

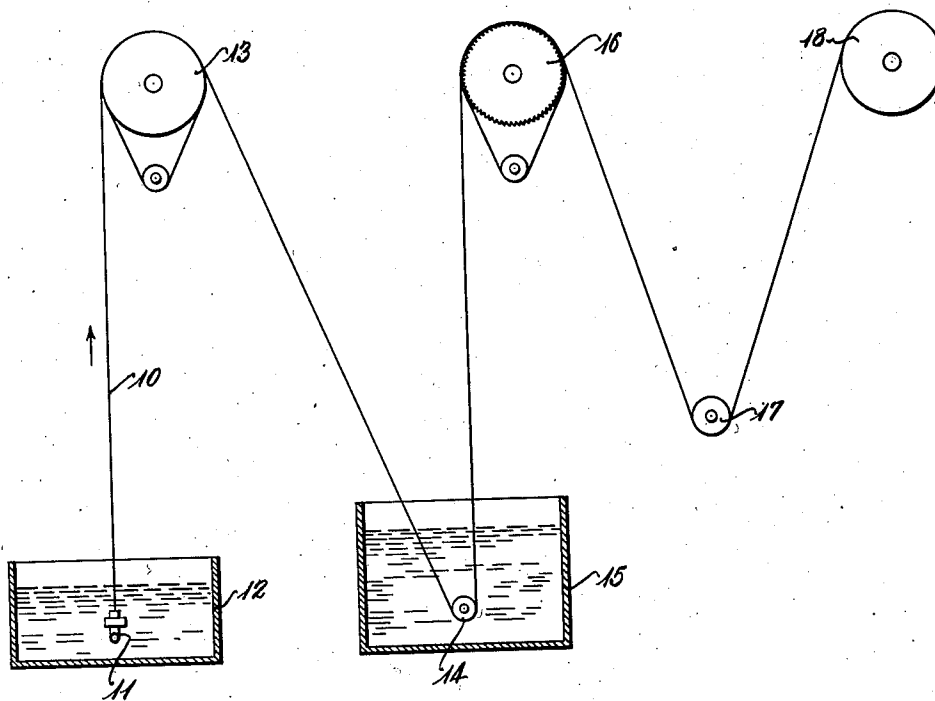
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MANUFACTURE OF RAYON

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## UNITED STATES PATENT OFFICE

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## MANUFACTURE OF RAYON

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The present invention relates to the manufacture of viscose rayon according to the bobbin spinning method, and more particularly it relates to the production of high tenacity rayon of the order of the higher deniers.

In the production of such rayon for particular uses, certain characterizing features have been found to be necessary or at least desirable. It has been found that rayon reinforcements for cord tires and the like must have a high tensile strength and possess high fatigue resistance. Then, too, such rayon must be characterized by a low degree of elongation. Additionally, it has now been determined that the rayon cords used for the reinforcement of tires are more efficacious if they are formed from heavy denier rayon yarns.

Although it is not required that rayon yarn used for general purposes have a tensile strength comparable to that which is required of yarn used in the manufacture of tires and the like, nevertheless there has been a general increasing demand for higher strength in such yarn. Due to improvements in processes of manufacture the tensile strength of average rayon yarn has been gradually and continuously increased over the past few years until now it is quite common for normal rayon yarn to possess a tensile strength of at least two grams per denier.

It is known that rayon can be caused to have an increased tensile strength when the yarn, during its manufacture, is stretched under conditions to effect a rearrangement of the internal structure thereof. However, it was found that the strength of viscose rayon yarn could only be increased to a limited degree by the original processes as they involved merely the stretching of the filaments immediately following their formation.

It is well known that when the coagulating bath used in the production of viscose yarn contains zinc sulphate, or certain other metallic sulphates, the filaments formed therein may be stretched to a greater extent than filaments otherwise formed due to the fact that regeneration of the cellulose is retarded. The United States patent to Napper, No. 1,045,731, discloses and claims a precipitating bath of the general type referred to, i. e., one containing zinc salt.

