

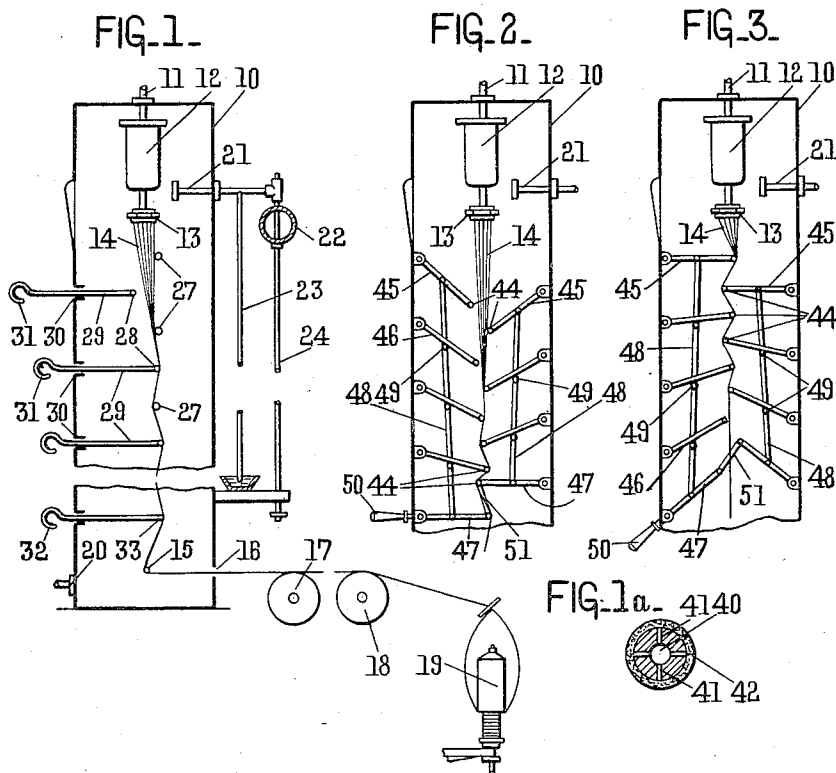
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PRODUCTION OF ARTIFICIAL MATERIALS

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PRODUCTION OF ARTIFICIAL MATERIALS

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This invention relates to the production of artificial filaments and like materials either by the dry or evaporative method or by the wet or coagulation method, and is particularly concerned with the stretching of such filaments during their production.

In the spinning of artificial filaments stretch may be imparted to the filaments, primarily for the production of filaments of fine denier, or to produce filaments at a greater linear rate, or for both these purposes. The stretch may also serve to increase the strength of the filaments, and for this purpose in particular, it is a factor of some importance that the stretch should be applied to the filaments at a stage in their setting, whether by coagulation in a spinning bath, or by evaporation in an evaporative atmosphere, where the filaments are best fitted to receive the applied stretch, and that the greatest freedom of control should be available as to the stage in the setting of the filaments at which the stretch should be applied. Ordinarily, the effect of stretch applied to the filaments largely falls in the soft and principally liquid part of the filaments close to the spinning jet, and results mainly in a reduction in denier. The above-mentioned advantages of increased strength and/or very low denier can be obtained by applying stretch to a part in the filaments when they are still plastic, i. e. by preventing the stretch from being applied almost wholly to the filaments as they leave the spinning jet. Thus, tension means may be applied to the filament to isolate those parts of the filaments near the spinning jet, from stretching which no advantage could be obtained. Owing, however, to the fact that such stretching means should be applied to the filaments at a point where they are strong enough to withstand not only the degree of stretch to be applied, but also the abnormal momentary stress resulting from the initial application of such tension means, it results that stretch cannot be applied over that part of the plastic zone of the filaments where they are likely to be ruptured or otherwise damaged in the initial application of the tension means. This limitation seriously curtails the effectiveness of restricting tension, since it cuts out the possibility of applying stretch to those parts of the filaments which would be more advantageous. The object of the present invention is to enable tension to be applied in a manner which allows stretch to be applied over a greater range of the plastic filaments than heretofore.

