Aug. 31, 1937. C. A. HUTTINGER 2,091,282

PROCESS OF TREATING FINE FILAMENTOUS THREADS

Filed March 21, 1936 3 Sheets-Sheet 1

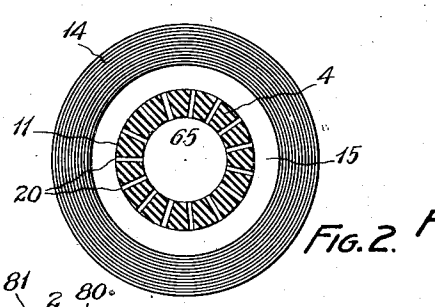

FIG. 2.

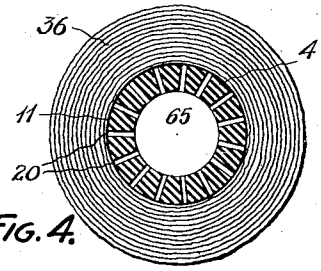

FIG. 4.

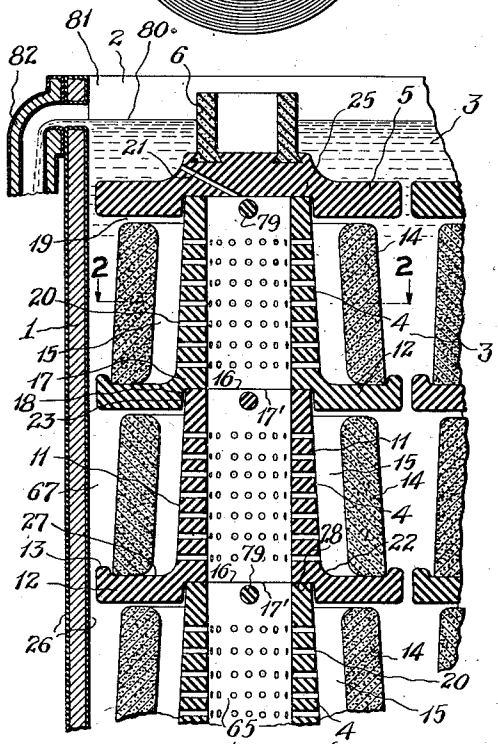

FIG. 3.

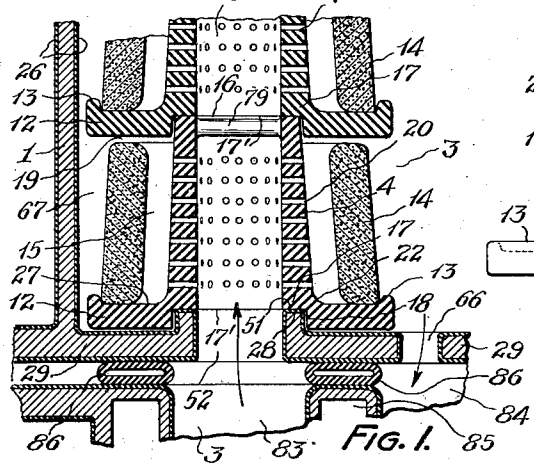

FIG. 1.

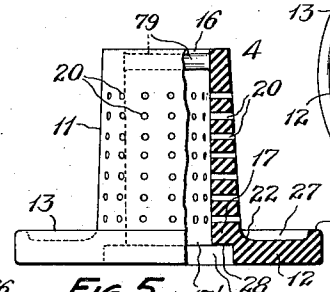

FIG. 5.

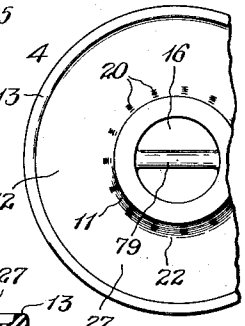

FIG. 6.

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PROCESS OF TREATING FINE FILAMENTOUS THREADS

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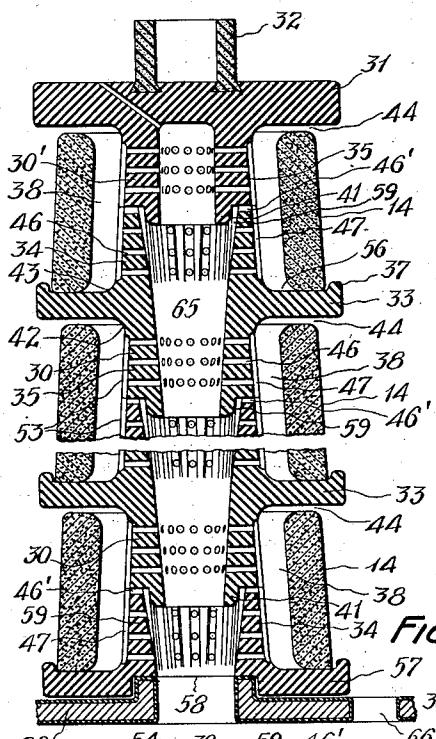

FIG. 7.

