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E. F. WESP

2,273,240

PRODUCTION OF YARN

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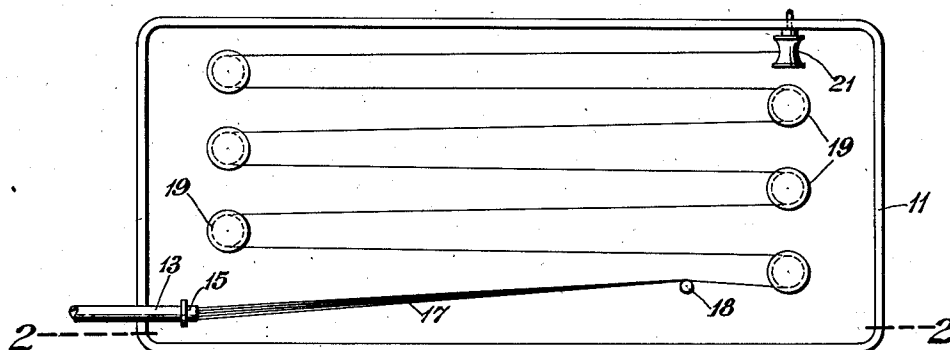


Fig.1

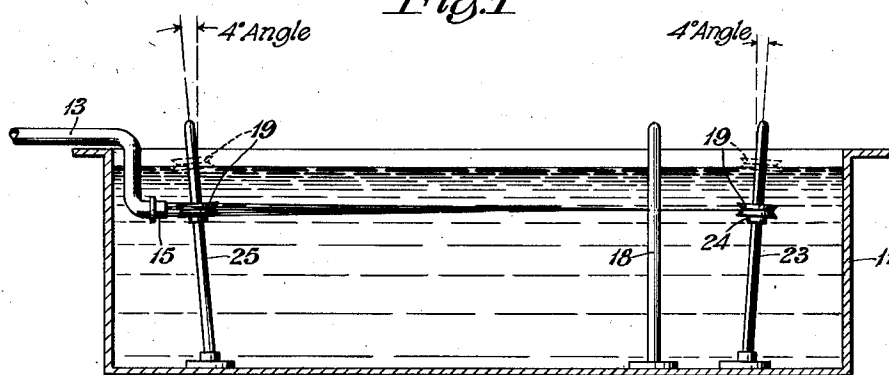


Fig. 2

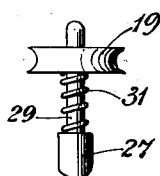


Fig. 3

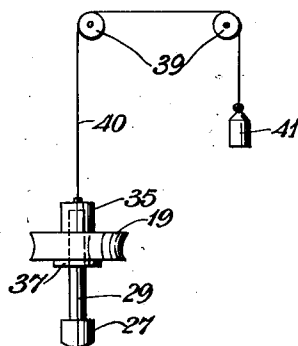


Fig. 4

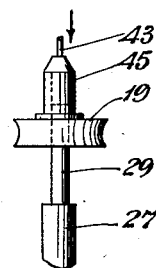


Fig. 5

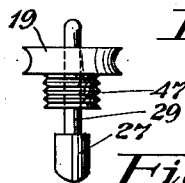


Fig. 6

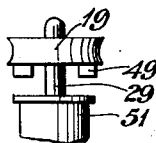


Fig. 7

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2,273,240

PRODUCTION OF YARN

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9 Claims. (Cl. 18—8)

The present invention relates to the production of yarn or thread comprising artificial filaments, and more particularly, it relates to a new and improved method and apparatus for the tension spinning of such yarn from filament-forming compositions in a coagulating and/or regenerating bath.

Heretofore, regenerated cellulose yarn or thread has been tension spun from a viscose solution in a coagulating and regenerating bath containing a plurality of thread-driven roller guides positioned on upwardly extending axles. The use of such thread-driven roller guides in a coagulating and regenerating bath permits the imposition of a gradually increasing tension on the yarn which serves to produce a yarn of good strength and satisfactory elongation. The patent to Banigan No. 1,878,455 discloses apparatus for tensioning yarn in a coagulating bath which comprises a plurality of thread-driven roller guides arranged on upwardly extending axles to operate at or near the surface of the coagulating bath.