According to the present invention tension is

imparted by means arranged along the path of the filaments which are being drawn from the spinning jet, said means being so operated that tension can first be applied to a relatively strong part of the filaments, so avoiding undue stress on the filaments, and then at a part of the filaments nearer the jet, i. e. at a part of the filaments which is more soft or plastic. In this way, the softer part of the filaments between the point at which tension is first applied and the jet is relieved from the full effect of the stretching force, so that the later application of tension to this part can be effected without danger of rupture or breakage. Once the tensioning means have been applied, the point of application may be moved progressively nearer the jet until the fullest possible range of the soft filaments is being utilized and receives the applied stretch. By the use of a plurality of tensioning devices, the point of application may be moved in quite a gradual manner.

All the plurality of tension means used according to the invention may remain effective during the spinning operation, thus breaking the filaments up into zones over which different degrees of tension are imparted, or alternatively after the operation has been started some or all the tension means except the one nearest the jet may be removed from operation, leaving the stretching force to operate closer to the jet than would otherwise be possible. A very convenient form of tension device consists simply of a rod, so disposed as to deflect the filaments so that they pass in contact with the rod and are deflected thereby from a straight path. Two or more of such rods, operating from opposite sides of the filaments, afford a form of tension device which is simple in character and capable of being very readily moved into and out of operative position. For the application of a finer and more delicate degree of tension, light freely mounted rollers may be used in the same way. By providing means whereby after spinning is started such rods or rollers or other tensioning devices may be adjustably moved into engagement with the filaments, the application of stretch may be applied as gradually as may be necessary and over any desired range of softness of the filaments. In addition to the stretch applied by drawing down the filaments, further stretch may be applied to the filaments outside the cell by passing them round rollers rotating at successively increasing speeds.

The invention is applicable generally to the production of artificial filaments or like mate-

rials either by the wet or coagulation method or by the dry or evaporative method. Thus for example the invention may be applied to the production of viscose, nitrocellulose or cuprammonium threads or of threads of cellulose derivatives by the wet or coagulation method. It is, however, of particular importance in enabling the incidence of stretch to be controlled in the production of threads of derivatives of cellulose by the dry or evaporative method in which the spinning solution of a derivative of cellulose is extruded into an evaporative atmosphere. Examples of cellulose derivatives are the organic derivatives of cellulose, e. g. cellulose esters such as cellulose acetate, cellulose formate, cellulose propionate and cellulose butyrate and the ethers of cellulose such as ethyl, methyl and benzyl cellulose and inorganic derivatives such as cellulose nitrate. The invention will hereafter be described with particular reference to its application to dry spinning, but it is to be understood that the invention is also applicable, with suitable modifications, to wet spinning.

The tension devices used according to the present invention may be disposed at intervals along the whole length of the filaments while they are passing through the evaporative atmosphere, or they may be grouped together closer to one end than to the other, and preferably somewhat closer to the jet. For example, the devices may be wholly disposed within a range where the solvent content of the filaments amounts to 50% or more, the filaments after this point being generally sufficiently strong to resist fluctuations of tension which would break or damage the filaments immediately issuing from the jet. Furthermore the range of application of the devices may be adjusted during their application. For example, in a downward dry-spinning operation tension rods or rollers may be brought into operation towards the bottom of the spinning cell first, the higher rods or rollers close to the jet being successively closed so that the tension is gradually increased and sudden changes take place only at this point where the thread is comparatively strong. As the closing of the tension rods or rollers extends up the spinning cell towards the jet, the rods at the bottom may be opened so that the point at which the filaments leave the tension devices is moved nearer to the jet and the stretching action is allowed to extend over a greater zone than before. Alternatively, if desired, the rods may be successively closed on the filaments, the action of the lowest rods being maintained in addition to that of the higher rods.

