Dec. 6, 1938. G. M. KARNS 2,139,449

METHOD AND APPARATUS FOR PRODUCING ARTIFICIAL THREAD

Filed June 3, 1936 4 Sheets-Sheet 1

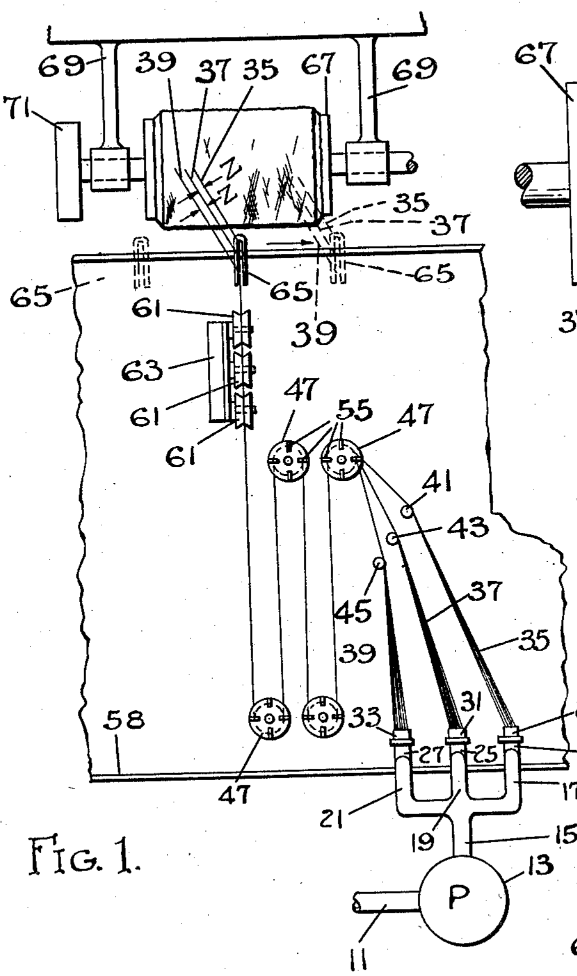
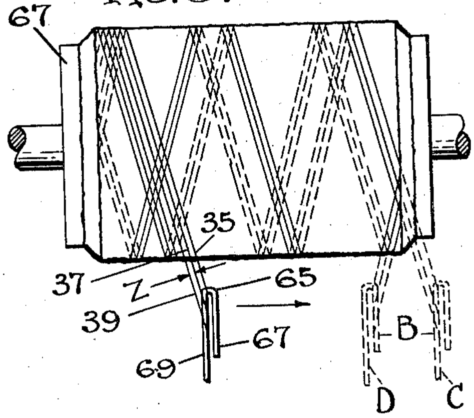


FIG. 1.

FIG. 3.



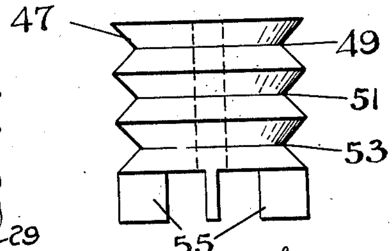


FIG. 4.

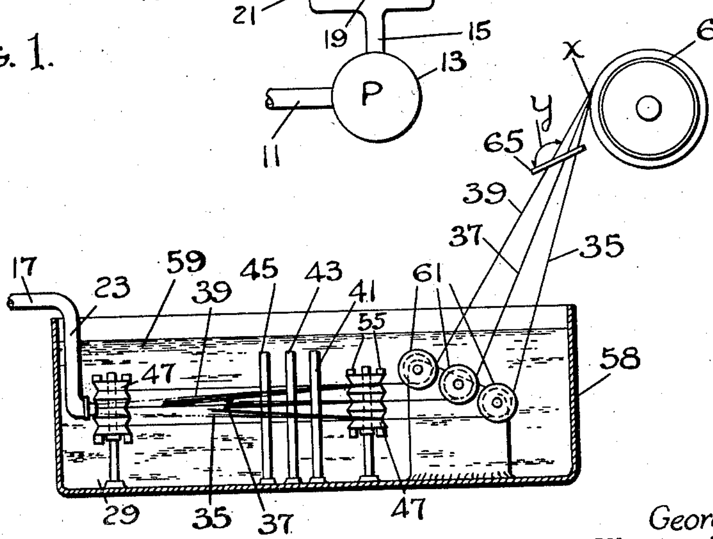


FIG. 2.