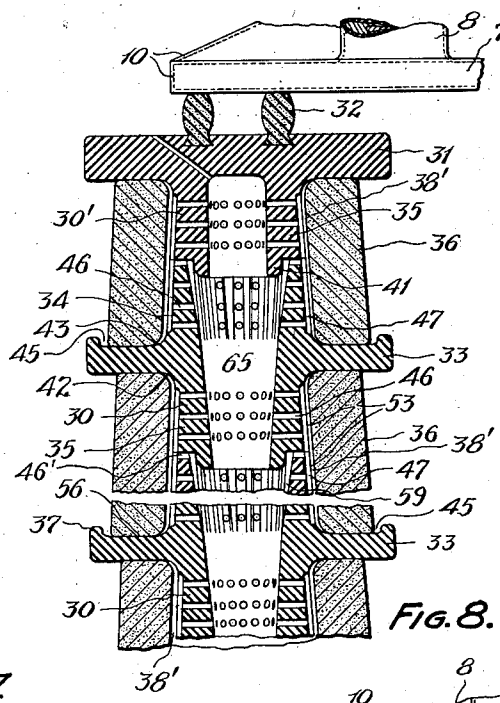

FIG. 8.

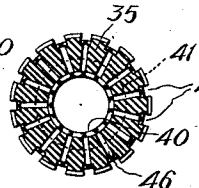

FIG. 10.

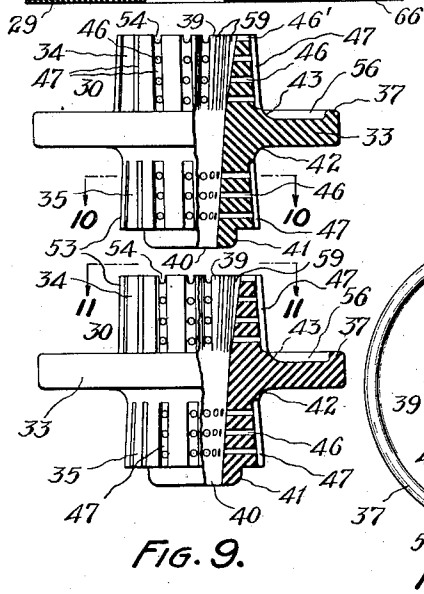

FIG. 9.

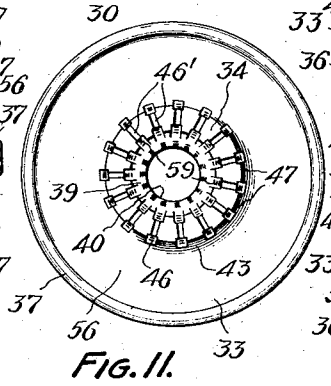

FIG. 11.

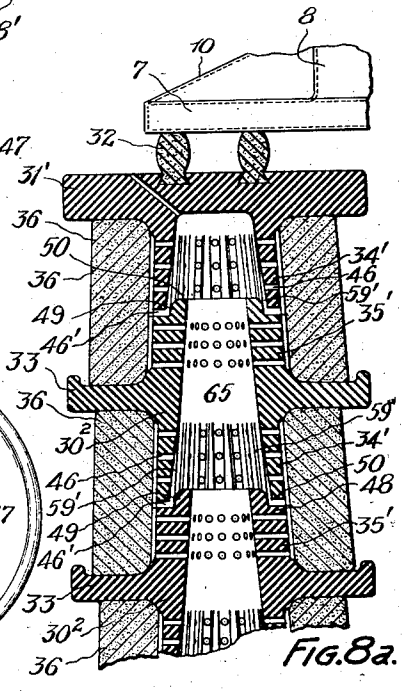

FIG. 8a.

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PROCESS OF TREATING FINE FILAMENTOUS THREADS

Filed March 21, 1936 3 Sheets-Sheet 3

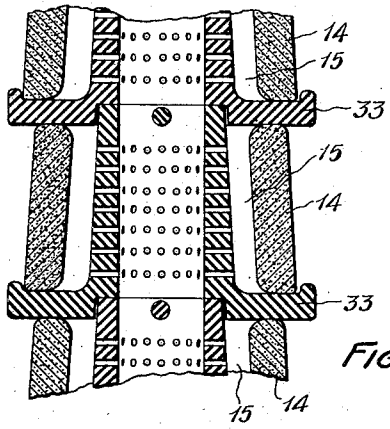

FIG. 12.