When the yarns are subjected to a long coagulating bath travel with the use of a plurality of tensioning roller guides, the spinning of the yarns requires an excessively large area of coagulating bath surface. However, to effect economies in the production of artificial yarn it is desirable to reduce this required area so that a bath trough of a given size may serve a greater number of spinning positions with a resultant lower cost of equipment per spinning position. This reduction in area can be accomplished by reducing the diameter of the roller guides and also the space between them. However, when the diameter of the roller guides is decreased, it is found that unless the speed of the yarn passing through the bath and around the guides is also greatly reduced, the roller guides are caused, by the yarn passing around them, to rotate at a speed that is sufficiently high to cause cavitation of the bath above the upper surfaces of the guides. In such a case, the bath does not contact the upper surfaces of the guides and hence, the total drag imposed on the guides by the bath is less than in a case wherein cavitation does not occur. As a result of this lessened drag effect, the roller guides impose a lower tension on the yarn passing over them.

The effect of cavitation cannot be lightly dismissed because the lower tension which the guide imposes on the yarn results in an increase in the number of roller guides required and therewith the bath area. Further, because the occurrence

and effect of cavitation is uncertain and variable, it is impossible under these conditions to maintain a constant and uniform tension on the yarn from position to position and from time to time for any given position.

To avoid cavitation and still use the smaller diameter roller guides and to maintain a normal yarn speed, it is necessary to so position the guides in the bath that their upper surfaces are always at least a given distance below the level of the bath. This critical distance is dependent upon several factors, including the speed of rotation of the roller guides, their diameters, and the viscosity of the bath. Hence, it is desirable to operate the roller guides at such a distance under the bath surface that no cavitation will take place under any conditions met with in normal operating practice.

An arrangement which will satisfy the above desired ends can be obtained by employing roller guides which have a specific gravity higher than that of the bath and which can be supported at any desired level under the bath surface. However, the operation of such an arrangement on a large scale wherein numerous individual spinning positions are crowded closely together presents many practical difficulties, chief among which is the increased difficulty in threading up the guides at the start of the spinning operation. The fact that the roller guides are totally submerged, combined with the very little space existing between them, makes a smooth motion of the spinner's hand as he guides the yarn around each of the roller guides almost impossible. This smooth motion is necessary to keep the yarn tight around the guides because if the yarn becomes loose, as occurs when the spinner hesitates in drawing it from the spinneret, the yarn will float up out of the submerged guide and foul around the roller guide post at the bath surface.

It is, therefore, an object of the present invention to provide an improved method and apparatus for the tension spinning of yarn in a coagulating bath.

It is another object of the present invention to provide a method and apparatus for the tension spinning of yarn in a coagulating bath which will advantageously permit a reduction in size of the bath surface to be used in a given spinning position.

Other objects of the invention will appear hereinafter.

The objects of the invention may be accomplished by positioning in a coagulating and/or regenerating bath, a plurality of small diameter,

yarn-driven, tensioning rollers which will lie approximately at the surface of the bath when not used to conduct a yarn through the bath, and providing the rollers with cooperating means to submerge the same to a sufficient depth to avoid their causing a cavitation of the bath when the rollers are used to conduct a yarn through the bath.

The present invention is applicable to any process which involves the spinning of a thread or yarn under tension or the wet stretching of a yarn while passing the same through a bath liquid, but for simplicity and convenience, the invention will be more fully described hereinafter by reference to the spinning of regenerated cellulose yarn by the viscose process.

The details of the invention will be more clearly apparent by reference to the following description when taken in connection with the accompanying illustrations, in which:

Figure 1 is a plan view of a spinning bath provided with yarn-driven tensioning rollers arranged in accordance with the present invention.

Figure 2 is a side elevational view taken along the line 2—2 of Figure 1 and showing the bath tank in section.

Figure 3 is a side elevational view showing a specific construction of thread-driven roller guide in accordance with this invention.

Figures 4, 5, 6, and 7 are side elevational views showing modified forms of thread-driven roller guides.