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METHOD AND APPARATUS FOR PRODUCING ARTIFICIAL THREAD

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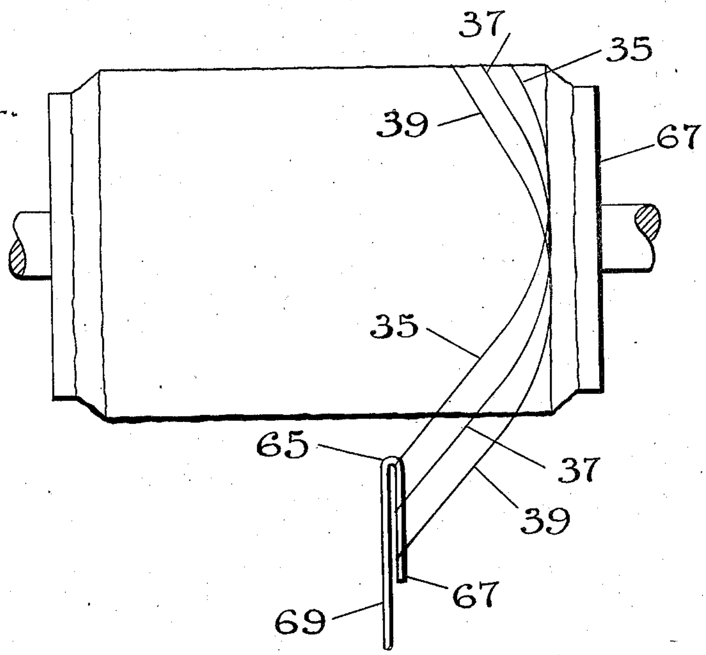
FIG. 3A.



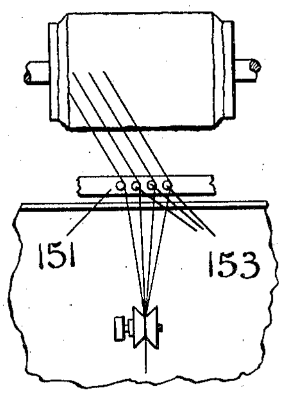


FIG. 10.

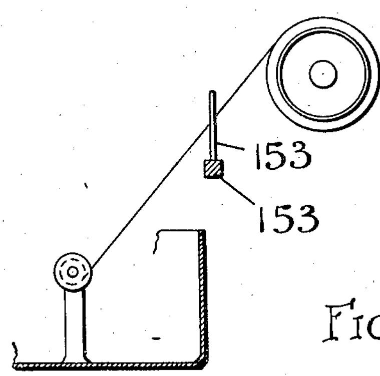


FIG. 11

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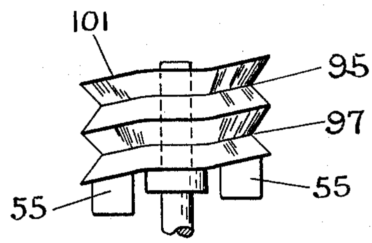
FIG. 5.



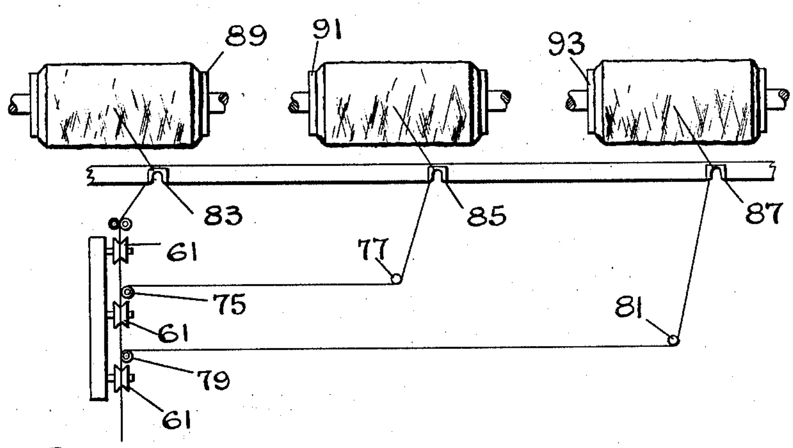


FIG. 6.

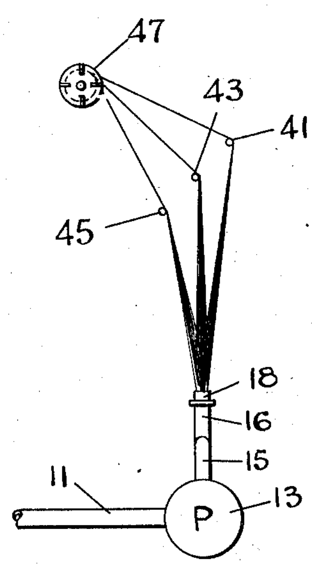


FIG. 7.

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METHOD AND APPARATUS FOR PRODUCING ARTIFICIAL THREAD

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FIG. 8.

