

March 10, 1942.

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2,276,208

METHOD OF MANUFACTURING HAIRY YARN

Filed May 25, 1937

4 Sheets-Sheet 2

FIG. 3

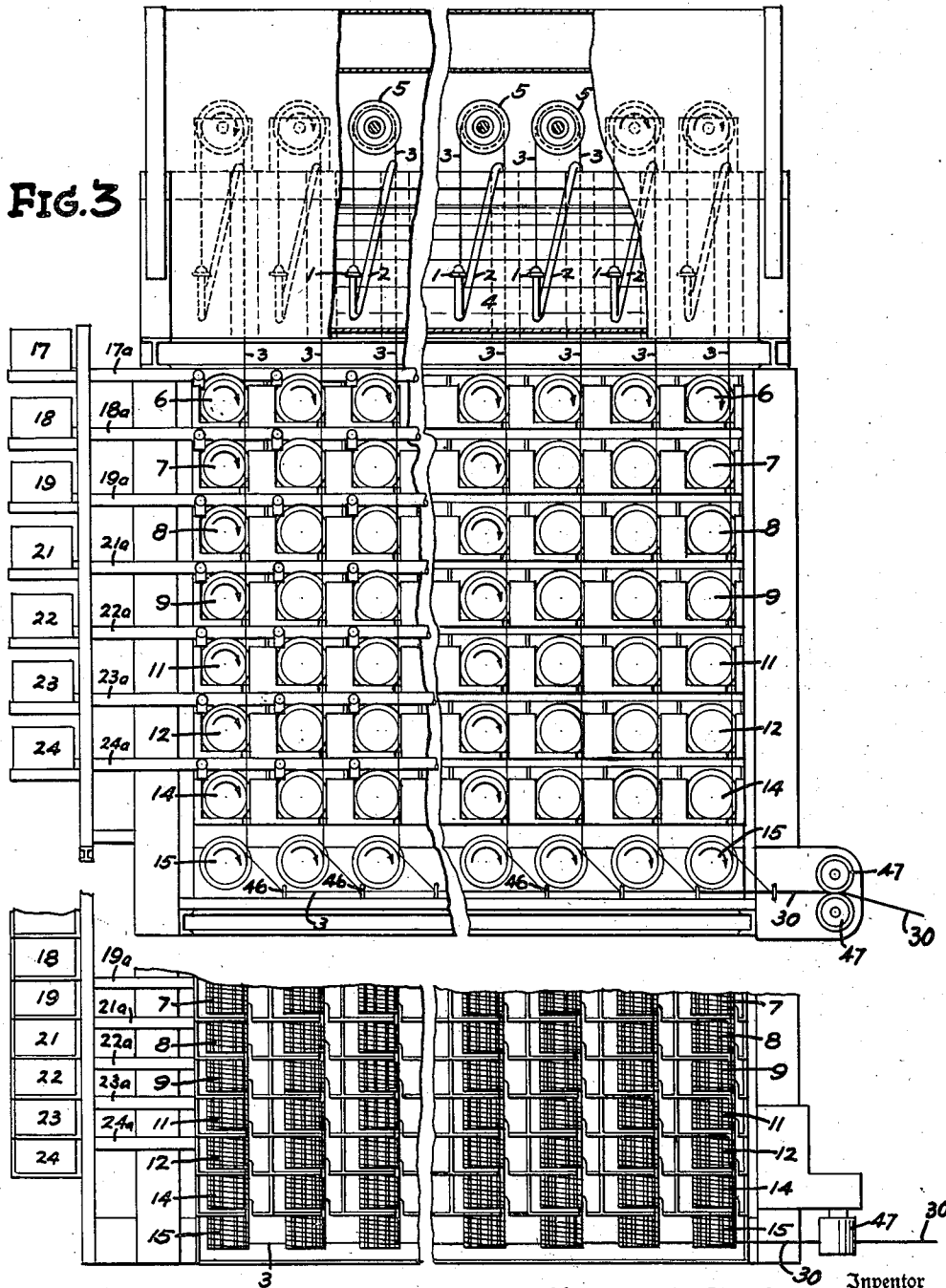


FIG. 4