The tension applying means along the path of the filaments may conveniently be connected together, so that the operation of one of such means automatically effects the operation of the others in the desired sequence and in the desired manner.

The invention in its application to the dry spinning of artificial filaments will now be described in greater detail with reference to the accompanying drawing, but it is to be understood that this description is given by way of example only and is in no way limitative.

Figure 1 is a side elevation in section of a dry spinning chamber provided with means for carrying out the present invention, and Figure 1a is a detail of Figure 1; and

Figures 2 and 3 show two views of a spinning chamber provided with another form of mechanism for carrying out the invention.

In Figure 1 a spinning cell 10 is provided with a pipe 11 for the supply of spinning solution which is led through a filter 12 and extruded through a jet 13 in the form of filaments 14. The filaments proceed down the cell and turn round a thread guide 15, leaving the cell by an opening 16 and passing successively round two rollers 17, 18, the roller 18 leading them to a cap spinning device 19 on which they are collected. Evaporative medium enters the cell by an inlet 20 and leaves by a draw-off device 21 and conducted to a header 22. Gauge means 23 and valve means 24 are provided for adjusting the amount of evaporative medium passing through the cell. The roller 17 draws the filaments away from the jet 13 at a rate greater than the rate of extrusion of the filaments, so that the filaments are stretched, and further stretch may be imparted to the filaments between the two rollers 17 and 18, by rotating the roller 18 at a higher rate than the roller 17.

Along the path of the filaments 14 and just to the right of the direct line between the spinning jet 13 and the guide 15 are disposed a number of fixed tension rods 27, and alternating with these on the other side of the filaments are a number of movable tension rods 28, 33 integral with rods 29 at right angles thereto which pass through openings 30 in the cell wall and terminate in hooks 31, 32 for convenient handling. When the hooks 31 are drawn to the left the filaments 14 pass directly from the spinning jet 13 to the guide 15.

When it is desired to impart tension to the filaments the lowermost hook 32 is pushed towards the cell and the rod 33 is brought into contact with the filaments. The rods 28 in the upper part of the cell are then successively pushed into position and in this manner tension is gradually imparted to the softer portions of the filaments. Since the rods 28 and 33 are individually controlled, tension may be applied along the whole length of the filaments, or alternatively, if desired, when tension is applied by means of the upper rods 28 tension applied by the lower rods, e. g. 33, may be withdrawn.

The stationary rods 27 are hollow and are shown in greater detail in section in Figure 1. As will be seen in this figure the hollow space 40 inside the rod communicates by small passages 41 to an absorbent coating 42 of suitable woven or felted fabric, so that lubricant material may be fed through the rod and applied to the filaments from the coating 42. In this manner the filaments are lubricated and are prevented from sticking to one another by reason of the solvent contained therein and the tension applied to the filaments.

In Figures 2 and 3 tension is applied by means of rods 44 which are disposed in the upper part of the cell, where the filaments still contain about 50% or more of solvent. The rods 44 are mounted on the ends of levers 45, 46, 47 the uppermost lever 45 and the lowermost lever 47 on each side of the cell being connected by means of substantially vertical rods 48. The middle rods 46 are supported by means of pegs 49 projecting from the rods 48. The length of the rods 48 and the spacing of the pegs 49 is such that when the lowermost of the tension rods 44 cross the line of the filaments 14, the uppermost of the tension rods do not cross the line. Tension is applied by means of a handle 50 on the left-hand side of the cell, the tension rods on the right-hand side of the cell being connected to those on the left by means of a link 51 between the ends of the two levers 47. As the handle 50 is pushed down tension is applied

first to the lower part of the filaments as shown in Figure 2, and as the operation proceeds, the upper rods 44 come into engagement with the filaments while the lower rods come out of engagement as shown in Figure 3. Initially the lever 50 is in a higher position than is shown in Figure 2 and all the rods are out of engagement with the filaments which therefore pass freely from the top to the bottom of the cell. In this manner the tension is first applied to the lower part of the filaments and then is applied to the upper part of the filaments, when the tension originally applied is released.