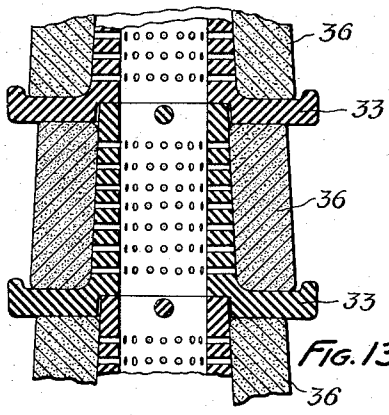

FIG. 13.

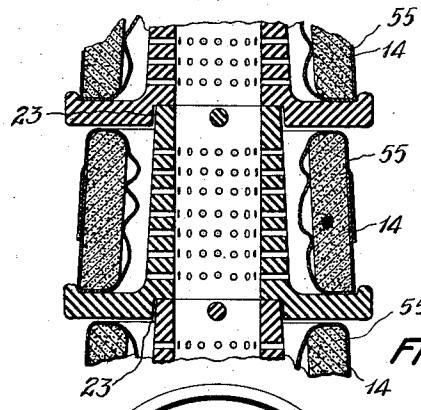

FIG. 14.

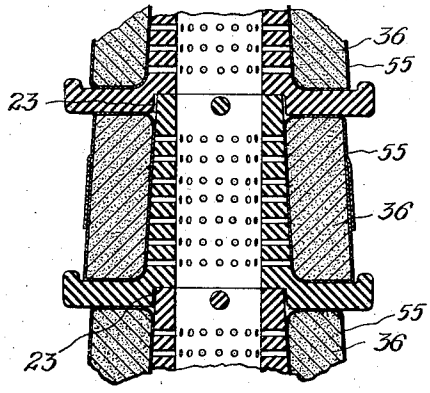

FIG. 15.

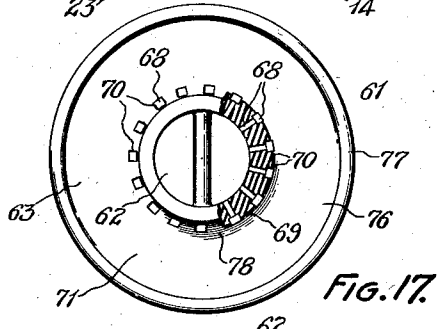

FIG. 17.

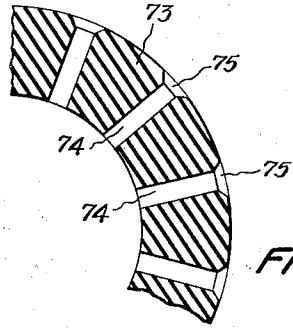

FIG. 18.

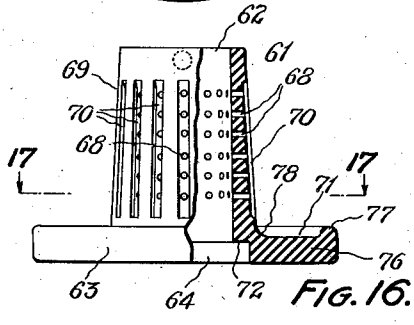

FIG. 16.

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Patented Aug. 31, 1937

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UNITED STATES PATENT OFFICE

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PROCESS OF TREATING FINE FILAMENTOUS THREADS

Charles A. Huttinger, Lakewood, Ohio, assignor to Acme Rayon Corporation, Cleveland, Ohio, a corporation of Ohio

Application March 21, 1936, Serial No. 70,047

16 Claims. (Cl. 18—54)

My invention relates to means for supporting rayon packages when liquid treating such packages to effect the different purifying operations to which rayon is necessarily subjected, before the precipitated and package-collected thread can be considered a final product ready for the market. These liquid treatments include various water washings, desulphurizing, bleaching, oiling, sizing, dyeing, drying, and other purifying and finishing operations.

Particularly, the invention relates to package supports utilized during such treatments of freshly spun rayon collected in tubular packages, such as the well known cakes, bobbins, spools, etc. Primarily, the invention relates to means used in such treatments which loosen up the freshly spun packages so as to provide for all parts of the package their respective scopes of natural free play, relative to other parts of the package, thus effecting a natural alteration of the relative positions of all of the thread strands comprising the packages and of the different portions of the package. This loosening of the packages is effected without injuriously disarranging the thread or the multiple filaments of which the thread is comprised, so that the package may be dried in the treated package form, preliminary to the sale thereof to the market, or to the rewinding thereof into some other form of package for such sale, without inducing strains or an immobile condition in any portion of the package which would result in a non-uniform dyeing or barred effect.

