periodical irregularities forming groups of, for example, 2, 3, 4, 6 or 10 or more variations may occur on the filaments, yarns, or threads, the groups alternating with each other or appearing in any desired order according to the effect to be produced.

It will be understood that where yarn or thread is formed by the association of a number of filaments all of which have a regular irregularity in denier which is the same for all the filaments, the variations in the individual filaments may be arranged to produce by a cumulative effect a similar regular irregularity in the denier of the yarn or thread formed therefrom.

The yarns or threads which have received the regular irregularities as above described may be wound or twisted and wound, for example, by means of cap-spinning devices, or centrifugal boxes.

The filaments of varying denier may be formed into yarns, either alone or twisted or doubled with threads of other natural or artificial filaments or fibres. Or they may be cut or reduced to staple lengths, either continuously with their production or subsequently thereto, and spun into yarns, either alone or mixed or blended with other natural or artificial filaments or fibres, and such spun yarns may, if desired, be twisted or doubled with the same or other yarns to form any desired type of thread.

Yarns or threads with irregular denier according to the invention impart a novel effect to fabrics or articles wholly or partly formed from them, by reason of the differential effect produced by the variations, and this effect may, moreover, be enhanced when the fabrics or articles are dyed, printed, or otherwise coloured, because of the regular irregularity of denier of the yarns or threads causing different penetration of the dyestuff or other colouring matter to be effected, a great variety of colour effects thereby being produced.

The yarns or threads of varying denier may be applied to the production of fabrics or articles, either alone or in association with yarns or threads of regular artificial silk or of other natural or artificial filaments or fibres, and may be utilized to give any desired design or pattern. They may be used, for example, in the warp and/or weft in weaving operations; in knitting operations, for example in the production of warp-knitted fabrics; in circular hosiery or other knitting machines; in braiding or cording operations; in net or lace-making operations; or in any other fabric-forming or textile operations.

While the invention applies particularly to filaments or threads of varying or irregular denier, produced by the dry or evaporative method, and especially filaments or threads having as a base cellulose acetate or other cellulose derivatives, such as cellulose formate, propionate, or butyrate, thiocarbamic or alkoxy-alkacyl esters of cellulose, methyl, ethyl or benzyl cellulose, or the condensation products of cellulose and glycols or other polyhydric alcohols, it applies likewise to filaments or threads of varying or irregular denier produced by the wet or coagulation method, whether having a base of cellulose acetate or other organic derivatives of cellulose, or composed of a reconstituted cellulose, such as viscose, cuprammonium, or nitrocellulose silk.

Various forms of apparatus which may be

employed in carrying the invention into effect are illustrated in the accompanying drawings, it being understood that the following description is given by way of example only and is in no way limitative.

Fig. 1 is a side elevation of one form of apparatus;

Fig. 2 is a side elevation of a further form of apparatus;

Fig. 3 shows examples of stretching rollers which may be employed;

Fig. 4 is a perspective view of an apparatus in which filaments are traversed along the length of a stretching roller;

Fig. 5 is a side elevation of a detail of a further form of apparatus;

Fig. 6 is a side elevation of another form of apparatus;

Fig. 7 is a plan view of Fig. 6; and

Figs. 8, 9, and 10 are views of a further form of device, Fig. 8 being an elevation of Fig. 9, and Fig. 10 a sectional view taken on the line 10—10 of Fig. 9, and illustrating a modified arrangement.