Referring to Figures 1 and 2 of the drawing, reference numeral 11 designates a bath tank which may contain a coagulating and/or regenerating bath. The filament-forming solution is passed into the coagulating bath by means of conduit 13 which is provided at the end thereof with a spinneret 15. A filament-forming solution is extruded through spinneret 15 to form a multi-filament yarn 17. The yarn 17 is passed about a convergence guide 18 and thence about a plurality of thread-driven tensioning rollers 19. The yarn is finally passed about a guide roller 21 from which it is passed out of the coagulating bath on to a collecting bobbin or the like (not shown). The tensioning rollers 19 are constructed of a material having a slightly lower specific gravity than the bath solution so that they will float at the bath surface when no yarn is being passed about the same. The various tensioning rollers 19 are mounted on axles located on opposite ends of the tank 11. The yarn is passed about the rollers, in series, from end to end of the tank as shown in Figure 1. The axles 23 along one end of the tank and the axles 25 at the other end of the tank are connected to the bottom of the tank so that they will project upwardly in diverging relationship to each other as illustrated in Figure 2 of the drawing. The angle of divergence of each of the axles as illustrated is 4°.

When the yarn is passed about the various yarn-driven tensioning rollers in a spinning operation, the tension imparted to the yarn by the collecting device will cause the tensioning rollers to revolve about their axles and will cause the rollers to be drawn downwardly into the bath liquid due to the downwardly directed component of force resulting from the angle of inclination of the several axles. If desired, jacks or stops 24 may be provided on the various axles to prevent the rollers from being submerged too deeply in the bath liquid.

Referring to Figure 3 of the drawing, the tensioning roller 19 is constructed of a material

which has a higher specific gravity than the bath liquid and is held at the surface of the bath by means of a very light coil spring 31 positioned around the stub shaft 29 at the upper end of the rod 27. The spring 31 will be sufficiently fine that the roller 19 will be barely held at the top surface of the bath. The rod 27 will be inclined in the manner shown in Figure 2 of the drawing. As a consequence, the rotation of roller 19 by the movement of the yarn will cause the roller to be submerged in the bath in the same manner as above described with reference to Figures 1 and 2.

The modified form of roller illustrated in Figure 4 comprises the tensioning roller 19, an inclined rod 27, a stub shaft 29 and a hood 35 containing a supporting flange 37. The hood 35 will be positioned over the upwardly projecting end of stub shaft 29. A weight 41 will be connected by means of a cord 40 to the top of hood 35. The cord 40 is passed about pulleys 39 so that the weight 41 will impart a lifting action to the hood 35 and, in turn, to the roller 19. The weight 41 is of such a size as to barely maintain the hood and roller at the bath surface. In this case, as in Figure 3, the roller 19 is constructed of a material which has a higher specific gravity than the bath liquid. The rod 27 will be inclined to the vertical in the same manner as above disclosed with reference to Figure 2, so that the tension of the yarn on the roller 19 will cause the same to be submerged together with the hood 35.

Figure 5 illustrates a thread-driven tensioning roller 19 having in combination therewith a submerging cylinder 45. The cylinder 45 is provided with a stem 43 which, in turn, is connected with any desired mechanism for forcing the same downwardly into the bath liquid. The cylinder 45 passes over the top of stub shaft 29 and is adapted to slide downwardly on the said shaft, thereby forcing roller 19 downwardly into the bath.

Figure 6 illustrates a thread-driven tensioning roller 19 having connected thereto a threaded projection 47. The threaded projection 47 is positioned at the bottom surface of the roller. The direction and pitch of the thread is such that a rotation of the roller 19 by the yarn will cause the threaded projection 47 to turn into the bath and thereby impart a downward component of force on the roller, thereby submerging the same.

Referring to Figure 7 of the drawing, the tensioning roller 19 is provided with vanes 49 on the lower side thereof. The stub shaft 29 is positioned on the plate 51. The plate 51 is slightly below the position of the vanes 49 when the roller is floating at the top surface of the bath. A rotation of roller 19 will cause the formation of a reduction in pressure between the bottom side of the roller and the plate 51 thereby causing the roller 19 to be submerged.

The various elements of the above-described mechanisms will preferably be made of a material which will withstand the corrosive action of a coagulating and/or regenerating bath in which they may be positioned. The axles, or the roller guides, may, for example, be made of glass, lead, rubber, Bakelite, plastic compositions, corrosion-resistant steel or the like.