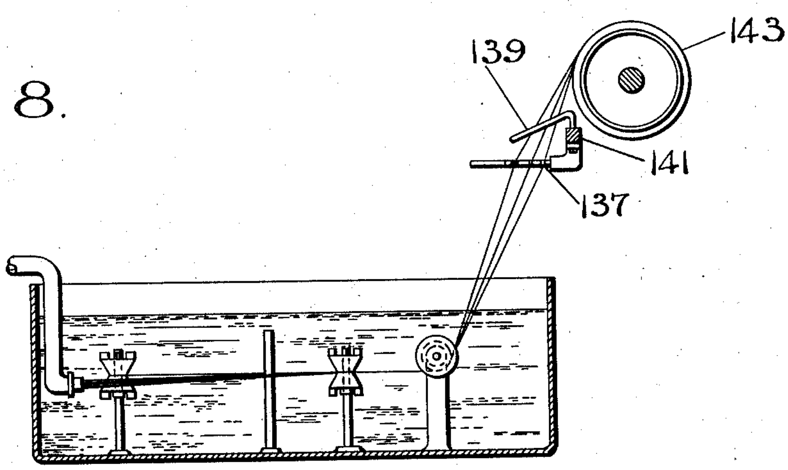
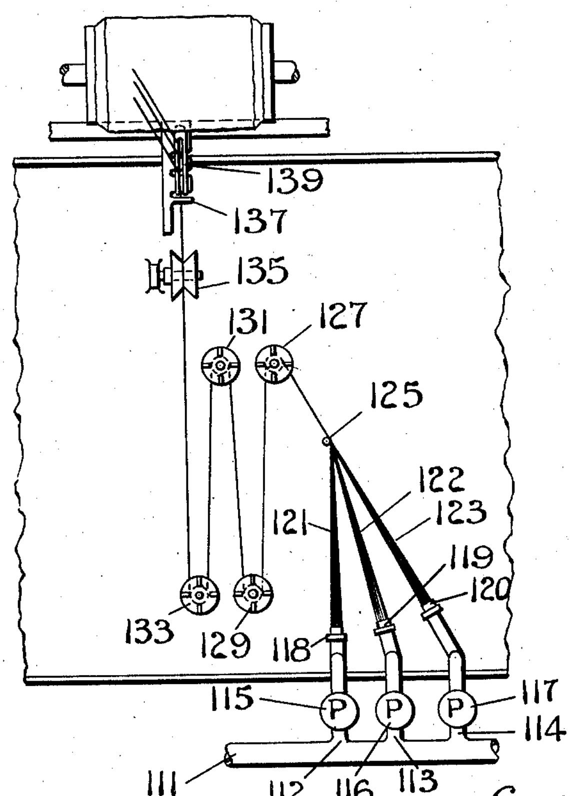


FIG. 9.



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Patented Dec. 6, 1938

2,139,449

UNITED STATES PATENT OFFICE

2,139,449

METHOD AND APPARATUS FOR PRODUCING ARTIFICIAL THREAD

George M. Karns, Kenmore, N. Y., assignor, by mesne assignments, to E. I. du Pont de Nemours & Company, Wilmington, Del., a corporation of Delaware

Application June 3, 1936, Serial No. 83,323

14 Claims. (Cl. 18—8)

This invention relates to the manufacture of continuous filament thread and more particularly it relates to a process of simultaneously spinning, tensioning and also preferably winding a plurality of continuous filament, artificial silk threads by the use of unitary tensioning and winding apparatus. In its specific aspects, the invention has particular utility in the production of fine denier artificial silk thread.

The invention will be described with particular reference to the manufacture of regenerated cellulose thread from viscose, however the invention is equally applicable to the production of all kinds and types of continuous filament artificial silk threads which are subjected to tension during the spinning thereof.

The production of continuous filament threads having uniform high tenacity, uniform elongation and uniform good affinity for dye stuffs involves the use of considerable equipment for each thread during its passage between the spinneret through which the spinning solution is extruded and the bobbin on which the freshly formed thread is collected. This is particularly true in apparatus provided with roller guides or the like, which will impart a stretch to a freshly formed thread without any substantial sliding friction. Each thread, in such case, will be provided with its individual series of roller guides and a bath tank of large area in which each thread requires its own area of bath travel. Furthermore, each thread must be provided with its individual guiding mechanism for traversing the thread as it is being wound onto the collecting bobbin.

Continuous filament thread of fine denier, such as 25 to 50 denier, and having a comparatively high tenacity, such as 2.5 grams per denier or greater, has many desirable characteristics which render it admirably suitable for certain uses, for example, for the production of transparent velvet and sheer underwear. Continuous filament fine denier thread having a suitably high tenacity has never been considered of great commercial importance heretofore due to its high cost and difficulty of production.