The purification and other treatments of the packages are carried out without unduly impairing the tenacity and elasticity of the thread which are essential to later handling and processing and use, and without setting up local tension areas or non-uniform strains in the package.

Essentially, the improved package support provides a chamber in which the spun package as a whole, and different package portions, may expand inwardly and may pulsate and make to-and-fro floating movements, under the action of a treating liquid applied under pressure to the package, transversely of the axis thereof, and alternately in both directions, thus to increase the wall thickness of the package and decrease its density. The effect is to loosen up the package and treat it.

Preferably, my entire improved package-treating apparatus is formed of solid rubber or, at least, it is lined with rubber, so as to obviate metallic corrosion which would contaminate the treating liquid and the rayon packages. Certain other advantages attach to the solid rubber construction which will clearly appear in other portions of this specification.

Some forms of my invention also include means for permitting to the package, under the action of the treating liquid, and during the early stages of the treatment, a predetermined amount of lengthwise elongation, so that packages liquid-treated by these forms of the invention not only expand inwardly and become loosened up in planes transversely intersecting their axes but also are increased in length to a certain extent in planes parallel to the package axes.

My invention also includes improved processes of liquid-treating fine filamentous thread in package form. In my improved method of package treatment, the package is surrounded by the treating liquid and the latter acts as a lubricant for the thread obviating injury to the latter.

It is well understood by those skilled in the art that rayon packages of the character herein described are spun so that the strands thereof substantially prevent any enlargement of the package perimeter, during liquid treatment, when using liquid pressures within practicable limits. Therefore, the effect of the treating liquid passed into the package, under any pressures practicably usable, is not to expand or deform the package outwardly so as to increase its perimeter to any material extent. Although the range of practicable liquid pressures is considerable, particularly by reason of the different effects of different treating liquids, and by reason of the different characteristics of packages made in different ways, I preferably use a nominal pressure of from two to three pounds when working the improved processes of the instant invention. The net effect of a liquid treatment upon a package by my improved process is somewhat to decrease the perimeter of the original package.

The annexed drawings and the following description set forth in detail certain means illustrating my improved package-treating apparatus and certain procedures illustrating my improved package-treating process, such means and procedures constituting, however, only a few of the various forms in which the principle of the improved apparatus may be embodied, and only a few of the various methods by which the principle of the improved process may be worked. The claims of this application are directed to my improved package-treating process.

In said annexed drawings:

Figure 1 is a broken longitudinal section of one

form of my improved supporting means for rayon packages, showing both ends of a longitudinal tier of aligned packages loosely mounted thereon, whereby they can be liquid-treated by my improved process. This view illustrates one form of support in which a loosening up of the package by liquid treatment is effected both by an inward transverse expansion of the package and a certain lengthwise elongation thereof, the view showing cake packages in the form in which they are collected by the spinning of the freshly precipitated thread from the setting bath;

Figure 2 is a fragmentary transverse section, taken in the plane indicated by the line 2—2, Figure 1;

Figure 3 is a view of the upper part of Figure 1 but showing the form and position which the packages assume as a result of the liquid treatment, this view also showing certain means for effecting a tight clamping together of the several parts of the supporting means before commencing the liquid treatment;

Figure 4 is a fragmentary transverse section, taken in the plane indicated by the line 4—4, Figure 3;

Figure 5 is a partial elevation and a partial lengthwise section of one of the package inserts shown in multiple in Figure 1;

Figure 6 is a fragmentary plan view of the package insert shown in Figure 5;

Figure 7 is a broken lengthwise section of a modified form of package-supporting means, in which also during the liquid treatment the package is both expanded transversely and permitted a certain lengthwise elongation, the view showing cake packages in the form in which the freshly spun thread is collected;

Figure 8 is a view of the upper part of Figure 7 but showing the form and position assumed by the packages as a result of the liquid treatment and also showing means for effecting a tight clamping together of the several parts of the supporting means before commencing the liquid treatment;

Figure 8*a* is a view similar to Figure 8 but showing a reversed end-for-end structure of the individual package inserts, so that adjacent inserts are nested together differently than shown in Figure 8;