Up to the present time, the normal process for spinning viscose rayon has involved the use of a single acid coagulating bath. As distinguished from the said single bath, the trend in the industry is to utilize the so-called "two-bath" spinning system. Such a system includes a primary coagulating and partial regenerating bath,

and a second bath in which further regeneration to the cellulose is effected while a high stretch is simultaneously applied thereto. In order to permit a relatively high degree of stretch and to thereby produce yarn of high wet and dry tenacity, it has been found preferable to maintain the said second bath at a relatively high temperature, i. e., above 60° C. and preferably in the neighborhood of 80° C. At this relatively high temperature it is possible to effect a high stretch of the yarn and at the same time the tension in the yarn is prevented from increasing to a point where breakage of filaments would occur.

In accordance with the present conventional process the viscose solution is extruded into a coagulating bath of sulphuric acid which contains a metallic salt having regenerating inhibiting properties. The coagulated and slightly regenerated yarn is given a certain degree of stretch in this highly plastic state during and immediately following the coagulation thereof. The yarn, after passing over a draw-off godet, is given a very material stretching while it is in contact with a second bath of hot water maintained at the desired temperature noted above. This stretching is effected by passing the yarn over a second driven godet revolving at a materially higher peripheral speed than the draw-off godet. The yarn is then collected on a bobbin or spool. Yarns thus prepared have valuable properties, in that the high degree of stretching which may be accomplished in this manner increases the tensile strength considerably. However, it is impossible to achieve accurate control of all the variables involved in the preparation of the yarn and when the stretching operation and the winding of the yarn are effected at predetermined speeds, as by passing the yarn about positively driven godets without slippage in the manner now practiced, the resulting tensions vary widely. Such tension variations occur as a result of variations in winding speed caused by the cross-wind movement, and by a slight increase in peripheral speed of the winding bobbin during the spinning period. The said increasing speed compensates for small denier differences that would otherwise occur. If no slippage is provided on the second godet and if the speed of winding increases slightly while the peripheral speed of the second godet remains constant, it can be seen that the relation of the tension between the two godets, to the tension between the last godet and the bobbin will be materially affected over the period of formation of the

package if no slippage is provided on the second godet. In the manufacture of high tensile strength, high denier yarn the additional tension applied during the latter portion of the spinning period will tremendously increase washing difficulties if such tension is present between the last godet and the bobbin.

Avoidance of the processing difficulties such as in washing, insofar as these are attributable to winding tension variations which cause temporary excessive high tensions, constitutes one of the principal advantages of the present invention. The tension variations are avoided according to this invention by arranging the apparatus so that the yarn is subjected to a compensating slippage on the intermediate godet, the desired slippage being controlled to a major extent by characteristics of this godet and the manner in which the yarn is passed thereabout. Another slippage factor may be the peripheral speed of this godet in relation to the speed of the winding spool. That slippage of the yarn on the last intermediate godet will occur, is clearly in evidence when the peripheral speed of the said godet is at least 7 or 8% greater than the winding speed, and the yarn tension between the godet and the winding bobbin is maintained sufficient to draw the yarn tangentially in a straight line from the circumference of said godet.

If compensating slippage is allowed on the intermediate godet, then it is found quite permissible to run this godet at a constant speed without causing an undue increase in tension during the formation of the package. Also jerks in the winding will not cause excessive increases of tension. While the use of an intermediate godet driven at a constant linear speed is a major advantage in that it permits elimination of apparatus such as gear trains adapted to impart the desired variable speeds to this godet, methods involving variations (particularly increases) in the speed of the intermediate godet during the formation of a spinning package are to be considered as within the scope of this invention.

It may be advantageous under certain circumstances to employ more than two godets, in which case the yarn is withdrawn from the setting bath by a draw-off godet and highly stretched between the same and the first intermediate godet driven at a higher peripheral speed. The reduction in tension is then effected in a series of stages, for example, a second intermediate godet can be interposed between the first intermediate godet and bobbin. The peripheral speed of this third godet might be either greater, equal to, or less than that of the second godet depending on the characteristics of the intermediate godets and the arc of contact of the yarn thereon. In that case, the compensating slippage would be divided over the two spaced points where the yarn is contacted by the second and third godets respectively and the total percentage let-off would be greater.