The production of continuous filament fine denier thread having a suitably high tenacity, by prior known methods, comprises the same expensive procedure above referred to, namely it requires the use of individual series of roller guides, bath tanks of large areas and individual traversing guides for the winding of the threads. Consequently, the poundage of thread produced with comparatively expensive equipment is extremely low. Furthermore, the use of a plurality of roller guides to provide the desired long bath travel results in imparting too much tension to the threads. Threads of 100 denier or more are not subjected to nearly so high a tension in grams per denier as are fine denier threads (25 to 50 denier) under similar condition because the load is distributed over larger or a larger number of filaments. Therefore, it has been necessary, heretofore, to pass fine denier threads about a smaller number of roller guides and to materially reduce length of bath travel to prevent material degradation thereof. In either case the thread produced will be of inferior quality.

It has now been found that high quality, fine denier threads can be produced by passing a plurality of threads about a single series of roller guides whereby to cause said threads to collectively propel said series of roller guides thus to collectively share the burden and benefits presented by the process. The burden of turning the rollers is uniformly distributed among the several threads and a long bath travel is possible without over-tensioning any of the threads.

It is therefore an object of the present invention to provide a method of increasing the production of artificial silk thread.

It is another object of this invention to provide a method for increasing the production and preventing the over-tensioning of high tenacity fine denier artificial silk thread.

It is another object of this invention to provide means for the production of a plurality of artificial silk threads on unitary tensioning and winding apparatus.

It is a still further object of this invention to provide means for the production of a plurality of high tenacity fine denier artificial silk threads on unitary tensioning and winding apparatus whereby to distribute the tension imparted by the apparatus jointly on the several threads.

Other objects of the invention will appear hereinafter.

The objects of the invention may be accomplished, in general, by simultaneously passing a plurality of freshly formed, partially set threads, particularly fine denier threads, as they issue from one or more spinnerets, around a single series of roller guides, and simultaneously winding said threads on one or more collecting bobbins.

In accordance with the preferred embodiment of the invention the production of high tenacity fine denier threads comprises passing each of a plurality of fine denier threads about individual, separated grooves of a single series of roller guides. In this manner the tension on the threads is borne collectively by the several threads, and consequently it is possible to pass the fine denier threads over the desired length of bath travel and about any desired number of roller guides without danger of placing an excess tension thereon.

The features of the invention and the benefits to be derived therefrom will be more clearly apparent by reference to the following detailed description taken in connection with the accompanying drawings, illustrating several specific embodiments of the invention.

In the drawings:

Figure 1 is a diagrammatic plan view of a spinning and winding apparatus constructed and arranged in accordance with the invention.

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

Figure 3 is an enlarged plan view of a collecting bobbin and the manner in which a plurality of threads would theoretically be wound thereabout.

Figure 3A is a plan view of a bobbin showing the manner in which the threads actually will be wound at the ends thereof.

Figure 4 is an enlarged elevational view showing a roller guide of the type suitable for use in the present invention.

Figure 5 is an enlarged view of a modified form of roller guide.

Figure 6 is a top plan view showing a modified form of winding apparatus suitable for use in the present invention.

Figure 7 is a modified form of spinning nozzle and thread guide arrangement suitable for use in the present invention.

Figure 8 is a side elevational view of a modified form of apparatus.

Figure 9 is a diagrammatic plan view of the apparatus shown in Figure 8.

Referring to the drawings reference numeral **11** designates a supply conduit of a cellulosic solution, such as viscose, and which is connected to metering pump **13**. The pump **13** forces the cellulosic solution through header conduit **15** and branch conduits **17**, **19** and **21**. The branch conduits **17**, **19** and **21** are provided with downwardly extending conduit lines **23**, **25** and **27** so that the ends thereof may be submerged below the surface of the coagulating bath **59** in the tank **58**. Each of the downwardly extending conduits **23**, **25** and **27** are provided with spinnerets **29**, **31** and **33** respectively. The cellulosic solution is extruded through the spinnerets to form threads **35**, **37** and **39**. The threads **35**, **37** and **39** are guided by means of stationary guides **41**, **43** and **45** respectively to the first of a series of roller guides **47**. The roller guides are all provided with a plurality of circumferential grooves **53**, **51** and **49** (see Figure 4). The individual threads are passed about the single series of roller guides **47**, four of which are shown in Figure 1, each of which roller guides is provided with a separate groove for each thread so that the individual threads may be maintained separate from the other threads throughout their travel in the coagulating both, and the tension under which the threads are placed by the guides in evenly divided among the several threads. In this manner a plurality of threads are coagulated and tensioned in a bath tank of small area in which the various threads are spaced vertically from each other in the same bath area. From the last roller guide **47** the threads are passed over individual roller guides **61**. The individual roller guides **61**, see Figure 2, are spaced from each other in such a manner that the threads **35**, **37** and **39** are spaced from each other a considerable distance at the points where they leave the said guides **61**. The individual thread guides **61** are positioned on stub-shafts connected to a frame **63** which is fixedly connected in any desired manner to the tank **58**. The spaced threads **35**, **37** and **39**, as viewed from Figure 2, converge at a point x where they contact the collecting bobbin **67**. A reciprocating thread guide **65** is positioned at an angle y to the thread so that the length of the individual threads from the reciprocating guide **65** to the bobbin **67** will be unequal in length.

