

May 1, 1945.

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2,374,744

APPARATUS AND PROCESS FOR TAPERING ARTIFICIAL FILAMENTS

Filed Sept. 22, 1942

2 Sheets-Sheet 1

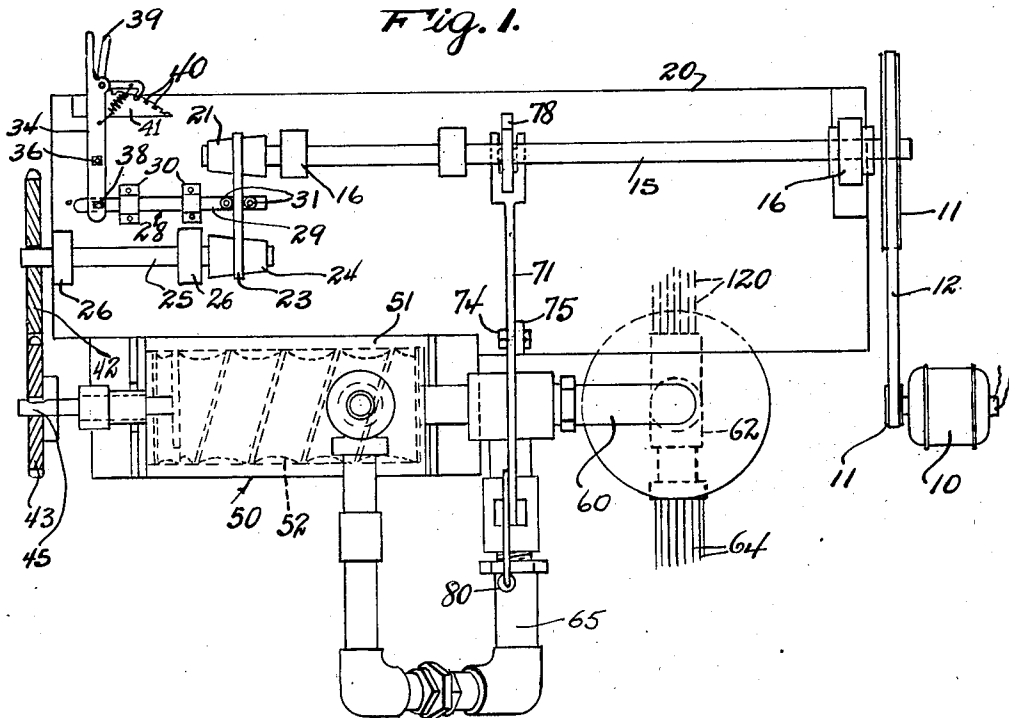


Fig. 4.

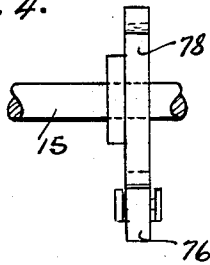


Fig. 5.

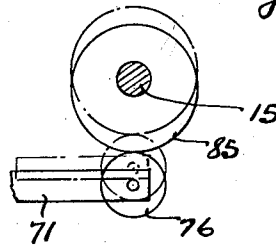


Fig. 6.



Fig. 7.

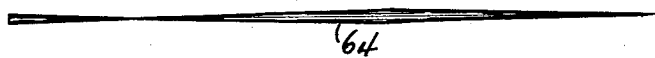
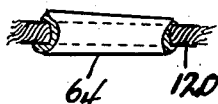


Fig. 8.



Fig. 9.