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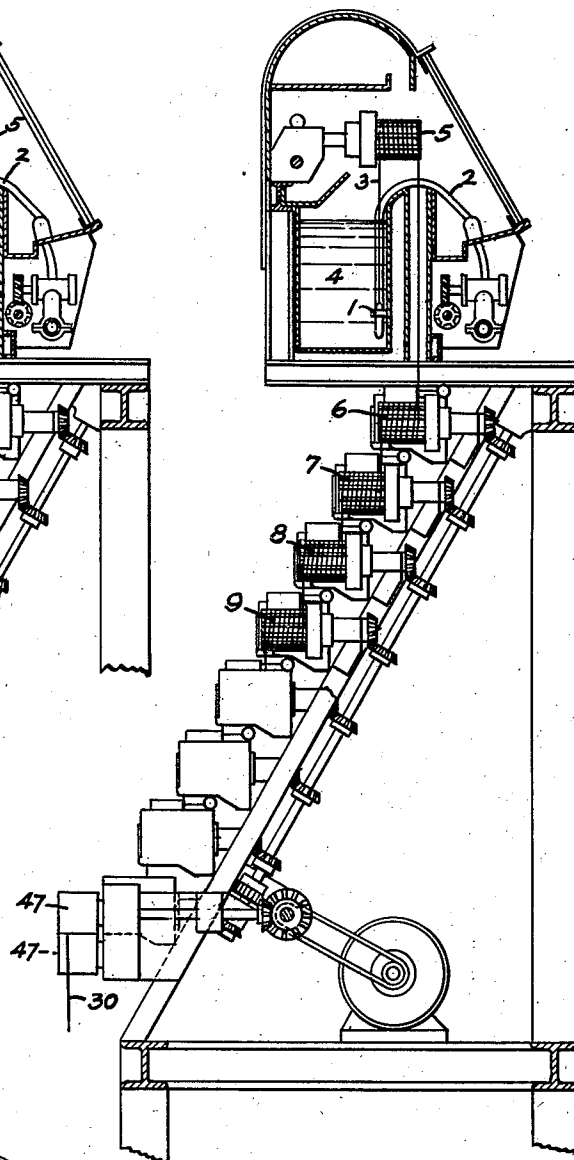
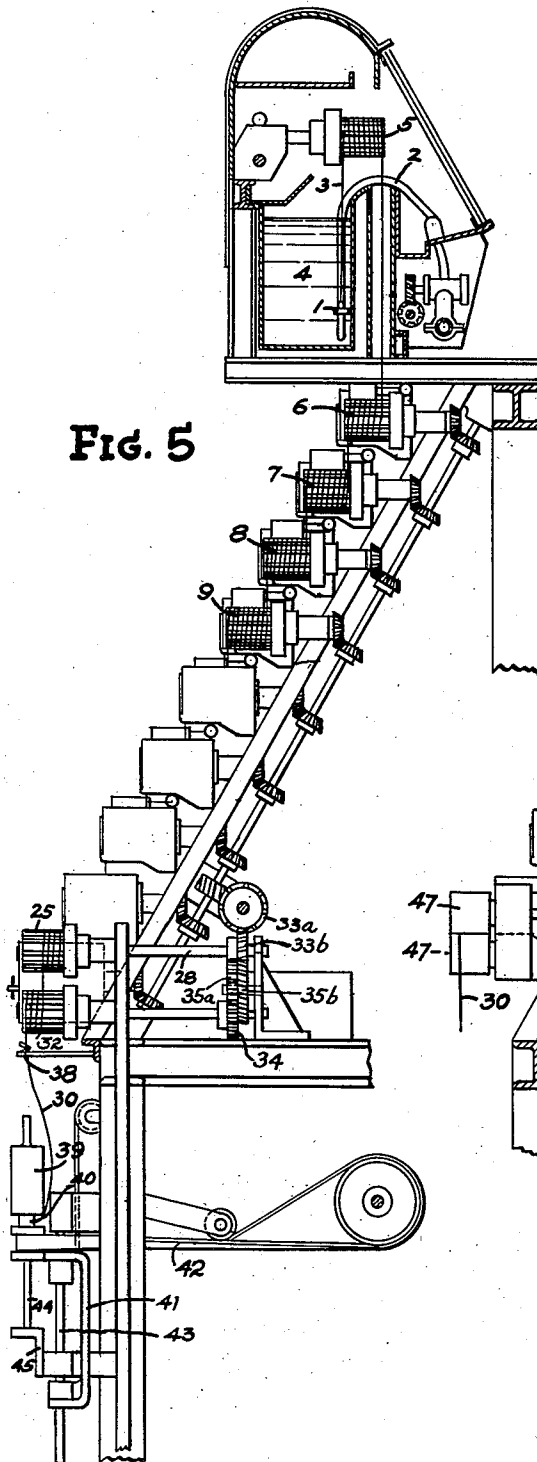
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METHOD OF MANUFACTURING HAIRY YARN