Inasmuch as the length of the individual threads, **35**, **37** and **39**, between the reciprocating thread guide **65** and the bobbin **67** are unequal in length, the individual threads will contact the guide **65** at spaced points from each other and will be laid on the bobbin in parallel helixes which are spaced from each other a distance z which is determined by the difference in length of each thread between the guide **65** and the bobbin **67** and the angle of the helix. The reciprocating thread guide **65** is composed of two legs **67** and **69**, between which the threads are positioned. Leg **69** of the guide **65** will contact and guide the individual threads when the guide is traversing in the direction of the arrow shown in Figures 3, whereas leg **67** of the guide will contact the thread when the guide is being traversed in the opposite direction. Referring again to Figure 1 of the drawings, when the guide **65** is travelling to the right as shown by the arrow the threads will be laid on the bobbin in parallel helixes until they reach the position shown by the dotted line on the right hand side of the bobbin. At this position of the individual threads **35**, **37** and **39** the traversing guide **65** will be reversed to travel in the opposite direction and the individual threads will naturally and inherently cross themselves, since the thread **35** which defines the shortest distance between the guide **65** and the bobbin **67** will again lead the other two threads, **37** and **39**, when the three threads are being laid on the bobbin, and the traversing guide **65** is moving, in a direction opposite to the arrow.

Figure 3 shows the theoretical lay down of the threads if the reversal of the traverse guide were instantaneous and if the guide also moved the distance B instantaneously at the time of reversal. It is to be noted that thread **35** leads in both directions and at the time of reversal crosses threads **37** and **39** as shown. In actual practice, however, there is a small fraction of a second when the guide **65** reverses its motion and moves back from position C to position D which necessitates shortening the stroke somewhat from that shown by position C in Figure 3. Consequently the threads will be laid down as shown in Figure 3A so that the threads are parallel and superimposed for a short portion of their length.

By this arrangement, though the threads run separated and in phase during the greater portion of the cake or while the rate of thread travel along the bobbin is essentially the same as the rate of travel of the traverse guide, the threads are out of phase with one another when the rate of travel of the traverse guide slows down and reverses at the end of the traverse stroke at first approaching one another, then crossing one another and finally separating once more, the thread with the shorter enrollment radius leading in both directions as has heretofore been mentioned. At the ends of the cake where difficulty might be encountered in winding a plurality of threads side by side to produce a cake that could be uniformly treated, the threads lie together and behave as a single thread. Thus by means of a single traverse guide a plurality of yarns may be wound as a single cake of excellent formation which permits easy and uniform washing and other liquid treatment of the yarns on the bobbin and permits the several yarns to be subsequently unwound from the bobbin without difficulty.

The angle *y* (see Figure 2) which the guide 65 makes with the threads is important in enabling me to keep the threads separated one from the other in the major portion of the cake and although this separation is no more than $\frac{1}{32}''$ it is sufficient to effect easy unwinding of the individual threads.

The bobbin 67 may be rotatably positioned in any desired manner such as, for example, by stationary arms 69, and may be driven by any desired known mechanism, such as, for example, pulley 71.

Each of the roller thread guides 47 may be provided with any desired number of grooves for the accommodation of two, three, four or more threads. These roller guides may furthermore be provided with vanes 55 for the purpose of imparting a slightly increased resistance to the rotation of the roller guides and thereby supplying to the threads an even tension, substantially free from sliding friction, which is gradually increased from roller guide to roller guide as the thread is being traversed through the coagulating bath. The advantages and benefits to be derived from the use of vanes on roller guides comprises the subject matter of application No. 303,574, filed September 1, 1928, by W. H. Bradshaw et al.

Although the above described arrangement is one of the preferred means and methods for carrying out the applicant's invention, various modifications of this apparatus and procedure may be used with very beneficial results. It may, for example, be desired to use a single spinneret of large size for the forming of the threads in the coagulating bath and the filaments issuing from the large spinnerets may be divided and passed over stationary guides and to a single series of roller guides in the manner illustrated in Figures 1 and 2 of the drawings. Such a modified form of apparatus is partially illustrated in Figure 7 in which the cellulosic solution is passed from the supply conduit 11 through the pump 13 to conduits 15 and 16 and forced through the spinneret 18 from whence the invidiual filaments are divided and passed about the stationary guides 41, 43 and 45, and are thence passed to the first thread guide 47.