Referring to Fig. 1, the filaments 5 are shown emerging from a spinning cell 6, the filaments being caused to pass round a roller 7 of elliptical section mounted for rotation on a shaft 8. On leaving the roller 7, the filaments pass to a thread guide 9 and to a cap-spinning device 10. It will be seen that as the filaments are engaged by the roller 7 in the position shown in full lines, the filaments will be drawn from the cell 6 at a speed equal to the peripheral speed of the roller at the ends of its major axis, this speed being greater than the speed of extrusion of the filaments. As the roller moves to the position shown in broken lines, the filaments are drawn from the cell at a speed corresponding to the peripheral speed of the roller at the ends of its minor axis. The filaments are thus stretched to different extents depending on the part of the roller with which they are engaged, the stretch varying from a maximum when the engagement is at the end of the major axis to a minimum at the end of the minor axis. At each revolution of the roller of elliptical cross-section, two variations in the amount of stretch, and, therefore, in the denier of the filaments, are imparted to the length of filaments drawn from the cell during the revolution. By employing rollers of other cross-section, different numbers of variations of stretch at each revolution may be obtained.

In Fig. 2, the filaments 5 on leaving the cell 6 are caused to pass round a roller 11 mounted on a shaft 12 carried by the upper end of an arm 13, the lower end of the arm being pivoted about a shaft 14. Pivoted at 15 on the arm 13 is an eccentric rod 16 driven by means of an eccentric 17, the arrangement being such that the arm 13 and the roller 11 are caused to oscillate about the shaft 14 to an extent and at a rate dependent on the throw of the eccentric 17 and the speed at which the eccentric is driven. The roller 11 is rotated by means of a pulley 18 connected by a belt 19 to a pulley 20 freely mounted on the shaft 14. The pulley 20 is in turn driven by a belt 21. The roller 11 by its rotation, draws the filaments 5 from the cell 6 and variations in the length thus drawn are effected by the oscillatory motion of the roller. By varying the rate at which the eccentric 17 is driven with respect to the peripheral speed of the roller 11, e. g. by the use of elliptical gears, varying amounts of stretch and consequent variations in the denier of the filaments may be effected.

If desired, the variable stretch imparted to the filaments may be confined to a particular length of the filaments being produced, such an arrangement being shown in Fig. 2. At some distance from the spinning jet 22 a roller 23 is arranged. The filaments are caused to pass round the roller 23 which is driven at a rate equal to or exceeding the rate of extrusion of the filaments, so that the stretch imparted according to the invention is confined to the length of filaments between the roller 23 and the stretching apparatus, the length 24 of the filaments between the jet 22 and the roller 23 being free from such stretching.

Fig. 3 illustrates at (*a*) a stretching roller of roughly square cross-section but having rounded corners, and at (*b*) an approximately triangular section roller. A roller of circular cross-section but mounted eccentrically for rotation is shown at (*c*) Fig. 3, and at (*d*) a roller of similar cross-section to (*b*) is shown also mounted eccentrically. It will be seen that by the employment of rollers of such cross-section, many variations in the amount and frequency of the variation in denier may be imparted. Moreover, by using such rollers in conjunction with apparatus such as that illustrated in Fig. 2, the variations may be produced in groups on the filaments, the recurrence of the groups to form a pattern depending on the form of the roller and the manner in which it is driven or moved.

In Fig. 4, the filaments 5 are shown passing round a conical roller 25 mounted on a shaft 26. A thread guide 27 is carried by a longitudinally movable bar 28, the bar being given a to and fro motion in any suitable way, e. g. by means of a cam, or by a crank disc 29, a pin 30 of which works in a fork 31 carried by the bar 28. The filaments are caused to engage parts of the roller 25 which move at different peripheral speeds, and the consequent variations of stretch imparted to the filaments result in corresponding variations in denier. The roller 25, which may be driven at a varying speed, may have an irregular cross-section such as is indicated at (*a*) and (*b*) of Fig. 3, or it may be eccen-

trically mounted as shown at (*c*) and (*d*) of Fig. 3.

The employment of irregular gearing for driving a stretching roller is illustrated in Fig. 5, elliptical gears 31 being shown in connection with a roller 32 of circular cross-section, though other cross-sections, such as those shown in Fig. 3, may be employed. This form of drive causes the roller to rotate with an irregularly peripheral speed during each revolution, thus producing a variation in the denier of the filaments 5.