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4 Sheets-Sheet 3



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METHOD OF MANUFACTURING HAIRY YARN

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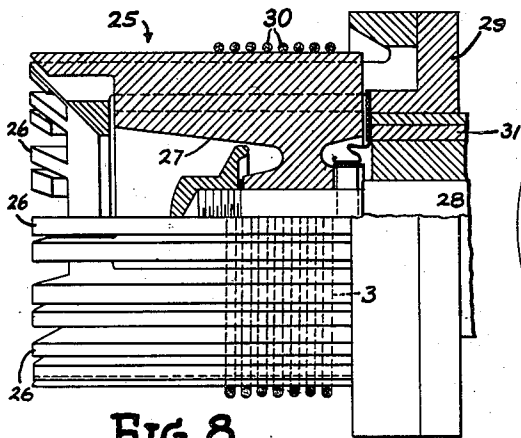


FIG. 8

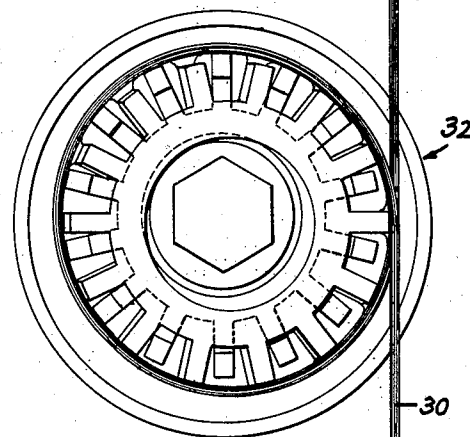
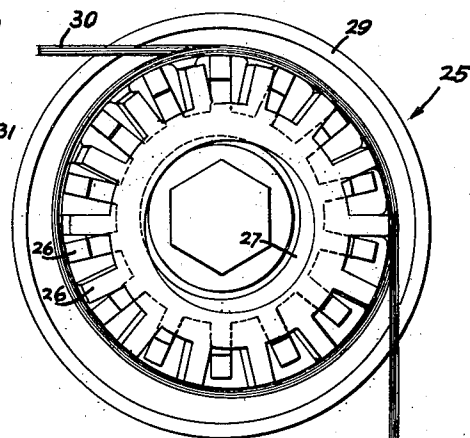


FIG. 7

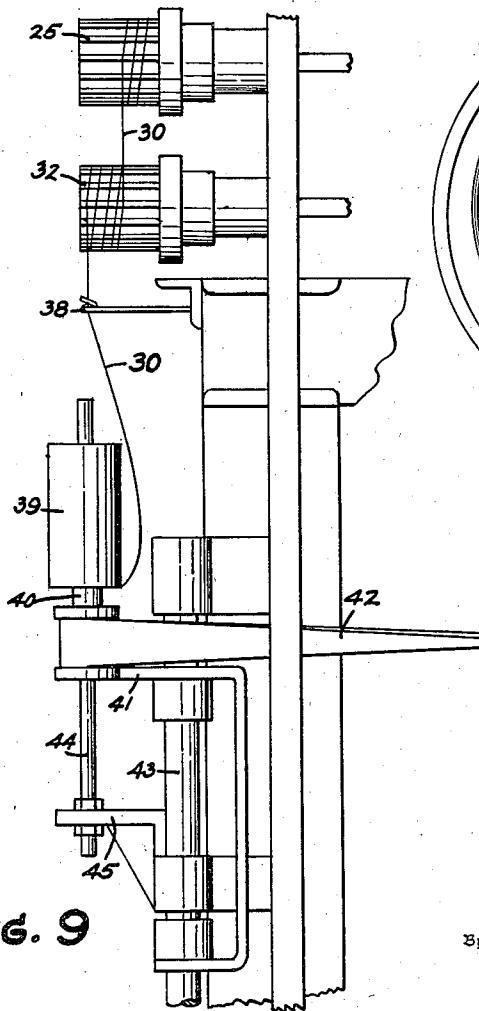


FIG. 9

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METHOD OF MANUFACTURING HAIRY
YARN

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Application May 25, 1937, Serial No. 144,581

13 Claims. (Cl. 18-54)

This invention relates to a method of manufacturing yarn for textile purposes.