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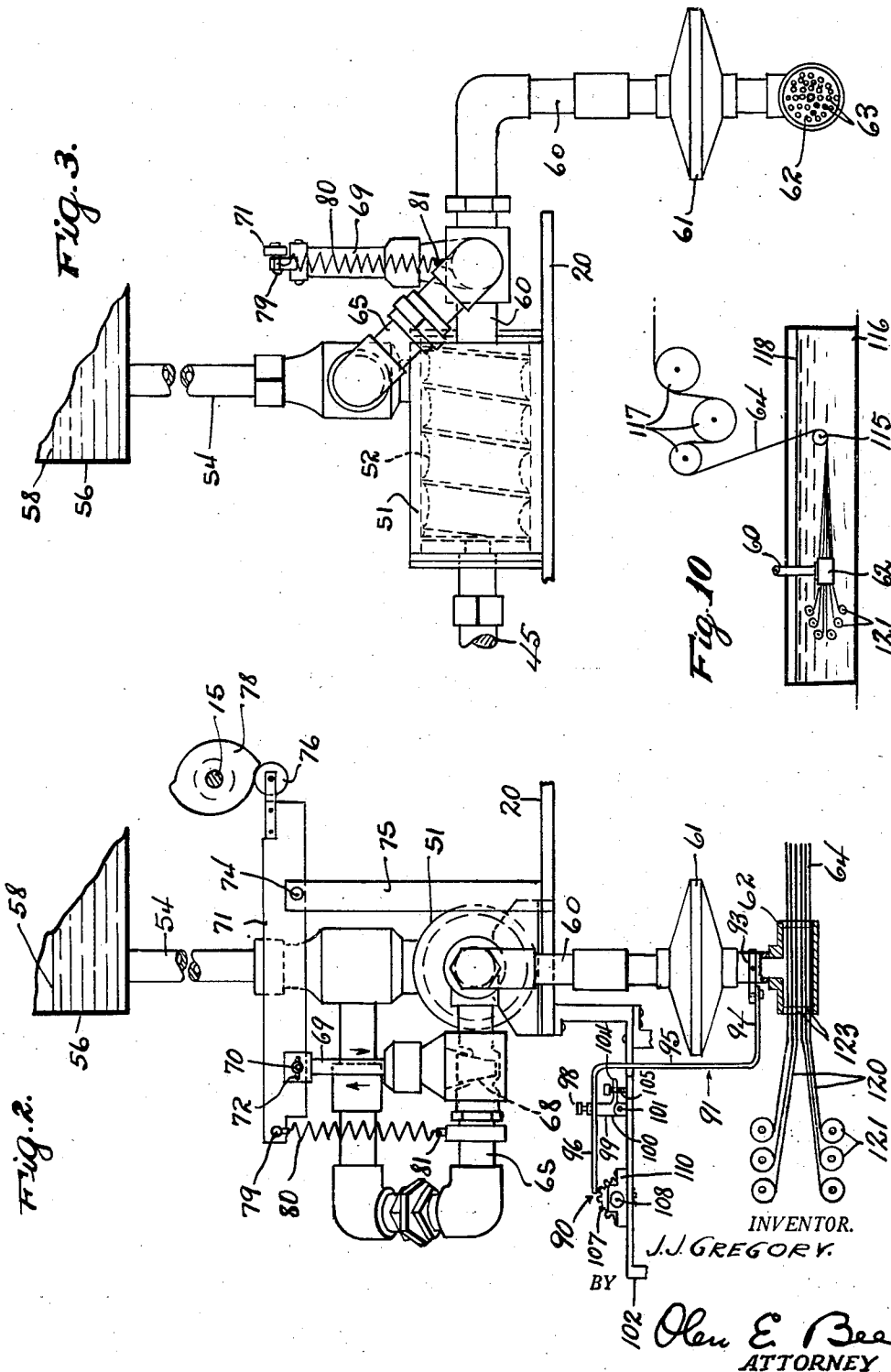
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2 Sheets-Sheet 2



UNITED STATES PATENT OFFICE

2,374,744

APPARATUS AND PROCESS FOR TAPERING
ARTIFICIAL FILAMENTSJohn J. Gregory, Catonsville, Md., assignor to
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Application September 22, 1942, Serial No. 459,251

7 Claims. (Cl. 18—8)

This invention relates to artificial filaments, yarns or strands, and it has particular relation to a process and apparatus designed to produce filaments of tapered form.

One object of the invention is to provide an improved process of tapering an artificial filament as it is formed so as to include a series of successive tapered sections.

Another object of the invention is to provide a tapered artificial filament by an improved extrusion process in the operation of which the filament is extruded at a substantially constant speed.

Another object of the invention is to provide an improved apparatus for manufacturing filaments having tapered sections.