A primary object of this invention is to provide for the control of slippage of the yarn on the intermediate godet in such a manner that the winding tension during the spinning period will not be materially increased with resultant detrimental aggravation of the problems encountered in processing or purifying of packages of yarn.

This invention contemplates generally the utilization of either the single bath process or the so-called "two-bath" spinning process in combination with the steps of applying specific tensions upon succeeding portions of the yarn be-

ing produced by means of driven devices having peripheral speeds equal to the linear speed of the yarn in contact therewith, and driven godets on which slippage of the yarn is adjusted and controlled.

It has now been found that serious variations in properties of such yarn when completely processed may be substantially eliminated and that the yarn may be caused to have physical properties markedly superior to normal yarn when it is formed by the introduction into the system of means of the character referred to above for achieving a balance between the tension applied during the tensioning and winding operations.

More specifically this invention contemplates the provision of a process for automatically and continuously adjusting the relationship between the tensions applied to the yarn before and after the intermediate godets in a two-bath spinning process.

A further object of the invention is the provision of suitable apparatus capable of maintaining constant but different degrees of tension on the yarn while being stretched and while being collected on a bobbin.

In its preferred embodiment, the invention contemplates a process in which filaments are extruded into and withdrawn from a coagulating bath, which contains a regeneration inhibiting ingredient, by a driven godet such that the yarn may not slip thereon whereupon it is passed through the final treating bath under an idler roller to a second driven godet, on which compensating slippage is effected. Thence the filament bundle or yarn passes to a bobbin driven by means so adjusted that the yarn will be collected at a constant or slightly increasing linear speed.

Further objects and advantages of this invention will become apparent from the following detailed description when considered in connection with the accompanying drawing wherein the single figure is a diagrammatic illustration of the preferred embodiment of the apparatus contemplated by the present invention.

Now, in referring to the drawing the numeral 10 designates a yarn formed by the extrusion of a viscose solution through a spinneret 11 into a coagulating bath 12. Bath 12 is preferably of the type specified in United States Patent Number 1,045,731 to Napper. The filaments as formed are withdrawn from the bath as a bundle at a constant linear speed. The withdrawal is effected by a godet on which no slippage is allowed. In order to insure that no slippage of the yarn 10 shall occur upon the godet 13, it has been found advisable to wrap the yarn about  $3\frac{1}{2}$  times around a portion of the periphery of the godet in the well known manner. The yarn is then passed from godet 13 to an idler roller 14 which is submerged at a depth of approximately 20 centimeters below the surface of the final treating bath 15. Bath 15 is preferably one of hot water or weak acid. This bath if desired may be maintained at a temperature of about 80° C. From the bath 15 the yarn is drawn over godet 16 on which controlled slippage is effected and it is then passed under idler roller 17 to bobbin 18 which is driven at such a speed that the yarn will be collected thereon at a substantially constant linear velocity, although there may be a slight increase in the rate of collection. A driven godet may be substituted for the idler roller 17 and will then function in a similar manner as godet 16.

The composition and contour of the godet 16

and the manner in which the yarn is propelled thereby are of major importance to this invention by reason of the fact that slippage of the yarn on the godet 16 introduces the necessary control in the ratio between the tensions applied in the successive stretching and winding operations. It is found that the corrugated type of godet described in Patent Number 2,001,742 to Moritz is very useful for the present process. Although the manner in which the corrugated godet is used in the process and apparatus of this prior patent and the reasons therefor differ radically from the corresponding features of the present invention, those skilled in the art are referred to said patent for a discussion of the godet and its manner of operation. In operating in accordance with the principles of this invention, it is found advisable to pass the yarn about  $1\frac{1}{2}$  times around a portion of the periphery of the corrugated godet 16. If a smooth godet is used, then about half a turn around such godet would cause a similar tendency for slippage to occur and for the tensions in the yarn before and after passing over the godet to adjust themselves.