More particularly, it relates to a process for the spinning, processing, and fabrication into hairy yarn, whether twisted or untwisted, of threads made up of a large number of continuous filaments. Among other things, the invention contemplates the spinning in much the usual way of a plurality of multiple filament artificial silk threads; the separate treating of the threads to perform thereon such typical operations as desulphurizing, bleaching, washing, drying, etc.; the combining of the processed threads into a bundle lending itself to the subsequent severing of the filaments into fibers of relatively short lengths; the cutting, breaking or other severing of the filaments; and in some cases, but not all, the twisting of the severed filaments.

The commercial value of artificial silk threads resides in part in the fact that the filaments of the thread can be made of very great length, in this respect resembling natural silk. However, in conventional processes for the manufacture of artificial silk thread, a considerable amount of material is unintentionally produced which for one reason or another does not have the length and parallelism necessary for the purposes originally intended. This material, once regarded as waste, has long since been found to be capable of being broken up into short lengths and spun into yarn in substantially the same way as cotton and wool fibers. Yarn so produced, when knitted or woven into cloth, gives rise to fabrics having characteristics of great value in respect of softness and feel, without, however, the objectionable luster often found in such materials.

These characteristics have resulted in a demand for more of the material than has been available as manufacturing waste, in consequence of which fact it has at times been the practice to cut ordinary artificial silk threads into short lengths to produce what is called "staple fiber." Fibers made in this way, unlike those made from manufacturing waste, to a considerable degree possess the characteristic of uniformity of length, as a result of which characteristic certain valuable properties appear in yarns made therefrom. Fabrics knitted or woven from such yarns have been found to possess desirable attributes, being in many cases vastly superior to fabrics made from fibers originating as manufacturing waste.

However, the preparation of hairy yarn from

artificial silk thread produced in the conventional way; i. e., by the pot- and spool-spinning systems, is, in proportion to the market price of the product, unduly expensive, largely because of the excessive amount of handling which is involved. In order to reduce the cost, it is desirable to modify the conventional procedure and the machinery therein employed to minimize the amount of handling, preferably by providing some sort of continuous process. Such processes have been proposed heretofore, but have been found to have the disadvantage that they result in a decidedly inferior product. The present invention contemplates a process giving rise to a product of definitely superior quality.

The present invention produces hairy yarn by a mechanized continuous process which makes use of a spinning solution prepared in the usual way. Such spinning solution is spun through a plurality of spinning jets into a common coagulating medium. The resulting threads, after coagulation in such medium, are separately subjected to successive chemical processing operations. For these purposes, a spinning machine may be employed utilizing a plurality of trains of end-supported processing reels as shown, for example, in the co-pending application of Lavern J. Jordan, Serial No. 71,468, filed March 28, 1936, (patent 2,225,637).

The threads may conveniently, but need not necessarily, be spun at the normal size and rate for a thread having a denier of approximately 150 and 40 filaments to the thread; however, threads of larger deniers and filament numbers may be equally readily utilized. The processed threads, either with or without application of a drying operation, are brought together into a bundle, in which form the filaments are reduced to fibers of the desired lengths. Such a bundle may have a total denier as high as or higher than 20,000. The severing step may be performed in various ways, as on breaking reels, between drafting rolls, by a cutter of some suitable type, or by other severing means.

The details of the invention are hereinafter described in connection with a process and machine utilizing viscose as the spinning solution, but it will be understood that the invention is applicable substantially without change to the manufacture of hairy yarn by the cuprammonium, nitrocellulose and cellulose acetate processes. Apart from simplification resulting from a possible reduction in the number of reels, only such minor changes need be introduced as are made necessary by differences in the spin-

ning solutions. The invention is equally applicable to the manufacture by other processes of still other synthetic products such, for example, as artificial wool.

Other features of the invention will be apparent from the following description when read in connection with the accompanying drawings, wherein Figure 1 is a front elevation of a machine comprehended by the invention utilizing breaking reels for severing the fibers; Figure 2 is a plan of the rear portion of the machine of Figure 1; Figure 3 is a front elevation of a somewhat similar machine for producing and combining a plurality of threads without meanwhile drying them; Figure 4 is a plan of a portion of the machine of Figure 3; Figure 5 is a side elevation of the machine of Figures 1 and 2; Figure 6 is a side elevation of the machine of Figures 3 and 4; Figure 7 is a front elevation on a larger scale of the breaking reels appearing in Figures 1, 2 and 5; Figure 8 is a side elevation partly in section of one of the breaking reels of Figure 7; and Figure 9 is a side elevation on an enlarged scale of cap-twisting mechanism which may be employed with the machine of Figures 1, 2 and 5.