Figure 9 is a partial elevation and partial lengthwise section of two of the adjacent package inserts shown in multiple in Figure 7, the two inserts being spaced apart somewhat so as to make clear how inserts can be nested together for the assembling thereon of a plurality of closely adjacent packages in a longitudinal tier;

Figure 10 is a transverse section, taken in the plane indicated by the line 10—10, Figure 9;

Figure 11 is a plan view, taken from the plane indicated by the line 11—11, Figure 9;

Figure 12 is a fragmentary longitudinal section of a form of my improved package supporting means which is similar to that shown in Figure 1 except that no provision is made in the form of support shown in Figure 12 for a lengthwise expansion of the cake packages during the liquid treatment;

Figure 13 is a view similar to Figure 12 but showing the packages in the form and position which they assume as a result of the liquid treatment;

Figure 14 is a view similar to Figure 1 but in which there are additionally provided fabric covers for the respective individual packages, the view showing cake packages in the form in which the freshly spun thread is collected, and also showing the general arrangement of the fabric covering upon the packages before the liquid treatment;

Figure 15 is a view similar to Figure 14 but showing the form and position assumed by the package and its covering as a result of the liquid treatment;

Figure 16 is a partial elevation and a partial lengthwise section of an individual package insert of modified structure, the modification consisting in the provision of lengthwise recesses intersecting the peripheral surface of a package insert such as shown in Figure 5;

Figure 17 is a transverse section of the package insert shown in Figure 16, the view being taken in the plane indicated by the line 17—17, Figure 16; and

Figure 18 is an enlarged view of a fragmentary portion of a transverse section of a modified form of package insert, the modification consisting in enlarging the outer ends of certain ports provided in the package insert shown in Figure 5.

Referring to the annexed drawings, in which the same parts are indicated by the same respective numbers in the several views, and first particularly referring to the form of package supporting means shown in Figures 1–6, I mount a lengthwise tier of axially-aligned tubular rayon packages, such as cakes 14, collected during the spinning of freshly precipitated rayon thread, upon improved supporting means assembled in the manner hereinafter fully described, and effect the liquid treatments of the packages when so mounted in a suitable treating chamber 1 having an open top 2 and within which is circulated the treating liquid 3 through the package bodies. The showing of the packages 14 in Figure 1 is in substantially the form in which such packages of the cake type are collected from a viscose-precipitating bath during the spinning operation.

For mounting the packages 14 I use a plurality of improved package inserts 4, Figure 5, one for each package, in the form of invention illustrated, which are adapted to be nested together to form continuous supporting means for a lengthwise tier of axially-aligned packages 14. The supporting structure has a cover consisting of a pad member 5 having a smooth lower face intersected by a recess 25 which is circular in cross section and receives the upper end of the upper individual package insert 4, the diameter of the recess 25 being slightly greater than the diameter of the upper end of the package insert 4. The cover 5 is provided with an annular chambered and open-top resilient buffer 6 upwardly extended from the top surface thereof and adapted to be engaged by a vertically-movable plate 7 which has extended from its upper surface a hub 8 within which is secured a rod 9 actuable by any suitable means to move the plate 7 downwardly and upwardly so as to effect the tight clamping together or the releasing of the lengthwise tier of individual inserts 4, since the ends of these inserts 4 each have cooperating nesting means hereinafter more fully referred to. The plate 7 serves also as a complete or partial cover for the surface of the liquid 3 in tank 1 to prevent escape of vapors.

My improved support structure is preferably made of solid rubber, so that the support structure is a tightly clamped non-leakable mass—except for certain designed liquid ports—in the clamped condition of the individual rubber inserts 4, the annular resilient buffer 6 being

squeezed into the shape shown in Figure 3. The clamping means have a rubber cover 10 and the tank 1 is provided on all surfaces with a rubber cover 26.

The individual hard rubber package insert 4 is a tubular column having an outwardly extended annular flange 12 at one end, Figure 5, and a surface 11 outwardly tapered from the flange 12. The flange 12 has an upwardly extended peripheral bead 13 so that there is formed an annular upper recess 27 in the flange 12 for the reception of the larger end of a frustro-conical tubular rayon package 14, the package 14 surrounding the insert column, as clearly shown in Figure 1. The taper of the surface 11 corresponds quite closely to the taper of the inside face of the package 14. The diameter of a cross section of the column of the insert 4 is materially smaller than the inside diameter of an untreated package 14 so that when the latter is mounted on one end on the flange 12 and in the recess 27 an annular lengthwise opening 15 is created between the surface 11 of the insert 4 and the inside face of the rayon package 14. This opening 15 is a chamber in which the package 14 may transversely pulsate and inwardly expand and become loosened up during the liquid treatment, as hereinafter more fully described.