In the manufacture of artificial filaments composed of organic plastics, it is desirable under certain conditions to vary the filament size at regular or irregular intervals in order to produce goods having desired characteristics. Filaments of varying denier, or composed of sections successively tapered, can be formed into yarns either alone or twisted in multiple relation with threads or other artificial filaments or natural filaments or fibers. The filament structure can also be cut along its length at the termination of each tapered portion which is of any length desired. The cut sections can be employed in the manufacture of bristles for brushes or like structures.

Filaments of the type referred to can be formed of organic plastics, such as cellulose acetate, cellulose nitrate or other cellulosic derivatives, for example, 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, or artificial or natural resin, such as vinyl acetal, nylon, etc. The processes and structures herein described are applicable 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 regenerated cellulose, such as that obtained by appropriate regeneration of viscose, cuprammonium, or nitrocellulose silk.

In the drawings:

Fig. 1 is substantially a plan of an apparatus illustrating the principles of the invention and with portions shown in cross section; Fig. 2 is an end elevation of principal parts of the apparatus; Fig. 3 is a side elevation of portions of the structure shown in Fig. 2; Fig. 4 is a fragmentary elevation of a cam arrangement included

in the apparatus; Fig. 5 is a fragmentary elevation of another form of cam arrangement; Fig. 6 is a diagrammatic elevation of one type of filament produced by the apparatus; Fig. 7 is a diagrammatic plan of another type of filament produced by the apparatus; Fig. 8 is a fragmentary elevation of a synthetic bristle of another form; Fig. 9 is a fragmentary elevation of a filament having a fiber core; and Fig. 10 is a diagrammatic elevation of extruding and collecting mechanism.

In practicing the invention, there is provided a motor 10 connected by means of conventional gearing, such as pulleys 11 and belt 12, in driving relation with a horizontal shaft 15 that is mounted in bearings 16 in a frame 20. An end portion of the shaft has a cone pulley 21 rigidly mounted thereon and a belt 23 trained about this pulley is also trained about a companion cone pulley 24 which is rigidly mounted upon a second shaft 25. Suitable bearings 26 carry the shaft 25 horizontally upon the frame 20.

A belt shifter 28 of conventional form is mounted upon the frame 20 and includes a bar 29 slidably mounted in guides 30 that are secured upon the frame. The belt 23 travels between rollers 31 that are mounted in spaced relation upon an end portion of the bar 29 and a handle 34 pivoted, as indicated at 36 upon the frame has a pivotal connection 38 secured to the bar 29 for operating the latter. An adjusting lever 39 mounted upon the handle 34 engages in notches 40 of a segmental plate 41 on the frame to hold the belt shifter in adjusted position. By manipulating the handle, the belt 23 can be shifted to change the speed of the shaft 25 faster or slower than the speed of the shaft 15. It is possible that the change in speed can be effected during the operation of the apparatus. However, satisfactory results have been attained by pre-adjusting the speed as desired for particular purposes. It is to be understood that the variable speed arrangement shown in connection with the cone pulleys is merely illustrative and that various other types of gears, sprockets, chains, etc. employed in variable speed mechanism can be adapted for the same purposes as those for which the apparatus referred to was designed.

The outer end of the shaft 25 has a gear 42 rigidly mounted thereon for engagement with a similar gear 43 that is rigidly mounted upon the outer end of an axial shaft 45 of a screw pump 50. This pump includes a fluid-tight casing 51 in which a screw or propeller 52 is fitted. The casing communicates by means of an inlet conduit 54 with a supply tank 56 containing a spin-

ning solution 58 of organic plastic which is preferably located above the pump in order that the solution may flow by gravity into the pump casing.

An outlet conduit 60 leading from the pump 50 is provided with a filter 61 and at its outer end with a spinnerette 62 having openings 63 through which filaments 64 can be extruded in response to the operation of the pump. The filament structure can be composed of one or more strands. A by-pass conduit 65 connected to the outlet 60 is also connected to the inlet 54 for by-passing a portion of the solution back into the pump casing. An intermediate portion of the by-pass conduit 65 is provided with a gate valve 68 having an upright stem 69 pivotally connected, as indicated at 70, to a lever 71. The pivotal connection 70 includes a slotted portion 72 to provide for play in the relative movement of the parts involved. An intermediate portion of the lever 71 is pivoted, as indicated at 74, upon a bracket 75 that is rigidly mounted upon the frame 20. One end of the lever 71 opposite the connection to the valve stem 69 is provided with a roller 76 which is constantly pressed in contact with a cam 78 carried rigidly upon the shaft 15. The other end of the lever adjacent the valve stem is connected, as indicated at 79, to one end of a tension spring 80 and the other end of this spring has a connection 81 securing it to the by-pass conduit 65. The action of the spring is such as to maintain the roller 76 at all times pressing against the surface of the cam 78.