As shown in Figures 1, 2 and 5, the machine of the invention embodies a plurality of descending series of substantially similar processing devices. Each descending series is provided with a spinneret 1 mounted upon a mass tube 2 which in turn is connected through a measuring pump of the conventional type to the supply pipe through which the spinning solution, in the present instance viscose, is delivered. The threads 3, spun at the rate usual in the case of thread of 150 denier, are led upward from the spinnerets 1 through coagulating bath 4 to holding reels 5.

Each reel 5 is made up of a pair of rigid, interdigitating reel members as shown in Figure 8 mounted and driven as shown in Figures 1, 2 and 5. While the reels are shown as of cantilever form, they are otherwise of the type and operate on the principle of the reel described in Knebusch application Serial No. 652,089, filed January 16, 1933, for "Winding reel" (patent 2,210,914). Each reel 5 serves to store the thread in a substantial number of turns in the form of an advancing helix of thread and to convey it lengthwise of the reel to the discharge end thereof. The reels 5 provide an opportunity for completion of the coagulation of the viscose in the threads, since considerable quantities of the coagulating bath are carried upward by the threads 3 and remain on the threads 3.

From reels 5 the respective threads 3 are led to other reels 6, in general similar to the reels 5, upon each of which the respective threads 3 are again stored in a substantial number of turns while being advanced along the reels. During this time the threads are desirably given any further treatment necessary to complete the coagulation of the viscose, the treating liquid being supplied through distributors 10. From reels 6 the respective threads 3 are then led to washing reels 7 where they are washed with water supplied from suitable distributors. From the washing reels 7 the threads 3 are then led to desulphurizing reels 8 for removal of sulphur. They are led thence to washing reels 9 for removal of the desulphurizing solution. Thereafter each thread is conducted to a bleaching reel 11, upon which the thread is bleached, and thereafter to a washing reel 12. If desired, the

threads are then given a finishing treatment upon reels 14, being transferred therefrom to drip reels 15 for removal of as much of the excess liquid as possible. From drip reels 15, threads travel to drying reels 16 disposed in individual compartments where they are dried in a current of hot air.

The various treating liquids are supplied from the tanks 17, 18, 19, 21, 22, 23 and 24 shown at the lefthand side of Figure 1.

As is shown in Figures 1, 2 and 5, the machine is made up of a large number of parallel trains of elements cooperating with a single coagulating trough, each train comprising a spinneret, coagulating reel, a descending series of treating reels, and a drying reel. As indicated, these trains of elements are positioned side by side upon a common frame, being supplied with treating liquids through the conduits 17a, 18a, 19a, 21a, 22a, 23a and 24a shown as extending from tanks 17, 18, 19, 21, 22, 23 and 24. A convenient number of trains is 48, but the machine is not necessarily constructed with this number of trains. Depending upon the requirements of the process, a lesser number of trains may be utilized or, if desired, a greater number may be employed.

The threads 3 from all trains are preferably, but need not necessarily be, combined into a single large thread bundle 30. As shown in Figures 1, 2 and 5, the thread 3 from the reel 16 at the extreme left-hand end of the machine is carried to the right through an opening 20 in the top wall of the dryer compartment, through a guide 37 and over the top wall of the dryer compartment for the second reel 16, where it is combined with the thread 3 from such second reel 16. The combined threads are then carried through another guide 37 over the top of the dryer compartment for the third reel 16 and combined with the third thread 3 and carried therefrom to a point above the fourth reel for combining with the fourth thread 3, this procedure being continued until the right-hand end of the machine is reached. The final thread bundle 30 thus comprises all of the threads 3 supplied by the various drying reels 16.

At the right-hand end of the machine, as shown in Figures 1, 2 and 5, there is provided a pair of breaking reels similar to those employed in the parallel trains of treating elements. The construction of such breaking reels is shown in further detail in Figures 7, 8 and 9. The thread bundle 30 is led from the last reel 16 over the top of the first breaking reel 25 and caused to take a number of turns thereabout. It passes thence to the second breaking reel 32, on which it is likewise caused to take a number of turns. As will be hereinafter explained, breaking reel 32 rotates at a greater peripheral speed than the breaking reel 25.

Breaking reels 25 and 32 are generally speaking cantilever reels of the type disclosed in the above-mentioned patent of Walter F. Knebusch.