The insert 4 has an open top end 16 and a bottom 17 formed with an opening 17'. The bottom 17 is formed with a recess 18 circular in cross section and intersected by the opening 17' and of a diameter somewhat in excess of the diameter of the open top end of an insert 4 so that the top ends of the inserts will nest with the bottoms of respectively adjacently higher inserts against shoulders 28 to form a lengthwise column of inserts, such as shown in Figure 1. The bottom insert 4 is mounted upon the bottom 29 of the tank 1 and the bottom 29 is formed with an opening 52 surrounded by a raised seat 51 formed in the bottom 29 of the tank 1. The opening 52 through the bottom 29 forms a port for the passage of liquid between the exterior of the tank 1 and the chamber 65 formed within the lengthwise tier of inserts 4. The bottom 29 of the tank 1 is formed with a plurality of ports 66 communicating with the chamber 67 of the tank 1 exteriorly of the cakes 14, so that, since the columns of the inserts 4 are ported, as hereinafter mentioned, treating liquid can be circulated in the tank 1 in either direction through the cakes 14, either by being passed into the tank 1 through the ports 52 and out through the ports 66, or in through the ports 66 and out through the ports 52, and, in either event, the treating liquid passes through the bodies of the lengthwise tier of cakes 14.

In order to effect an assemblage of the inserts 4 easily and conveniently, the inserts 4 are nested together somewhat loosely, a small annular space 23 being formed between the side wall of the recess 18 and the outer surface of the top end of the insert 4 which is nested therein. The wall of the tubular column of each insert 4 is intersected by a multiplicity of ports 20 which provide for the passage of treating liquid through the wall of the column and between the interior and exterior thereof. The top open end 16 of an insert registers with the bottom opening 17' of the adjacently higher insert 4 so that fluid communication is provided between the interiors of adjacent inserts and fluid flow throughout the chamber 65 of the whole column of inserts.

In the form of device shown in Figures 1–6, the flanges 12 of adjacent inserts 4, when the latter are assembled as shown in Figure 1, are spaced apart a distance somewhat greater than the length of a freshly spun package 14, so that when the packages are assembled for treatment, as shown in Figure 1, a space 19 is provided between the top of each package 14 and the adjacently higher flange 12. By reason of this space 19, the package 14 is permitted a certain lengthwise elongation during the liquid treatment, as hereinafter more fully explained.

The inner wall bounding the recess 27 of each insert flange 12 is of curved formation, as indicated by "22", so as to accommodate, without entangling the rayon threads, the inner lower corner of the package 14 when the latter has been expanded into the opening 15, as shown in Figure 3, and as hereinafter fully described.

The treatment liquid is derived from a suitable source, and circulated by suitable means, and reversed in flow-direction, as desired. In coming from and returning to the circulating means, the treating liquid passes to and from the ports 52 and 66 via chambers 83 and 84 formed in a treatment base or foundation, which chambers 83 and 84 are separated by partition members 85, portions of which are suggested in Figure 1. The treatment tank 1 rests upon a rubber gasket 86 mounted on a fixed working base (not shown, except that a portion of said base is suggested by the partition members 85).

A column of inserts 4 and packages 14, assembled as shown in Figure 1, with the bottom of the outside faces of the packages 14 substantially in contact with the beads 13 of the support flanges 12, is subjected to a treating liquid 3 circulated under pressure repeatedly through the tank 1 and, during certain stages of the treatment, alternately reversed in direction of flow, now being passed into the interior 65 of the column of inserts 4 through the ports 52, and thence passed through the insert ports 20 into the openings 15 and thence passing through the packages 14 from within outwardly, and out through the ports 66; and then being passed into the tank 1 through the ports 66, thence through the packages 14 from without inwardly through the openings 15 and through the ports 20 to the interior of the column of package inserts 4, and out through the ports 52. During the treatment of the packages 14 by the liquid 3, the packages expand inwardly into the openings 15, due to the gradual loosening up of the packages effected by the liquid treatment and due to the fact that the packages are so spun that they cannot expand outwardly to increase their perimeters to any material extent, as hereinbefore explained. Also the packages pulsate in the entire space provided therefor between the package support surfaces 11 and the plane containing the inner walls of the flanges 13, in to-and-fro floating movements. The outside surfaces 11 of the package inserts 4 form stops or abutments limiting the inward movements of the packages 14.