It will be understood that the value of the several variables in the process and apparatus of this invention will depend, in large measure, upon the denier of the yarn and upon each other. Although the principles hereof are found to be of great value in connection with yarns of normal low denier, the present advantages are particularly noticeable in the preparation of high denier yarns for use in the manufacture of cords for the reinforcement of rubber tires. For example, from 275 to 1100 or more denier yarns spun for the making of tire cord were found to be greatly improved as to low elongation, high tensile strength and high fatigue resistance when prepared by the present process.

Although the advantages of the invention may be achieved to some extent when employing tensions of widely varying values in the stretching and winding operations, we find that particularly advantageous results are achieved when the tension between godets 13 and 16, is maintained in excess of about 0.5 gram per denier and preferably above 0.8 gram per denier. More specifically it was found that when spinning 275 denier high tensile strength yarn, very satisfactory results are obtained if this tension is maintained above 0.5 gram per denier. When spinning very heavy denier high tensile strength yarn, it is advantageous to maintain a tension above 0.8 gram per denier.

In order to provide the most washable spool, i. e., one wherein the washing time is maintained at a minimum, the tension on the yarn between the godet on which slippage occurs and the bobbin should be as low as possible. The extent to which the tension can be reduced depends on several factors, namely, the composition of the godet, the contour of the yarn contacting surface of the godet, etc. However, it is obvious that the tension must not be lowered to a point where objectionable sticking on the godet takes place; or in other words, the tension must be sufficient to draw the yarn from the godet tangentially in a straight line in order to prevent wrapping thereon. It has been determined that the tension to which the thread may be practically subjected during winding between the godet 16 and the winding device 18, is within the approximate range of 0.04 to 0.15 gram per denier and preferably at about .07. Specifically

it was found that when spinning very heavy denier strong yarn, such as 1100 denier, for tire cord it is advantageous to maintain the tension between the intermediate godet and bobbin in the lower range of the above indicated limits, e. g. between 0.04 and 0.08 gram per denier. When spinning medium heavy strong yarn such as 275 denier, then it is permissible to increase this tension to about 0.15 gram per denier.

It can be seen that in the preferred mode of operation, when spinning strong yarn of the order of 275 denier, the ratio between the tension before and after the intermediate godet is at least 0.5:0.15 or greater than 3:1. When spinning very heavy, high tensile strength yarn such as 1100 denier then the ratio between the tension before and after the intermediate godet may be about 0.8:0.07 or about 11:1. For best results this ratio should not be less than 8:1.

In summing up, we have determined that it is usually advantageous to maintain the ratio of the initial tension to the final tension at a value not substantially less than about 3:1, and preferably over 8:1.

Thus it is essential to this invention that the ratio between the tension before and after the intermediate godet is kept at a very high level and that simultaneously a compensating slippage is permitted on the intermediate godet. In this manner the resulting winding tension is maintained at a minimum throughout the entire spinning period so that the resulting yarn package can be treated and purified without difficulties.

The advantages of the invention are particularly well shown by the results obtained in the preparation of rayon yarns for tire cords in accordance with the several specific examples hereafter referred to:

In practicing one specific process in accordance with the present invention a normal viscose solution was extruded through a spinneret in the conventional manner into a spinning bath of the following composition, the percentages given being calculated on the weight of the bath:

|                        | Percent |
|------------------------|---------|
| Sulfuric acid.....     | 9.25    |
| Sodium sulfate.....    | 17.25   |
| Magnesium sulfate..... | 4.95    |
| Zinc sulfate.....      | .9      |
| Water.....             | 67.65   |