It may furthermore be undesirable to wind all three threads on a single bobbin as illustrated in Figures 1 and 2 of the applicant's drawings. In such case the threads as they pass from the individual roller guides 61 are led by means of stationary or roller guides 75, 77, 79 and 81, see Figure 6, to individual traverse guides 83, 85, and 87, respectively, to be wound on individual collecting bobbins 89, 91 and 93. The traverse guides in this case may be connected to reciprocate in unison with each other, and the various bobbins 89, 91 and 93 may, if desired, be driven by a single shaft. Alternatively the threads may be wound on a large beam in the manner above described or on individual sections of the beam.

The individual threads, may, for example, be maintained separated from each other over one or two rollers having the necessary number of individual separating grooves, and may then if desired be converged and carried together over successive rollers and subsequently separated by the individual roller guides 61 and the traverse guide in the manner shown in Figures 1 and 2 of the drawings.

It may in some cases be desired to preserve the individual filaments of the thread in closer contact with each other so as to prevent any entanglement of the filaments of the thread with the mechanism. It may, therefore, be of advantage to position the roller guides 47 at slight angles to the vertical whereby to impart a temporary twist to the thread due to the rolling action of the bundle of filaments on the surface of the individual roller grooves. Alternate twists to the left and to the right can be imparted to the threads by passing the same about a roller guide which will oscillate allowing the yarn first to ride on one bevel of the V-shaped groove and then on the other. This may be accomplished, for example, by the use of a roller guide as illustrated in Figure 5 of the drawings. In this case the grooves 95 and 96 of the roller guide 101 are cut with an irregular curvilinear outline of a rather deep axial pitch to cause the individual threads to be oscillated in the manner above described. These roller guides may, if desired, also be provided with vanes 55 for the purpose above set forth.

By using 3, 4, 5 or more rollers in the bath for each group of threads a very long bath travel and a gradual application of a relatively high spinning tension can be secured while spinning 2, or 3, or more threads instead of the customary single thread spun in the same space. Thus, it is not only possible to spin an increased number of fine denier threads on a single spinning machine, but it is possible, at the same time to produce uniform and high tenacity yarn that is eminently satisfactory for knitting or weaving operations. For example, a uniform spinning tension of as much as 0.8 or even 1 gram per denier on a bath travel of 50, 70 or even 100 inches may be used to produce a yarn having a dry tenacity of 3 grams per denier or more, an elongation of over 10% and which has a uniform affinity for a direct dye stuff.

Figures 8 and 9 illustrate a very desirable modified form of apparatus in which the spinning solution is passed from conduit 111 to branch conduits 112, 113 and 114, then through individual metering pumps 115, 116 and 117 and is extruded through spinnerets 118, 119 and 120 to form threads 121, 122 and 123 respectively. The several threads are passed around the stationary guide 125 and rotatable roller guides 127, 129, 131, 133 and 135. Each of the roller guides is provided with a single circumferential groove, as shown in Figure 8, although if desired roller 135 may be replaced by a plurality of rollers such as rollers 61 in Figure 2, whereby the threads 121, 122 and 123 are coagulated and tensioned while in close contact with each other. From the roller guide 135 the threads are passed over a separating comb 137, which maintains the threads separated from each other. The comb 137 is preferably connected with the traverse guide 139 to be reciprocated in unison therewith. This may be achieved, for example, by fastening both the traverse guide 139 and the comb 137 to the traverse bar 141. The separated threads are passed over guide 139 which is positioned at an angle to the threads whereby to wind them onto bobbin 143 in substantially parallel helixes as above described with reference to Figures 1, 2 and 3 of the drawings. In positioning the three threads about the apparatus shown in Figures 8 and 9, the individual threads or groups of filaments extruded from each spinneret are kept separated to the extent that they may be individually passed through the comb 137 and thus to be maintained separated from each other when they contact the traverse guide 139. Since the several threads or bundles of filaments are not twisted together but are maintained in parallel relationship while on the roller guides they will be easily and continuously separated by comb 137. If desired, the several spinnerets 118, 119 and 120 may be rotated at a comparatively slow speed to place a slight twist in the individual threads, thus to prevent any possible entanglement of the filaments of one of the threads with those of another.

Figures 10 and 11 designate another modified form of traverse guide which is adapted to separate the threads and lay them onto the bobbin in parallel helixes. In this form of device the traverse bar 151 is provided with a plurality of spaced separating guides 153.