As shown in Figures 7 and 8, each breaking reel consists of a pair of interdigitating rigid reel members made up of longitudinally extending bars 26. Two hubs 27 and 29 are provided to which alternate bars 26 are attached, forming primary and secondary reel members, with the bars of the respective primary and secondary reel members interleaved with respect to each other. Hub 27 is rigidly attached to drive shaft 28 and the reel as a whole is rotated thereby. Hub 29 is journaled on a bearing 31 attached to

the frame of the machine in a position which is not coaxial with the shaft 28, but in which the axis of hub 29 is a short distance below and inclined at an angle in a horizontal plane to the axis of shaft 28.

This arrangement of the hubs and their attached bars results in radial projection of the set of bars 26 attached to the hub 29 beyond the bars of the other set on the lower side of the reel, whereas at the upper portion of the reel the bars 26 attached to the hub 27 project radially beyond the set of bars attached to hub 29. At the sides of the reel there is a longitudinal displacement of the thread bundle between the adjacent bars caused by the inclined relationship of hub members 27 and 29. This causes a thread bundle which contacts at the top of the reel with the bars attached to hub 27 to be transferred as the reel rotates to the bars attached to the hub 29. Transfer from one set of bars to the other occurs repeatedly as the reel rotates.

During such transfer, the thread bundle 30 is given a longitudinal displacement from its prior position as a result of the skewed relation of the reels, thereby to produce an advancing helix upon the reel. The transfer from one set of bars to the other occurs at the sides of the reel approximately at the level of the axis of the driving shaft. The skew position of the lower reel member carries the thread forward with respect to the upper reel member during the travel of any given point of the thread bundle 30 along the lower half of such reel member.

The turns taken around the reels 25 and 32 are in any event sufficient in number to give the thread a firm grip upon the reel but may, if desired, be considerable in number.

Breaking reel 25 is driven from the same power source as the processing reels. It is driven through the gears 33a and 33b at the same peripheral speed as the drying reels 16, so that it draws the thread bundle 30 from the reels 16 at substantially the speed at which it is produced. As shown in Figure 5, breaking reel 32 is driven by a gear 34 which is substantially smaller than the gear 33, idler gears 35a and 35b being interposed therebetween to cause the reels 25 and 32 to rotate in the same direction, whether clockwise or counterclockwise, but with the reel 32 rotating at a speed substantially in excess of the speed of rotation of the reel 25. This excess may be from 90% to 500% above the speed of rotation of the reel 25.

Since thread bundle 30 grips both reels firmly, the excess speed of reel 32 results in a drafting stress which is greater than the tensile strength of the various fibers in the bundle. Inasmuch as the filaments are parallel at this place in their path of travel, the individual filaments in spanning the space between the reels break at their weakest points. These points of minimum strength being distributed at random, the filaments break at random points in the thread bundle 30. However, since the filaments are broken at random points, the identity of the thread bundle 30 is maintained and, accordingly, the product is discharged from reel 32 in the form of an untwisted yarn.

In this embodiment of the invention, the filaments are broken into lengths which are approximately equal to the distance between the points of tangency of the thread bundle 30 to the circumferences of the two reels. The lengths of the fibers thus produced are not identical; however, the lengths of the great majority of

the fibers approximate the spacing between the axes of the reels with progressively smaller percentages of the fibers departing more and more therefrom. The median length of the fibers may thus be controlled by adjustment of the space between the respective reels 25 and 32. The diameter of these reels is conveniently in the neighborhood of 5 inches and the necessary clearance between them results in a spacing, and therefore a median fiber length, of approximately 6 inches.

For some purposes, however, this fiber length is too great, wherefore, in order to produce a shorter median length, reel 32 may be spaced somewhat more closely to reel 25 and rotated in the reverse direction; that is, counterclockwise when reel 25 is rotated in a clockwise direction. By this procedure, the points of tangency of the thread bundle 30 to the two reels may be a relatively short distance apart which may without difficulty be made as short as one or two inches. This arrangement thus produces fibers of very short length. As in other arrangements, the median length of the fibers may be determined by adjustment of the distance of separation of the axes of the two reels.

In connection with breaking reels 25 and 32 may be used the cap-twisting mechanism particularly shown in Figure 9, or, if desired, some other suitable form of twisting device. As shown in Figures 1, 2, 5, 7 and 9, thread bundle 30 is led from the last guides 37 to the breaking reels 25 and 32, from which it is led through another guide 38 to and under the cap 39 of the cap-twister. Bobbin 40 is supported on a spindle running in bearings on a frame member 41 and is driven by a belt 42 running upon a whirl adapted to rotate the bobbin 40. The frame 41 is guided upon vertical rods 43. Cap 39 is supported upon a rod 44 which in turn is carried upon a cross bar member 45 attached to the rods 43. Frame member 41 carrying the pulley and bobbin assembly is oscillated up and down by any convenient mechanism, such as a cam. Twister bobbin 40 is conveniently rotated at a high rate of speed which may desirably be in the neighborhood of 6,000 revolutions per minute.