The spinneret utilized was provided with 480 orifices since the process involved the production of 480 filament 1100 denier yarn. The bundle of filaments was withdrawn without slippage by a godet driven at a peripheral speed of 34.3 meters per minute. Regeneration of the cellulose xanthate in the yarn to cellulose was retarded by the employment of the particular spinning bath and the filaments, which were only partially regenerated as they passed from the draw-off godet, were immersed to a depth of about 20 centimeters below the surface in a bath of water and 0.5% sulfuric acid which was maintained at 73° C. The filaments were drawn around a freely rotatable roller within the hot bath and they were thereafter propelled as a yarn, one and one-half times, about a corrugated glass godet which was driven at a constant peripheral speed of 68 meters per minute. About its circumference the corrugated godet measured 250 millimeters and the width and depth of the depressions between the ridges were 4 millimeters and 2 millimeters respectively. The godet was

formed with 64 evenly arranged corrugations. Slippage of the yarn on the intermediate godet was caused by the winding speed which was materially lower than 68 meters per minute, the peripheral speed of said godet.

Adjustment of slippage of the yarn on the surface of the corrugated godet was controlled by the manner of contact of the yarn therewith and by tensions to which the yarn was subjected before and after its contact with the godet.

During the complete process a length of about 1830 meters of the 1100 denier yarn was spun uninterruptedly on a spool and it formed a yarn body thereon having a thickness of about 15 millimeters. During this spinning operation which extended over a period of about 33 minutes the respective tensions to which the yarn was subjected were measured at the beginning and at the end of the period. It was found that at the beginning of the spinning the tension between the draw-off godet and the corrugated godet was 920 grams, whereas at the end of the spinning period the tension was only increased to 950 grams. The tension between the corrugated intermediate godet and the spool was found to be 85 grams at the beginning of the period and this tension had increased to only 90 grams at the end of the period. These measurements show clearly that the respective tensions were only slightly increased during the entire spinning period.

The yarn after passing over the corrugated godet was then collected upon a spool in the usual manner at a speed which at the beginning of the spinning period was 60 meters per minute. At the end of the spinning period the speed of collection of the yarn had increased to 62.5 meters per minute. From the above it will be noted that at the beginning of the spinning period a stretch of 73.8% was given to the yarn between the draw-off godet and the winding spool and that at the end of the spinning period the stretch was increased to 82%. This yarn package as thus produced was extremely soft and was readily processed and purified by means of a so-called "pressure-vacuum wash treatment."

It was found that the yarn produced by the process of this specific example had a dry tensile strength of 380 grams per 100 denier and an elongation of about 12% at the breaking point; and that fatigue resistance as determined by practical tests in automobile tires was very satisfactory. This specific process shows that it is possible to run the corrugated godet at a constant speed during the build-up of a complete spinning package, and provided there is compensating slippage on this godet, the winding tension towards the end of the spinning period is not built up appreciably.

It has been found that if in practicing a process similar to the above example a smooth godet having dimensions similar to the corrugated godet is used in place thereof, but operating at a lower speed than the bobbin so that no slack develops between the godet and the bobbin at the beginning of the spinning period, and if the yarn is run one and one-half times around it so that no compensating slippage of the yarn is occasioned as a result of the tensions exerted on the yarn at the beginning and at the end of the spinning period, then the winding tension on the yarn at the end of the period would build up to well over 200 grams and possibly over 250 grams or to about 0.2 gram per denier. A yarn

body produced in this manner is extremely difficult to process and purify by means of the pressure-vacuum wash treatment.

In practicing another specific process in accordance with this invention, like in the above example, a normal viscose solution was extruded through a spinneret in a known manner into a spinning bath of the following conventional composition, the percentages, as in the above example, being based on the weight of the bath:

|                        | Per cent |
|------------------------|----------|
| Sulfuric acid.....     | 9.3      |
| Sodium sulfate.....    | 17.3     |
| Magnesium sulfate..... | 5.0      |
| Zinc sulfate.....      | 9.3      |
| Water.....             | 64.47    |

The bundle of filaments was withdrawn from the spinning bath by a godet driven at a peripheral speed of 33.6 meters per minute. This godet had a smooth surface and the yarn was wrapped two and one-half times around it so that no slippage of the yarn over the godet occurred. The filaments which consisted of only partly regenerated cellulose xanthate after they left this draw-off godet were immersed to a depth of about 20 centimeters below the surface in a bath of hot water and a sulfuric acid concentration of about 1%, maintained at 75° C. The filaments were drawn around a freely rotatable roller within the hot bath and they were thereafter propelled as a yarn, one and one-half times, about a corrugated glass godet such as described in the above example but driven at a constant peripheral speed of 63.8 meters per minute. The adjustment of the slippage of the yarn was controlled in a similar manner as it was in the above example.