In Fig. 6, filaments 33 on withdrawal from the spinning cell 34 are led to a device comprising an arm 35 mounted for oscillation on a shaft 36. Bars 37 project from the arm 35 in a direction parallel to the shaft 36, a bar 37 being arranged on each side of the shaft. An eccentric 38 driven in any suitable manner is connected by an eccentric rod 39 to an arm 40 fixed to the shaft 36. The arm 35 is thus caused to perform an oscillatory motion with an ampliture governed by the throw of the eccentric 38 and the position of the connection 41 between the eccentric rod 39 and the arm 40, a series of holes 42 being provided on the arm 40 to permit of the connection being adjusted. The bars 37 are preferably adjustably mounted on the arm 35, a series of holes 43 being provided on each half of the arm. On leaving this device the filaments 33 pass round a feed roller 44 and are collected in any suitable manner. It will be seen that as the filaments pass first over one bar 37 and then under the other before reaching the roller 44, the oscillation of the arm 35 causes a variable pull to be imparted to the filaments which are thereby stretched to a varying extent, with the consequence that they receive variations in denier along their length. Instead of the arms 35 and 40 being secured to the shaft 36, they may be arranged to oscillate freely thereon, the arm 40 being connected directly to the arm 35 to impart its movement thereto.

The device shown in Figs. 8–10 is adapted to receive the filaments either in a manner similar to that of the roller 7 shown in Fig. 1 while the filaments are on their way to a winding device, or alternatively, the device itself may serve as a winding device. Two flanges 45 are connected by a hub 46 which is mounted on a shaft 47. Slots 48 are formed in each flange, and they are arranged to receive bars 49 which extend from one flange to the other and may be secured in any desired position in the slots 48 by means of nuts 50. The rods constitute a roller-like surface, the periphery of the roller depending on the positions of the rods in the slots. Thus, Fig. 8 shows four of the rods arranged to form a square 51, the remaining rods being held out of position near the hub. Fig. 10 shows two diametrically opposed rods mounted in the slots, all the remaining rods being removed.

As shown in Fig. 8, the device may operate as a roller of non-circular periphery which, by reason of the varying peripheral speed of the roller, imparts a variable denier to the filaments passing over the roller to a winding device. Instead, however, of the filaments proceeding to a further winding device, they may be collected on the bars in the form of a hank, and in Fig. 10 a hank 52 is shown in the course of formation on the single pair of rods 49.

By means of devices such as those above described, the irregularity of denier may be caused to appear in a great variety of arrangements on the filaments, varying from a simple alteration in denier occurring at regular intervals of any extent along the length of the filaments to a grouping of alterations in denier occurring at regular or irregular intervals.

It will be understood that any desired number of devices may be arranged for simultaneous operation on the filaments or threads produced by a plurality of jets or nozzles in a single metier or machine, common actuation being provided for such parts as the oscillating rollers 11 shown in Fig. 2, the traversing guides 27 shown in Fig. 4 used for the several filaments or threads, or the oscillating arms 35 shown in Fig. 6. Thus, the shaft 12 may extend across the length of the metier or machine occupied by several jets or nozzles, a single eccentric 17 or the like, or a pair of such, being employed to oscillate the shaft. Similarly, the bar 28 may extend over the length of the metier or machine and carry a suitable number of guides 27 for operation with the rollers 25, which are preferably mounted on a common shaft 26. Likewise, any desired number of eccentrics 38 may be carried by the shaft 53.

The foregoing apparatus may be applied to the treatment of artificial filaments produced by the dry or evaporative method, as is indicated in Figs. 1, 2, and 6, or by the wet or coagulation method. It is to be understood that the expression "artificial filaments" used hereafter in the claims, includes yarns or threads consisting of artificial filaments as well as the filaments themselves.