Furthermore, during the initial stages of the treatment, the packages 14 elongate lengthwise under the action of the treating liquid and fill the spaces 19 and contact the bottom faces of the flanges 12 with their upper ends, these spaces 19 being so limited in depth that the lengthwise elongation of the packages is less in extent than the packages would make if they were permitted to elongate without restraint. In other words, the depth of a space 19 is not as great as the distance through which the package 14 would elongate if it were not restrained and were per-

mitted to elongate to the full extent which it would undergo under the liquid treatment. This lengthwise elongation of the packages 14 is particularly evident when treating freshly spun thread in the gel state. As more time elapses after the spinning of the thread and before the initial liquid treatment thereof, the tendency of the packages 14 to elongate under liquid treatment decreases.

If perchance the liquid pressure is such, or the density of the package 14 is such, as to prevent reasonably easy first passage and penetration of the package body 14 by the treating liquid, then, during the initial stages of the liquid treatment, the space 19 provides pressure-relief by permitting treating liquid to escape therethrough and thus by-pass the package body 14 until the package 14 has become somewhat more porous and has been loosened up both lengthwise and transversely and has closed the space 19.

The position and form of the treated package 36, after the liquid treatment, is shown in Figure 3 wherein it will be noted that the package 36 has filled the opening 15 and has its inner face substantially adjacent the surface 11 of its insert 4, and its upper end closely in contact with the bottom face of the flange 12 of the next higher package insert 4. Thus it will be noted that the ends and inner face of the expanded package 36 are accommodated by or seated against the surface 11 of the insert 4 and the adjacent flanges 12. Thus the construction affords relocating means for the expanded package while serving also to prevent any washing down or damaging of the package, or the dislocation of the thread layers thereof, during the liquid treatment. In so expanding and assuming the shape and condition shown in Figure 3, the package 36 has been pulled away, by the tension of the exterior strands thereof, and/or floated apart, somewhat from the inner face of the flange bead 13, as indicated by space 24, Figure 3.

For the escape of any air entrapped during the liquid treatment in the chamber 65, a small relief channel 21 is formed in the cover member 5.

In order to facilitate the assembling, removal, and handling of the individual inserts, each insert 4 may be integrally formed with or provided with a bar 79, preferably located near the top of the insert and disposed transversely of the opening 16.

In providing treating liquid 3 for the cake treatments, the treatment tank 1 is filled with the treating liquid 3 until the latter overflows at the level 80 into a chamber 81 whence the overflow passes out from the tank 1 by a down pipe 82.

When the direction of liquid flow is from without the cakes 14 and inwardly thereof, a negative pressure or suction is created by the liquid-circulating medium within the chamber 65 and openings 15 interiorly of the cakes 14, and the pressure of the treating liquid on the exterior faces of the cakes 14 is atmospheric, due to the provision of the overflow or vent 81.

Regardless of the pipes and other liquid flow apparatus, the difference in pressures between the inside and outside of the packages 14 is balanced. Of course, the pressure on that side of the package 14 facing the intake of the circulating medium will be a negative one, i. e., one below atmospheric pressure, and, when the flow of treating liquid is from without the packages inwardly, the pressure on the outside of the packages 14 is atmospheric, due to the overflow or vent 81 at the top of the treatment tank 1, as hereinbefore explained. Furthermore, the effective work done by the treating liquid is uniform on all packages 14 of a vertical tier of packages, regardless of the height of the tier, the formation of any substantial differential effect tending to arise from any hydrostatic head being obviated by reason of the provision of the overflow 81.

The depth of the space 19, which controls the amount of longitudinal elongation permitted to the package 14, can be coordinated with the amount of permissible lateral loosening of the package so as to produce a desired amount of longitudinal elongation of the package relative to the amount of inward expansion of the latter.

When the package 14 has been expanded inwardly by the action of a treating liquid applied to the exterior face thereof, the package tends to reestablish itself in its original form under the action of the treating liquid when the flow direction of the latter is reversed. However, only a comparatively short treatment period is necessary, and only a very few reversals of direction of liquid flow, to cause the package 14 substantially completely to fill the space 15, as hereinafter more fully explained.