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

1. Process for initiating the production of artificial filaments, said process comprising extruding the filaments into a hardening medium, drawing the filaments away from the point of extrusion at a rate greater than the rate of extrusion and applying tension to the filaments, the tension being first applied to a relatively strong part of the filaments and then to a part of the filaments nearer to the point of extrusion.

2. Process for initiating the production of artificial filaments, said process comprising extruding the filaments into an evaporative medium, drawing the filaments away from the point of extrusion at a rate greater than the rate of extrusion of the filaments and imparting tension to the filaments, such tension being applied first to a relatively strong part of the filaments and then to a part of the filaments nearer the point of extrusion.

3. Process for initiating the production of artificial filaments, said process comprising extruding the filaments into an evaporative medium, drawing the filaments away from the point of extrusion at a rate greater than the rate of extrusion of the filaments, imparting tension to the filaments, such tension being applied first to a relatively strong part of the filaments and then to a part of the filaments nearer the point of extrusion, and applying to the filaments a lubricant material at a point before tension is applied thereto.

4. Process for initiating the production of artificial filaments, said process comprising extruding the filaments into an evaporative medium, drawing the filaments away from the point of extrusion at a rate greater than the rate of extrusion of the filaments and imparting tension to the filaments, such tension being applied first to a part of the filaments containing about 50% of solvent material, and then to a part of the filaments nearer to the point of extrusion and thus containing a greater proportion of solvent material.

5. Process for initiating the production of artificial filaments, said process comprising extruding the filaments into a hardening medium drawing the filaments away from the point of extrusion at a rate greater than the rate of extru-

sion, applying tension to the filaments, the tension being first applied to a relatively strong part of the filaments and then to a part of the filaments nearer to the point of extrusion, and withdrawing the tension from that part of the filaments to which it was first applied.

6. Apparatus for the production of artificial filaments by the evaporative method, said apparatus comprising a spinning cell adapted to contain an evaporative medium, a spinning jet for the extrusion of the filaments into said medium, a plurality of tension rods disposed along the path of the filaments and alternately on opposite sides thereof, a pivotally mounted arm for supporting each of said tension rods, and a rod on each side of the filaments in connection with such arms adapted so to connect the tension rods that, on motion of one of them towards the filaments, the rods are moved successively into frictional contact with the filaments, and subsequently, in the case at least of the rods remote from the point of extrusion, out of such contact again.

7. Apparatus for the production of artificial filaments, said apparatus comprising, in combination, means for extruding the filaments, means for drawing the filaments away from the point of extrusion, a plurality of interposed retarding means disposed on each side of the path of the filaments each adapted to determine a point at which tension in the filaments is increased, and actuating means for bringing said retarding means successively into operation, during spinning, so as to move said tension point away from the drawing means and towards the extruding means.

8. Apparatus for the production of artificial filaments, said apparatus comprising, in combination, a cell adapted to contain evaporative medium, means for extruding filaments into said evaporative medium, means for drawing said filaments away from said extruding means, interposed retarding means adapted to determine the point at which tension in the filaments is increased, means for moving the point of application of said retarding means during spinning, away from the drawing means and towards the extruding means, and means for applying a lubricant to the filaments before they reach said retarding means.

9. Apparatus for the production of artificial filaments by the evaporative method, said apparatus comprising, in combination, a spinning cell adapted to contain an evaporative medium, a spinning jet therein, a plurality of movable tension rods disposed on each side of the path of the filaments, and means for causing the tension rods on one side of the filament path to mesh, one after the other, with those on the other side thereof so as to cause the filaments to follow a serpentine path and, by degrees, to set up tension in said filaments.

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