The yarn after passing from this corrugated godet was led to a second intermediate corrugated godet driven at a peripheral speed of 75.8 meters per minute.

The yarn was contacted with this godet for approximately half of its periphery and thus slippage of the yarn over its contacting surface was allowed. Thus it is understood that the yarn speed over both godets is less than the peripheral godet speeds.

During the complete process a length of 1830 meters of 1100 denier yarn was spun uninterruptedly on one spool and this formed a yarn body having a thickness of about 15 millimeters. During this spinning operation, which extended over a period of about 32 minutes, the respective tensions to which the yarn was subjected were measured at the beginning and at the end thereof. It was found that at the beginning of the spinning period the tension between the draw-off godet and the first corrugated godet was slightly over 900 grams, whereas at the end of this period it had increased to about 930 grams. The tension between the first corrugated godet and the second one was found to be about 200 grams at the beginning and 220 grams at the end of the spinning period. The winding tension in the yarn after passing over the second corrugated godet was also measured and found to be equal to about 50 grams at the beginning and to 55 grams at the end of the spinning period. These measurements clearly demonstrate that the respective tensions were not appreciably increased during the entire spinning period, and that in this manner a very low winding tension prevailed.

The yarn after passing from the second corrugated godet was then collected upon a spool in the usual manner at a speed which at the be-

ginning of the spinning period was 60 meters per minute. At the end of the spinning period, the speed of collection of the yarn had increased to 62.5 meters per minute. From this it is to be noted that at the beginning of the spinning period a stretch of 78.6% was given to the yarn between the draw-off godet and the winding spool and that at the end of the spinning period this stretch was increased to 86%. The package was wound in such a manner that it was readily processed and purified by means of a so-called "pressure-vacuum wash treatment."

It was found that the yarn produced by the process of this specific example had a dry tensile strength of about 400 grams per 100 denier and an elongation of about 10% at the breaking point. The fatigue resistance of this yarn, was very satisfactory. From the above it will be seen that the stretching tension between the draw-off and first corrugated godet was about 1.0 gram per denier while the winding tension between the second corrugated godet and the spool was reduced to about .05 gram per denier.

This specific process, as does the foregoing one, clearly demonstrates that it is possible to run the corrugated godet at a constant speed while a complete yarn package is spun; and provided there is slippage on this godet, the winding tension toward the end of the spinning is not materially increased.

In practicing still another specific process in accordance with the present invention a normal viscose solution was extruded through a spinneret having 120 orifices to form 275 denier yarn in a known manner into a spinning bath of the following conventional composition, the percentages being computed on the basis of the weight of the bath:

|                        | Per cent |
|------------------------|----------|
| Sulfuric acid.....     | 9.3      |
| Sodium sulfate.....    | 17.3     |
| Magnesium sulfate..... | 5.0      |
| Zinc sulfate.....      | .92      |
| Water .....            | 67.47    |

The bundle of filaments was withdrawn out of the spinning bath without slippage by a godet driven at a peripheral speed of 42.4 meters per minute. This godet had a smooth surface and the yarn was wrapped three and one-half times around it so that no slippage of the yarn over the godet occurred. Regeneration of the cellulose xanthate to cellulose was retarded by virtue of the employment of the particular spinning bath and the filaments were then immersed to a depth of about 20 centimeters below the surface, into a bath of hot water and a sulfuric acid concentration of about .9% which was maintained at 73° C. The filaments were drawn around a freely rotatable roller within the hot bath and then propelled as a yarn, one half turn, about a corrugated godet such as described in the first foregoing example and which was driven at a constant peripheral speed of about 100 meters per minute. The adjustment of the compensating slippage of the yarn was controlled as set forth in the aforesaid first example.