In all of the above-described devices, it is specified that the thread-driven tensioning rollers be positioned substantially at the surface of the bath when the yarn is not in contact therewith. This is desirable to afford the spinning operator the benefit of floating roller guides during the pe-

riod of stringing-up of the yarn. The operator thus is enabled to guide the yarn easily around the several tensioning rollers which become submerged to the desired depth as soon as the tension of the yarn has reached its normal operating value. Furthermore, if the smooth motion of the operator's hand is impeded and the yarn becomes loose, it will not pull out of the guide because the guide immediately rises to the surface of the bath along with the yarn.

It has been found that when using tensioning rolls which cause a bath cavitation, the guides must be submerged to a distance of at least $\frac{1}{8}$ of an inch below the bath surface to avoid such cavitation. When using tensioning rollers of about 1 inch in diameter and having a yarn speed in the bath of about 3500 inches per minute, the bath cavitation will be avoided if the tensioning rollers are submerged during the normal spinning operation to a distance of about $\frac{3}{8}$ of an inch or more below the surface of the bath. Since the surface of the bath may vary, it is advisable to have these roller guides operate at about $\frac{3}{8}$ of an inch or more below the bath level. It is to be understood, of course, that with different sized guides and different spinning conditions, the depth at which cavitation will cease will vary, but this depth can be readily determined for any given set-up and a desirable operating depth selected. In order to secure the benefits of this invention, it is only necessary to have the rollers submerged sufficiently to avoid cavitation.

While the support axle for the roller is tilted 4°, in the specific set-up described above, it may need to be varied considerably from this angle when other spinning conditions are used. The angle of tilt is limited on the one hand by the smallest angle from the vertical at which a floating roller guide will ride down a slanting post support as the result of the downward component of the total force exerted by the yarn on the roller guide, which downward component must be slightly greater than the opposing upward force exerted by the buoyancy of the roller. The angle of tilt is limited on the other hand by the largest angle from the vertical which will permit a roller guide to float to the surface of the bath when not in active operation. This is determined by the shape and size of the roller guide and by the amount of tension applied. Thus, by varying the specific gravity of the bath or of the guides, by changing the submergence of the spinneret, by varying the tension on the yarn, for instance, by using vaned roller guides, by changing the speed of spinning, innumerable angles for the optimum tilt of the guide post support will be found. In general, however, the optimum angle will occur between 1° and 35° for spinning conditions normally encountered.

Many modified forms of devices other than the ones specifically described above may be used to accomplish the purpose and object of the present invention. In accordance with the present invention it is only necessary that the tensioning roller be positioned substantially at the bath surface until the yarn has been passed about the same and that the tensioning rollers then be submerged a sufficient distance below the bath surface to avoid bath cavitation. Mechanisms may be used, for example, which comprise a combination of the devices shown in Figures 1 to 4 with devices as shown in Figures 5, 6, and 7. Thus, a guide may be properly positioned in the

bath as a result of the forces imposed upon it by the combination of the spring of Figure 3 or the counterweight of Figure 4 and the plunger of Figure 5 or the threaded projection of Figure 6 or vane and plate mechanism of Figure 7.

This invention is extremely advantageous for use in the spinning of artificial yarns, or in the liquid after-treatment of yarns or threads of artificial or natural origin, as in a wet-stretching operation, wherein a long bath travel with a gradual application of tension is desired, and especially in those cases where the area of the spinning or treating bath is limited.

The invention facilitates such a spinning or treating of yarns or threads by providing on the one hand for the easy stringing-up of the yarn in the bath and on the other hand for the most ideal conditions for the actual spinning or treating operation. The fact that the guides are submerged when in active use, prevents cavitation of the bath surface above the guides, and thus assures that the yarn is subjected to a uniform tension during the spinning or treatment operation. Furthermore, the absence of cavitation insures against any splashing of the coagulating bath, which splashing is an important safety hazard.

The invention further provides a means of automatically adjusting the depth to which a guide will descend below the surface of the bath for any set of spinning conditions, including the tension of the yarn, the speed of the yarn, the condition of the bath, etc. The fact that a change in any one of these factors will alter the position of the guide in the bath provides an easy method of checking the spinning operation.