Thread bundle 30 is twisted as it leaves the breaking reel 32; i. e., before it has a chance to disintegrate, producing a relatively large yarn the denier of which depends upon the extent of drafting produced by the reels 25 and 32.

The above-described embodiment of the invention is particularly designed to dry threads of normal denier before they are bundled and severed into fibers. The drying operation, however, reduces the coherence between the filaments, wherefore it is preferable in some instances that the filaments be severed while wet. While the threads may, if desired, be left moist merely by cutting off the current of drying air from the dryer cells, it is better practice to omit the drying reels entirely, the thread being in such case passed directly from drip reels 15 to appropriate guides for bundling. An embodiment of the invention based on this method of operation is shown in Figures 3, 4 and 6.

In this form of the invention, spinnerets 1, mounted as before upon mass tubes 2 submerged in coagulating bath 4, are utilized for spinning the threads 3, which, as in the previously described embodiment, are further coagulated upon reels 5 and 6, washed upon reels 7, desulphurized upon reels 8, washed upon the reels 9, bleached upon the reels 11, washed upon reels 12, oil-

treated upon reels 14, and freed of excess moisture upon reels 15. The moist threads 3 are then combined into a bundle, being conducted through guides 46 which are, in general, similar to guides 37. Thread 3 from the first drip reel 15 is led to the first guide 46, thence to the second guide 46, where it is combined with thread 3 from the second reel, and so on until the right-hand end of the machine is reached, at which point the moist thread bundle 30 is drawn off by means of conveyor rolls 47, particularly shown in Figures 3, 4 and 6.

The filaments contained in thread bundle 30 are preferably reduced to fibers by the means hereinabove described but may, if desired, be severed by any one of several alternative operations.

A saving in cost can sometimes be effected by breaking the filaments into short lengths on drafting rolls of the conventional kind. According to this system, thread bundle 30 is led to a first pair of drafting rolls and passed there-through to a second pair of drafting rolls. The second pair of rolls grips the filaments and, because of the higher peripheral speed, pulls the filaments away from the preceding rolls. The individual filaments, upon being gripped, are broken at the weakest points intervening between the two pairs of rolls. However, the large number of fibers and the random distribution of points of weakness therein result in a somewhat irregular length distribution, most of the fibers, however, being broken to a length approximately the same as the separation between the bites of the two pairs of rolls.

While there are above disclosed but a limited number of embodiments of the invention, it is possible to produce still other embodiments thereof without departing from the inventive concept as herein disclosed. Thus with the apparatus of Figures 1, 2 and 5 may be used other types of severing devices; similarly, with the apparatus of Figures 1, 2 and 6 may be used, for example, the severing device of Figures 7, 8 and 9. It is therefore desired that only such limitations be imposed upon the appended claims as are stated therein or required by the prior art.

It is intended that the patent shall cover, by suitable expression in the appended claims, whatever features of patentable novelty reside in the invention.

What is claimed is:

1. A continuous process of manufacturing hairy yarn including the steps of forming a multiple filament thread by a wet-spinning method; continuously but temporarily storing the thread in one or more advancing helices characterized by a large number of generally helical turns, meanwhile processing the thread; and, while still wet, drafting the processed thread to the point of breakage between two drafting elements spaced sufficiently close together to produce fibers of relatively short lengths, the drafting operation being performed without interrupting the continuity of the thread as a whole.

2. A continuous process of manufacturing hairy yarn including the steps of forming a plurality of separate multiple filament threads simultaneously by a wet-spinning method; continuously but temporarily storing each of said threads in one or more advancing helices characterized by a large number of generally helical turns, meanwhile processing said threads; combining the processed threads to form a thread bundle; and drafting the thread bundle to the

point of breakage between two drafting elements spaced sufficiently close together to produce fibers of relatively short lengths, the drafting operation being performed without interrupting the continuity of the thread bundle.