A length of 5490 meters of the 275 denier yarn with 120 filaments was spun uninterruptedly on one spool and this formed a yarn body having a thickness of about 12 millimeters. During this spinning operation, the tensions in the yarn were measured at the beginning and at the end of this period, which in this case was 84 minutes, and it was found at the beginning of the spin-

ning period that the tension between the first godet and the second godet was 140 grams, whereas at the end of this period the tension was 148 grams. The tensions between the corrugated godet and the spool were found to be 40 grams at the beginning and 45 grams at the end of the spinning period. Thus, it is seen that there was only a slight increase in the respective tensions during the entire spinning period. The yarn, after leaving the corrugated godet, was then collected on a spool in the usual manner and, at a speed which at the beginning of the spinning period was 71 meters per minute, and at the end of same had increased to 74.5 meters per minute. It is to be seen that at the beginning of the spinning period a stretch of 67.2% was given to the yarn between the draw-off godet and the winding spool and that at the end of the spinning period the stretch was increased to 73.3%. Yarn packages so formed were readily treated by means of a so-called "vacuum-wash treatment." The resulting yarn had a dry tensile strength of about 380 grams per 100 denier and an elongation of about 10% at the breaking point. The stretching tension between the godets was about .5 gram per denier and the winding tension between the second godet and the spool was reduced to about .15 gram per denier. Fatigue resistance of this yarn as established by tests in automobile tires was also very satisfactory.

No claim is made in this application to the subject matter disclosed in U. S. Patent Number 2,076,802 to van der Walls (assigned to the same assignee as the present application). That patent relates to the production of rayon packages having uniform dyeing characteristics throughout the package. This is effected by means of decreasing the speed at which the yarn is withdrawn from the setting bath in order to gradually increase the stretch of the yarn during the spinning period. In contradistinction to the foregoing, the present invention is concerned with the production of high tenacity rayon in which a very high stretch is imparted to the yarn and the various tensions are substantially constant throughout the spinning period. This procedure, therefore, avoids the use of complicated speed-change mechanisms for the godets functioning to withdraw and tension the yarn. In order to adjust and control the relative tensions, it is of the utmost importance to provide substantial slippage on the godet at the point or points where the tension must be materially reduced in order to produce a yarn package which is extremely soft throughout and therefore readily washable.

In the description wherever the term "intermediate godet or godets" is employed, it is intended to cover one or more driven godets functioning to reduce the winding tension over which the yarn is passed after passing same over a draw-off godet and on which compensating slippage occurs.

Whereas the invention has been described in its preferred form, various modifications may be made without departing from the spirit and scope thereof and it is to be understood that this invention is only limited to the extent of the appended claims.

We claim:

1. A process of producing high tenacity viscose rayon yarn and the like according to the bobbin spinning method which comprises forming, coagulating and partially regenerating yarn by ex-

truding a viscose solution through fine openings into a setting bath, withdrawing the thus formed yarn at a constant speed from the setting bath by passing the same around the godet and propelling the yarn without gliding friction, completing the regeneration of the yarn while passing the same in its path of travel to a bobbin over an intermediate godet operating at a substantially constant peripheral speed greater than the linear speed of the yarn at that point so that a gliding contact occurs between the yarn and the intermediate godet, collecting the yarn at the bobbin at a greater linear speed than the peripheral speed of the first mentioned godet but at a lesser speed than the peripheral speed of the second mentioned godet, and maintaining throughout the spinning period a substantially constant and reduced tension between the intermediate godet and the bobbin, said tension being at least sufficient to draw the yarn from the intermediate godet tangentially in a straight line.

2. A process according to claim 1 in which the tension between the draw-off godet and intermediate godet as compared with the tension between the intermediate godet and bobbin is greater than 3:1, the tension between the draw-off godet and intermediate godet being not less than 0.5 gram per denier.