The individual threads will be passed between respective adjacent sets of guides 153 which will function simultaneously as a separating comb and traverse guide means to maintain the threads separated from each other and guide them onto the bobbin in spaced helixes.

By means of this invention I am able to spin simultaneously 2, 3, 4, 5 or more threads in a coagulating bath having substantially the same surface area as has heretofore been required to spin a single thread. This is an extremely desirable feature since a rayon spinning plant may now produce as much yarn of any denier as the capacity of the plant for making viscose permits. In other words there is no longer the necessity of running the viscose manufacturing plant at half capacity when the size of yarn is reduced from 150 denier to 75 denier, for now in the same bath area that was needed to produce one thread I can produce several threads without any additional investment in expensive equipment. For instance, by any of the usual prior art methods a regenerated cellulose thread of normal strength, i. e. 1.7 g/d dry strength can be produced with a bath travel of from 10 to 20 inches and a single tensioning guide which spinning arrangement will require about 75 square inches of surface bath area. Following my invention I can produce simultaneously 2, 3, 4, 5 or more threads of substantially the same character, each of the several threads being spun with the same bath travel, same tension and same thread speed and all of the threads in substantially the same surface area of the bath as the prior art thread.

In the case of regenerated cellulose thread having a dry tenacity of at least 2.5 grams per denier where a bath travel of more than 100 inches is required and where a total spinning tension of at least 0.5 g./d. is imposed by means of a plurality of roller guides, a much larger surface area of bath is required being about 200 square inches. Here again by means of my invention I am able to produce 2, 3, 4, 5 or more threads of substantially the same character as the single prior art thread referred to whether it be 25, 50, 75, 100 or still larger denier in size and spin all the threads in substantially the same surface area of the bath as the prior art thread or in an area of about 200 square inches. In previously known spinning methods, the spinning of 2, 3, 4, 5 or more threads would therefore necessitate a bath area of 2, 3, 4, 5 or more times the 200 square inches above referred to.

Thus it is possible to spin a plurality such as 2, 3, 4, 5 or more 50 denier threads at a thread speed of at least 3000 inches per minute, a bath travel of 100 to 150 inches, a bath temperature of 45° C. and a spinning tension of 0.5, 0.7 or even more grams per denier in an area of 150 to 250 square inches which area was previously required to spin a single 50 denier thread of substantially the same physical properties.

Yarn produced in the manner above set forth has uniform physical properties and is at least as free from broken filaments, fluff, and the like as is yarn of this type processed according to the usual method. If it is desired to produce yarn of different physical properties, this can be accomplished by increasing or decreasing the number of rollers in the bath, by varying the length of bath travel and by changing the tension or stretch imparted to the yarn by each roller, for instance by changing the size of the vanes on the roller guides.

Bobbins of yarn, produced in accordance with this invention, containing a plurality of threads may be subjected to washing, desulfuring, bleaching and similar purification operations in the same manner as bobbins of yarn produced in accordance with previously known methods. If the yarn is to be twisted it may be desirable to merely wash the yarn on the bobbins and to carry out further purification of the yarn subsequently to the twisting thereof. As a further alternative, yarn produced in accordance with this invention may be washed and purified and, prior to drying, unrolled from the bobbin, drawn through a sizing bath then through a drying zone and finally wound on a spool or cone. The size sticks the filaments together and makes it unnecessary to twist the yarn. By drying the sized yarn on the run under very little or no tension it will have a low and uniform residual shrinkage characteristic.

When the yarn is to be twisted, it may be dried on the bobbin, or if desired, it may be twisted directly from the wet cake, for example, by passing the yarn for some distance through warm air or around a dryer roll. In either case, the bobbin of yarn is preferably placed on a roll-off device and the individual threads carried through separate guides around feed rolls and thence to separate spools on a ring twister or the like. The yarn will unwind without difficulty when wound in the manner above-described and the plurality of threads can be twisted from the single bobbin as easily and quickly as could the same length of yarn be twisted from two separate bobbins under the same twisting conditions, i. e. spindle speed, feed roll speed, etc.

Although the invention has particular utility in the production of high tenacity, fine denier yarn in view of its possibility of providing a long bath travel with a long and gradual increase of tension on fine denier thread by causing the fine denier threads to jointly bear the burden of tension produced by each individual roller guide, nevertheless, a very important broad advantage of the invention is the increased production of a spinning machine. Therefore the invention in its broad aspects includes the spinning of threads of large denier as well as fine denier.

Since it is obvious that various changes and modifications may be made in the above description without departing from the nature and spirit thereof, it is to be understood that the invention is not to be limited thereto except as set forth in the appended claims.