The gate valve 68 operates in response to the rotation of the cam 78 to vary periodically the volume of spinning solution passing through the spinnerette, and hence, also to vary the pressure in the solution passing through the outlet conduit 60. Depending upon the shape of the cam, the pressure can be gradually increased and suddenly relieved to produce a filament approximating the shape of that illustrated in Fig. 6, or by substituting a cam 85 (Fig. 5) for the cam 78, a filament of another contour can be produced as illustrated in Fig. 7. It will be noted that the cam 85 is circular and is mounted eccentrically upon the shaft 15.

A vibrating mechanism 90 which is mounted in conjunction with the spinnerette and outlet conduit 60 consists of a strip of resilient metal 91 connected rigidly to a collar 93 that is secured upon the lower portion of the conduit 60. The resilient strip 91 has a lower horizontal section 94, a vertical section 95 and an upper horizontal section 96, the latter of which is secured by means of a set screw 98 upon an upright arm 99 of a bell crank 100. A pivotal connection 101 supports the bell crank upon an extension 102 of the apparatus frame 20, and a laterally extending arm 104 of the bell crank is provided with a set screw 105 which is adapted to be screwed down against the upper surface of the extension 102 for the purpose of tilting the bell crank and thereby regulating and springing the strip 91.

The outer end of the upper horizontal section 96 of the resilient strip bears against a vibrator, such as a gear wheel 107, or other notched rotatable element similar to a wheel. This wheel is rigidly mounted upon a rotatably driven shaft 108 which is supported in suitable bearings 110 carried upon the frame extension 102. By manipulating the set screw 105, the resilient strip 91 can be sprung against the wheel 107 under such pressure as desired. The intensity of vibration of the strip can thus be varied. This vibration is transmitted to the spinnerette 62 and causes small ribs 112 to

be formed circumferentially upon the extruded filaments, as indicated diagrammatically in Fig. 8. It is to be understood that the apparatus can be operated with or without the vibrating mechanism and it is only necessary to manipulate the set screw 105 until the upper strip section 96 is out of contact with the wheel 107 to discontinue its influence upon the spinnerette. It is also to be noted that the vibrations occur substantially lengthwise of the filaments as they are being extruded.

As shown diagrammatically in Fig. 10, the filament structure after extrusion through the spinnerette 62 passes around a guide roll 115 disposed in a tank 116 and thence successively around driven collector rolls 117 which are driven at a constant peripheral speed. The tank 116 contains a setting bath 118 for the filaments and the latter are drawn from the spinnerette under tension although at constant speed by the collector rolls 117. While the pressure in the outlet conduit 60 periodically increases and decreases, according to the intervals at which the gate valve 68 is operated to vary the amount of spinning solution to be by-passed to the inlet conduit, the rate of supplying spinning solution from the pump nevertheless continues to be substantially constant.

If desired, the filaments 60 can be of composite structure in which a core or fiber 120 is included. Fibers of cotton, silk, or the like, can be employed for this purpose. Strands of the fiber 120 are drawn through the rear portions of the spinnerette from suitable supply spools 121 through openings 123 which are substantially the same size as the fibers to prevent leakage of the spinning solution. The passage of the fibers through these openings also tends to prevent leakage tending to occur against the direction of movement of these fibers. The openings in the spinnerette are larger than the fibers and as the latter pass through these openings, they are coated with the spinning solution. The finished filament with the fiber core therein has substantially the same tapered shape as that imparted to the filaments without the fiber. The purpose of the fibers is to provide a substantial feathering at the smaller tapered end of the finished filament, especially when it is to be employed as a synthetic bristle for brushes. There is thus provided an improved painting or brush action in the brushes made from the synthetic bristles. The apparatus is operable with or without the inclusion of the fiber strands by closing the end of the spinnerette through which the fibers enter, or by substituting a conventional spinnerette, such as that shown in my copending application, Serial No. 459,252, filed September 22, 1942.