3. A process of producing high tenacity viscose rayon yarn and the like according to the bobbin spinning method which comprises extruding a viscose solution and passing the same through a setting bath, withdrawing the thus formed yarn from the setting bath by passing the same around a godet operating at a constant peripheral speed and propelling the yarn without gliding friction, passing the yarn in its path of travel to a bobbin over an intermediate godet operating at a substantially constant peripheral speed higher than that of the first mentioned godet and greater than the linear speed of the yarn at that point so that a gliding contact occurs between the yarn and the intermediate godet, collecting the yarn at the bobbin at a greater linear speed than the peripheral speed of the first mentioned godet but at a lesser speed than the peripheral speed of the second mentioned godet, and maintaining throughout the spinning period a reduced tension in a range of 0.04 to 0.15 gram per denier between the intermediate godet and the bobbin.

4. A process of producing high tenacity viscose rayon yarn and the like according to the bobbin spinning method which comprises extruding a viscose solution into a setting bath to form coagulated and partially regenerated filaments therefrom, withdrawing the thus formed yarn from the setting bath by passing the same around a godet operating at a constant peripheral speed and propelling the yarn without gliding friction, completing the regeneration of the yarn while passing the same in its path of travel to a bobbin over another godet operating at a substantially constant peripheral speed greater than the linear speed of the yarn at that point so that a compensating gliding contact occurs between the yarn and the second godet, thereby permitting continuous adjustments of the relative tensions, collecting the yarn at the bobbin at a slightly increasing peripheral speed during the spinning period and at a greater linear speed than the peripheral speed of the first mentioned godet, but at a lesser speed than the peripheral

speed of the second mentioned godet, maintaining throughout the spinning period a substantially constant and reduced tension between the second godet and the bobbin, said tension being at least sufficient to draw the yarn from the second godet tangentially in a straight line.

5. A process according to claim 1 in which the tension between the draw-off godet and intermediate godet is greater than 0.5 gram per denier.

6. A process according to claim 1 in which heavy denier yarn of the order of 1100 denier is produced and in which the tension between the draw-off godet and the intermediate godet is greater than 0.8 gram per denier.

7. A process according to claim 1 in which heavy denier yarn of the order of 1100 denier is produced and in which the tension between the draw-off godet and intermediate godet as compared with the tension between the intermediate godet and bobbin is greater than 8:1, the tension between the intermediate godet and the bobbin approaching 0.07 gram per denier.

8. A process according to claim 1 in which heavy denier yarn of the order of 1100 denier is produced and in which the tension between the draw-off godet and intermediate godet as compared with the tension between the intermediate godet and bobbin is greater than 8:1, the tension between the draw-off godet and the intermediate godet being greater than 0.8 gram per denier.

9. In the spinning of heavy denier yarns (of at least 1100 denier) onto a rigid winding device by applying a high yarn tension (more than 0.5 gram per denier) between two driven godets operating at different peripheral speeds, the method involving preventing substantial yarn slippage on the first godet, while effecting yarn slippage on the second godet, which comprises maintaining the yarn tension between the second godet and the winding device higher than 0.04 and lower than 0.15 gram per denier while maintaining a ratio of tension between the said driven godets as compared with the tension between the second godet and the winding device of at least 8:1.

10. A process for the production of rayon yarns having a denier of at least 1100, high tensile strength, low elongation and high fatigue resistance which comprises extruding a viscose solution into a coagulating bath containing zinc sulphate to coagulate, partially regenerate and form a bundle of filaments, passing said filaments about a draw-off godet operating at a constant peripheral speed and without slippage of the filaments thereon, completing the regeneration of the filaments by passing the same through an aqueous bath maintained at a temperature above 60° C. under a substantially constant tension above 0.5 gram per denier, passing said filaments around a corrugated godet and thence to a collecting device, said corrugated godet being driven at a substantially constant higher peripheral speed than the collecting device with slippage of the filaments thereon, and subjecting said filaments to a substantially constant winding tension approximately within the range 0.04 to 0.15 gram per denier while collecting said filaments on said collecting device, the ratio of said initial tension to the winding tension being at least 8:1.

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