I claim:

1. The process of producing artificial thread which comprises passing a plurality of threads simultaneously through a coagulating bath and placing all of said threads under a joint tension, while maintaining them in spaced relation to each other, and winding said plurality of threads in parallel spaced helixes to form a single thread package.

2. The process of simultaneously winding a plurality of threads on a single collecting bobbin to form a single thread package which comprises passing said threads toward said bobbin while maintaining the same separated from each other, positioning a traverse guide in such a manner as to continuously contact said threads at an angle to the direction of thread travel so that the lengths of the several threads between said guide and bobbin are unequal, and reciprocating said traverse guide during the rotation of said bobbin.

3. In an artificial thread producing apparatus, means for simultaneously forming a plurality of threads, a plurality of rotatable thread tensioning means, each of said thread tensioning means constructed and positioned to contact each of said threads, while maintaining the latter in spaced relation to each other, in such a manner as to simultaneously place tension of substantially equal amount per thread denier on all of said threads.

4. In an artificial thread producing apparatus, means for simultaneously forming a plurality of threads, a plurality of rotatable thread tensioning guides, a plurality of grooves on each guide, said guides positioned relative to each other in such a manner that each of said threads will contact a separate individual groove of each of said guides whereby to simultaneously place a tension of substantially equal amount per thread denier on all of said threads.

5. In an artificial thread tensioning mechanism, a plurality of rotatable thread tensioning guides, each of said guides having spaced means for individually contacting one of a plurality of threads, said guides positioned relative to each other in such a manner that said plurality of threads can be separatedly maintained in contact with each of said guides to simultaneously place a tension of substantially equal amount per thread denier on all of said threads.

6. In an artificial thread tensioning mechanism, a plurality of roller thread tensioning guides, each of said guides having spaced means for individually contacting one of a plurality of threads, said guides positioned relative to each other in such a manner that a plurality of threads can be separatedly maintained in contact with each of said guides to simultaneously place a tension of substantially equal amount per thread denier on all of said threads, said guides constructed and arranged to be rotated by said threads.

7. In an artificial thread producing apparatus, means for simultaneously forming a plurality of threads, a plurality of rotatable thread tensioning guides, said guides positioned relative to each other in such a manner that the several threads will contact each of said guides, whereby to simultaneously place a tension of substantially equal amount per thread denier on all of said threads, means for guiding said threads at angles to each other toward a collecting bobbin, a thread traverse guide for traversing said threads on said bobbin, said traverse guide positioned to contact said threads at an angle to their direction of travel in such a manner that the length of the thread between the traverse guide and the bobbin is unequal, means for reciprocating said traverse guide, and means for rotating said bobbin.

8. In a thread winding mechanism, a thread collecting bobbin, a traverse guide, means for passing simultaneously a plurality of threads at angles to each other through said guide toward said bobbin, said traverse guide positioned at an angle to the direction of travel of said threads so that the lengths of the threads between the traverse guide and the bobbin are unequal, means for reciprocating said traverse guide, and means for rotating said bobbin.

9. In an artificial thread producing apparatus, means for simultaneously spinning a plurality of threads, a coagulating bath, a plurality of thread driven rotatable guiding and tensioning means in said bath, each of said means being positioned to guide and tension each of said threads whereby the tension placed on the threads by the means is collectively borne by said plurality of threads.

10. In an artificial thread producing apparatus, means for simultaneously spinning a plurality of threads, a coagulating bath, a plurality of thread driven rotatable guiding and tensioning means in said bath, each of said means being positioned to guide and tension each of said threads while maintaining said threads separated from each other, whereby the tension placed on the threads by the means is collectively borne by said plurality of threads.

11. In an artificial thread producing apparatus, means for simultaneously spinning a plurality of threads, a coagulating bath, a plurality of thread driven rotatable guiding and tensioning means in said bath, a plurality of circumferential grooves on each means, said means being positioned relative to each other in such a manner that each of said threads will contact a separate individual groove of each of said means whereby the tension placed on the threads by the means is collectively borne by said plurality of threads.

12. The process of producing fine denier, artificial threads which comprises simultaneously passing a plurality of freshly spun threads substantially in parallel vertically spaced relationship to each other through a coagulating bath whereby to increase the number of threads produced in a coagulating bath of a given surface area.

13. The process of producing fine denier, artificial threads which comprises simultaneously passing a plurality of freshly spun threads back and forth substantially in parallel vertically spaced relationship to each other through a coagulating bath, whereby to increase the number of threads produced in a coagulating bath of a given surface area.

14. The process of producing fine denier, artificial threads which comprises simultaneously passing a plurality of freshly spun threads in substantially parallel vertically spaced relationship to each other through a coagulating bath and then simultaneously winding said threads in parallel spaced helixes into a single thread package.

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