Although processes and structures illustrative of the invention have been shown and described in detail, it will be apparent to those skilled in the art that the invention is not so limited, but that various changes can be made therein without departing from the spirit of the invention or from the scope of the appended claims.

I claim:

1. A process for the production of artificial filaments from a spinning solution of organic plastic, the steps which comprise supplying spinning solution at a constant rate from a pressure source, extruding the filaments under pressure from said source through a spinnerette, withdrawing the extruded filaments from the spinnerette at substantially constant speed, by-passing a portion of the solution from a point between the source of

pressure and the spinnerette to be resupplied from the pressure source, and periodically varying the volume of solution by-passed back to the source of pressure.

2. An apparatus for the production of artificial filaments comprising a spinnerette, a pump having an intake and an outlet for supplying from the outlet a spinning solution to the spinnerette, a by-pass conduit connecting the outlet to the inlet for returning a portion of the spinning solution back to the pump inlet in response to pumping action of the pump through its outlet and before such solution reaches the spinnerette, a valve in the by-pass conduit, and means to operate the valve at predetermined intervals during the operation of the pump whereby the amount of spinning solution supplied to the spinnerette is varied.

3. An apparatus for the production of artificial filaments comprising a spinnerette, a pump having an inlet and an outlet for supplying from the outlet a spinning solution to the spinnerette, a driven transmission for operating the pump, a by-pass conduit connecting the outlet to the inlet for returning a portion of the spinning solution back to the pump inlet in response to pumping action of the pump through its outlet and before such solution reaches the spinnerette, a valve in the by-pass conduit, a cam included in the transmission, and means operatively connecting the cam to the valve for operating the latter through continually changing positions in the by-pass conduit.

4. A process for the production of an artificial filament from a spinning solution of organic plastic, the steps which comprise supplying the spinning solution to a spinnerette from a pressure source that feeds the solution at a constant pressure, extruding a filament through the spinnerette in response to the pressure, by-passing a portion of the solution from a point between the source of pressure and the spinnerette back to be resupplied from said pressure source, periodically varying the volume of solution by-passed back to the source of pressure, vibrating the spinnerette while the filament is being extruded, and collecting the extruded filaments at a constant rate.

5. In a process for the production of artificial filaments from a spinning solution of organic plastic, the steps which comprise pumping the

spinning solution through an outlet at a constant rate, extruding under pressure of the pumping action the filaments through a spinnerette capable of extruding only a fraction of the pumped solution, by-passing under force of the pumping action the remainder of the pumped solution back to the source of pumping to be repumped through the outlet, restricting in progressively increasing and decreasing degrees the passage of the by-passed solution back to the source of pumping to vary the extruding pressure at the spinnerette thereby recurrently forming gradually tapered sections in the extruded filaments, and drawing the extruded filaments away from the spinnerette.

6. In a process for the production of artificial filaments from a spinning solution of organic plastic, the steps which comprise pumping the spinning solution through an outlet at a constant rate, extruding under pressure of the pumping action a filament through a spinnerette capable of extruding only a fraction of the pumped solution, by-passing under force of said pumping action the remainder of the pumped solution back to the source of pumping to be repumped through the outlet, restricting in progressively varying degrees the passage of the by-passed solution back to the source of pumping to gradually taper the extruded filament, vibrating the spinnerette in substantially the direction of extrusion therethrough thereby imparting multiple ribs circumferentially of the tapered portions of the filament.

7. An apparatus for the production of artificial filaments comprising a spinnerette, a pump having an inlet and an outlet for supplying the spinning solution from the outlet to the spinnerette, a by-pass conduit connecting the outlet to the inlet for returning a portion of the pumped spinning solution back to the pump inlet in response to the action of the pump before such solution reaches the spinnerette, a valve operable in the bypass conduit at gradually recurring intervals to vary the amount of spinning solution supplied to the spinnerette and thus successively tapering sections of the extruded filament, means for operating said valve at the gradually recurring intervals, and vibrating mechanism connected to the spinnerette to impart multiple ribs to the filaments along each tapered section thereof.

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