As a still further advantage, inasmuch as it is not necessary that the tilt of all the axles of any given spinning position be the same, and since, other conditions being constant, the depth to which a guide will descend in the bath depends on the tilt of the axle on which the guide is mounted, the invention provides a means of operating each of a series of guides at a separate and distinct level in the bath. The passage, thus made possible, of the yarn through different levels of the bath permits a more effective use of the bath in the spinning or treating of yarn, since all portions of the bath are thus used. Or, the same, more effective use of the bath may be obtained by so tilting the axles that all of the guides of a single spinning position operate at a single level in the bath, this level, however, being different for each spinning position using the same bath, so that here, too, all levels of the bath will be used.

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

I claim:

1. In a process for the tension spinning of yarn in a liquid bath having a substantially constant bath surface, the steps comprising forming a yarn in said bath, threading the said yarn about a plurality of yarn-driven tensioning rollers while the latter are positioned at the bath surface, and then moving said rollers below the bath surface a sufficient distance to prevent bath cavitation by said rollers.

2. In a process for the tension spinning of yarn in a liquid bath having a substantially constant bath surface, the steps comprising forming a yarn in said bath, threading the said yarn about a plurality of yarn-driven tensioning rollers while the latter are positioned at the bath surface, and then moving said rollers below the bath surface a distance of at least $\frac{1}{8}$ of an inch below the bath surface to prevent bath cavitation by said rollers.

3. In an apparatus for the tension spinning of yarn in a liquid bath, a plurality of upwardly extending axles in said bath, a plurality of yarn-driven tensioning rollers mounted on said upwardly extending axles in said bath, said rollers being freely movable axially of said axles, means for maintaining said rollers at the surface of the bath when the yarn has no contact therewith, and means coacting with said rollers to submerge the same below the bath surface upon driving the rollers by means of a yarn.

4. In an apparatus for the tension spinning of yarn in a liquid bath, a plurality of upwardly extending axles in said bath, a plurality of yarn-driven tensioning rollers mounted on said upwardly extending axles in said bath, said rollers being freely movable axially of said axles, means for maintaining said rollers at the surface of the bath when the yarn has no contact therewith, said axles and rollers cooperating with each other to submerge the rollers below the bath surface upon driving the rollers by means of a yarn.

5. In an apparatus for the tension spinning of yarn in a liquid bath, a plurality of upwardly extending axles in said bath, a plurality of yarn-driven tensioning rollers mounted on said upwardly extending axles in said bath, said rollers being freely movable axially of said axles, means for maintaining said rollers at the surface of the bath when the yarn has no contact therewith, said axles positioned at such an angle from the vertical that a pull by a yarn positioned on said rollers will submerge the rollers below the bath surface.

6. In an apparatus for the tension spinning of yarn in a liquid bath, a plurality of upwardly extending axles in said bath, a plurality of yarn-driven tensioning rollers mounted on said upwardly extending axles in said bath, said rollers being freely movable axially of said axles, means for maintaining said rollers at the surface of the bath when the yarn has no contact therewith, said axles projecting from the bottom of the bath, at a sufficiently large angle to the vertical away from the direction of the yarn pull thereon to submerge rollers when the latter are driven by the yarn.

7. In an apparatus for the tension spinning of yarn in a liquid bath, a plurality of upwardly extending axles in said bath, a plurality of yarn-driven tensioning rollers on said axles, means for maintaining said rollers at the surface of the bath when the yarn has no contact therewith, means for submerging said rollers upon rotation of the rollers by the yarn.

8. In an apparatus for the tension spinning of yarn in a liquid bath, a plurality of upwardly extending axles in said bath, a plurality of yarn-driven tensioning rollers on said axles, means for maintaining said rollers at the surface of the bath when the yarn has no contact therewith, screw threaded extension means on said rollers, said extension means projecting into said bath and adapted, upon rotation of the rollers by the yarn to cause the rollers to submerge below the bath surface.

9. In an apparatus for the tension spinning of yarn in a liquid bath, a plurality of upwardly extending axles in said bath, a plurality of yarn-driven tensioning rollers on said axles, means for maintaining said rollers at the surface of the bath when the yarn has no contact therewith, vane projection means on said rollers, said extension means projecting into said bath and adapted, upon rotation of the rollers by the yarn to cause the rollers to submerge below the bath surface.

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