3. A continuous process of manufacturing hairy yarn including the steps of forming a plurality of separate multiple filament threads simultaneously by a wet-spinning method; continuously but temporarily storing each of said threads in one or more advancing helices characterized by a large number of generally helical turns, meanwhile processing said threads; combining the processed threads to form a thread bundle; and, while still wet, drafting the thread bundle to the point of breakage between two drafting elements spaced sufficiently close together to produce fibers of relatively short lengths, the drafting operation being performed without interrupting the continuity of the thread bundle.

4. A continuous process of manufacturing hairy yarn including the steps of forming a plurality of separate multiple filament threads simultaneously by a wet-spinning method; continuously but temporarily storing each of said threads in one or more advancing helices characterized by a large number of generally helical turns, meanwhile processing said threads; drying said threads; combining the dried threads to form a thread bundle; and drafting the thread bundle to the point of breakage between two drafting elements spaced sufficiently close together to produce fibers of relatively short lengths, the drafting operation being performed without interrupting the continuity of the thread bundle.

5. In the manufacture of hairy yarn, the step of passing a bundle of substantially endless filaments in succession to two thread-advancing thread store devices disposed in propinquity to each other each of which serves to store the bundle in a series of generally helical turns, the peripheral speed of the second of said devices being sufficiently greater than that of the first so that the resulting drafting action serves to break the filaments of the bundle into fibers of relatively short lengths.

6. In the manufacture of hairy yarn, the step of passing a bundle of substantially endless filaments in succession to two thread-advancing reels disposed in propinquity to each other each of which serves to store the bundle in a series of substantially circular turns, the peripheral speed of the second of said reels being sufficiently greater than that of the first so that the resulting drafting action serves to break the filaments of the bundle into fibers of relatively short lengths.

7. A continuous process of manufacturing hairy yarn including the steps of forming a plurality of separate multiple filament threads by a wet-spinning method; continuously but temporarily storing each of said threads in one or more advancing helices characterized by a large number of generally helical turns, meanwhile processing said threads; drying said threads; combining the dried threads to form a thread bundle; reducing the filaments of the thread bundle to fibers of relatively short lengths, maintaining nevertheless the initial continuity of the thread bundle; and simultaneously twisting and spooling the product.

8. A continuous process of manufacturing hairy yarn including the steps of forming a plu-

ality of separate multiple filament threads by a wet-spinning method; continuously but temporarily storing each of said threads in one or more advancing helices characterized by a large number of generally helical turns, meanwhile processing said threads; combining the processed threads to form a thread bundle; reducing the filaments of the thread bundle while still wet to fibers of relatively short lengths, maintaining nevertheless the initial continuity of the thread bundle; and simultaneously twisting and spooling the product.

9. A continuous process of manufacturing hairy yarn including the steps of forming a plurality of separate multiple filament threads by a wet-spinning method; continuously but temporarily storing each of said threads in one or more advancing helices characterized by a large number of generally helical turns, meanwhile processing said threads; combining the processed threads to form a thread bundle; reducing the filaments of the thread bundle to fibers of relatively short lengths, maintaining nevertheless the initial continuity of the thread bundle; and simultaneously twisting and spooling the product.

10. In the manufacture of hairy yarn, the step of passing a moist bundle of substantially endless filaments in succession to two thread-advancing thread store devices disposed in propinquity to each other each of which serves to store the bundle in a series of generally helical turns, the peripheral speed of the second of said devices being sufficiently greater than that of the first so that the resulting drafting action serves to break the filaments of the bundle into fibers of relatively short lengths.

11. In the manufacture of hairy yarn, the step of passing a moist bundle of substantially endless filaments in succession to two thread-advancing reels disposed in propinquity to each other each of which serves to store the bundle in a series of substantially circular turns, the peripheral speed of the second of said reels being sufficiently greater than that of the first so that the resulting drafting action serves to break the filaments of the bundle into fibers of relatively short lengths.

12. In the manufacture of hairy yarn, the step of passing a dry bundle of substantially endless filaments in succession to two thread-advancing thread store devices disposed in propinquity to each other each of which serves to store the bundle in a series of generally helical turns, the peripheral speed of the second of said devices being sufficiently greater than that of the first so that the resulting drafting action serves to break the filaments of the bundle into fibers of relatively short lengths.

13. In the manufacture of hairy yarn, the step of passing a dry bundle of substantially endless filaments in succession to two thread-advancing reels disposed in propinquity to each other each of which serves to store the bundle in a series of substantially circular turns, the peripheral speed of the second of said reels being sufficiently greater than that of the first so that the resulting drafting action serves to break the filaments of the bundle into fibers of relatively short lengths.

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