What we claim and desire to secure by Letters Patent is:—

1. Process for the production of artificial filaments, said process comprising drawing the filaments at varying linear speeds in the course of their production, thereby imparting a systematic variation in denier to the filaments.

2. Process for the production of artificial filaments from solutions of organic derivatives of cellulose, said process comprising drawing the filaments at varying linear speeds in the course of their production,

thereby imparting a systematic variation in denier to the filaments.

3. Process for the production of artificial filaments from solutions of cellulose acetate, said process comprising drawing the filaments at varying linear speeds in the course of their production, thereby imparting a systematic variation in denier to the filaments.

4. Process for the production of artificial filaments, comprising extruding the filaments by the dry or evaporative method, and drawing the filaments at varying linear speeds in the course of their production, thereby imparting systematic variation in denier to the filaments.

5. Process for the production of artificial filaments from solutions containing cellulose acetate, said process comprising extruding the filaments by the dry or evaporative method and drawing the filaments at varying linear speeds in the course of their production, thereby imparting a systematic variation in denier to the filaments.

6. Apparatus for the production of artificial filaments comprising a filament-engaging member, and means for actuating said member in such a manner that its motion in engagement with the filaments causes the filaments to be drawn at systematically varying linear speeds, whereby corresponding systematic variations in denier are imparted to the filaments.

7. Apparatus for the production of artificial filaments comprising a rotating member round which the filaments are caused to pass, and means for causing the said member to rotate with a varying peripheral speed, whereby a systematic variation in denier is imparted to the filaments.

8. Apparatus for the production of artificial filaments comprising a collecting device adapted to collect the filaments continuously with their production, a rotating member round which the filaments are caused to pass on their way to the collecting device, and means for causing the said member to rotate with a varying peripheral speed, whereby a systematic variation in denier is imparted to the filaments.

9. Apparatus for the production of artificial filaments, comprising a rotating member round which the filaments are caused to pass, the said member being so mounted for rotation and having such cross-section that the peripheral speed of its point of engagement of the filaments is caused to vary, whereby a systematic variation in denier is imparted to the filaments.

10. Apparatus for the production of artificial filaments comprising a rotating member round which the filaments are caused to pass, and means for rotating the said member with a varying angular speed, whereby a systematic variation in denier is imparted to the filaments.

11. Apparatus for the production of artificial filaments comprising a collecting device adapted to collect the filaments continuously with their production, and a rotating member round which the filaments are caused to pass on their way to the collecting device, the said member being so mounted for rotation and having such cross-section that the peripheral speed of its point of engagement with the filaments is caused to vary, whereby a systematic variation in denier is imparted to the filaments.

12. Apparatus for the production of artificial filaments, comprising a collecting device adapted to collect the filaments continuously with their production, a rotating member round which the filaments are caused to pass on their way to the collecting device, and means for rotating the said member with a varying angular speed, whereby a systematic variation in denier is imparted to the filaments.

13. Apparatus for the production of artificial filaments, comprising a rotating member round which the filaments are caused to pass, the diameter of said member varying along its length, and means for causing the filaments to be engaged by successive parts of different diameters along the length of the said member, whereby a systematic variation in denier is imparted to the filaments.

14. Apparatus for the production of artificial filaments, comprising a collecting device adapted to collect the filaments continuously with their production, a rotating member round which the filaments are caused to pass on their way to the collecting device, the diameter of said member varying along its length, and means for causing the filaments to be engaged by successive parts having different diameters along the length of the said member, whereby a systematic variation in denier is imparted to the filaments.

15. Apparatus for the production of artificial filaments, said apparatus comprising a collector device adapted to collect the filaments continuously with their production, at least one bar adapted to contact with the filaments, and means for reciprocating said bar periodically across the path of the filaments to the collector device, whereby a systematic variation in denier is imparted to the filaments.

In testimony whereof we have hereunto subscribed our names.

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WILLIAM ALEXANDER DICKIE.
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