In the form of package supporting means shown in Figures 7, 8, 9, 10, and 11, a hard rubber cover member 31 is provided with an annular and chambered open-top resilient buffer 32 projected upwardly from its upper face and engageable by a plate 7 to clamp a vertical tier of inserts, as clearly shown in Figure 8. This member 31 is formed with a downwardly-extended tubular extension 35 forming the upper half of the topmost insert 30' of a vertical tier of inserts for a plurality of rayon packages 14. The remainder of the inserts each designated "30", forming the vertical tier of inserts, are adapted to each provide cooperating means for the lower half of one rayon package 14 and the upper half of the adjacently lower package 14, except a base insert 57 which forms the lower half of an insert for the lowermost rayon package 14. These supporting means have laterally-extended flanges 33 formed intermediate the ends of the inserts 30 and at the bottom of the insert 57 so that one frustro-conical package 14 can be rested upon its larger end on the top of the flange 33 and the smaller end of another frustro-conical package is disposed adjacently beneath the flange 33 and is rested by its larger end upon the flange 33 of the adjacently lower insert 30, all as clearly shown in Figure 7. The flange 33 of the insert is provided with a peripheral bead 37 forming a recess 56 within which the bottom end of the rayon package 14 may be mounted. The portion of the insert 30 upwardly extended from the flange 33 is indicated by "34", and the portion of the insert 30 downwardly extended from the flange 33 is indicated by "35". The top edge of an insert portion 34 and the edge of the adjacently higher insert portion 35 register to form a continuous surface 53 outwardly tapered from the adjacently lower flange 33 and having substantially the same inclination as the inner face of the frustro-conical rayon package 14 rested by its larger end upon the flange 33. The insert portions 34 have open tops 39 and the insert portions 35 have open bottom portions 40 formed with downwardly extended pilot members 41. The pilot members 41 register with the open tops 39 so as to provide for the nesting together of a plurality of inserts 30, the nesting together being loose enough to facilitate easy assembling of the inserts. The bottom

insert 57 is formed with a port 58 by means of which liquid may pass into and out of the interior of its portion 34. In the form of device shown in Figure 7, the flanges 33, and the body member of the cover 31 and the adjacently lower flange 33, and the body of the bottom insert 57 and the adjacently upper flange 33 are, respectively, spaced apart a distance somewhat greater than the length of a rayon package 14 so as to provide a space 44 between the top of each package 14 and the adjacently higher flange 33 or the body of the cover member 31. The outer lower surface of the insert members 34 and the upper outer surface of the insert members 35 are rounded as indicated by "43" and "42", respectively, so as to provide for the expansion of the packages 14 at the upper and lower edges of the inner faces of the packages 14, without entangling of threads thereof, as clearly shown by the expanded packages 36, Figure 8. The walls of insert members 34 and 35 are formed with ports 46 whereby liquid flow is provided between the interiors and exteriors of the inserts 30, this flow being into and from openings 38 provided between the exterior faces 53 of the supports 30, and the interior faces of the rayon packages 14, in the unexpanded condition of the latter, as clearly shown in Figure 7. The insert portions 34 and 35 are formed with lengthwise passages 47 in their outer surfaces which intersect the outer ends of the ports 46, and the insert portions 34 with lengthwise passages 59 in their inner surfaces which intersect the inner ends of the adjacent ports 46. These passages 47 and 59, which are in the form of grooves or recesses, serve to tie together the wall ports 46. Ports 46' formed in the upper faces of the insert portions 34 serve to connect the upper ends of passages 59 with the joints between adjacently vertical passages 47.

The effect of liquid treatment upon a lengthwise tier of packages 14 assembled as shown in Figure 7 is clearly indicated by the packages 36 in Figure 8 wherein it will be noted that the packages have expanded inwardly so as substantially to fill the openings 38 and have elongated so as to fill the spaces 44, the final position of the outer faces of the packages 36 being somewhat interiorly of the inner walls of the beads 37, as indicated by the spaces 45, Figure 8.

In the form of device shown in Figure 8*a*, the portions 34 and 35 of the inserts 30 and 30' of Figure 7 have been reversed end-to-end, so as to provide for the nesting of a pilot 49 which is formed upon the top 48 of each insert portion 35' of an insert 30^2 with the open bottom 50 of the insert portions 34' of the adjacently higher insert 30^2 and of the cover member 31'. The tapers of the insert portions 34' and 35', in this form of device, are such that the insert portion 35' tapers outwardly from the flange 33 and the insert member 34' widens outwardly from the flange 33, so that the insert 30^2 for a package 14 is formed with the same taper as the inserts 30 and 30', shown in Figures 7 and 8, whereby, similarly to the assemblage shown in Figures 7 and 8, a package 14 is rested by its larger end upon the flange 33 of an insert 30^2, Figure 8*a*, with its upper small end adjacent the lower face of the adjacently higher flange 33.

In the forms of package-supporting means shown in Figures 7 and 8*a*, the chamber 65 interiorly of the support structure is not of uniform cross-sectional dimension but changes in cross-section adjacent each joint between nested inserts 30, 30', 30^2, and 57. In Figure 7, assuming the flow of treating liquid is upwardly of the structure, some of the liquid at each joint passes upwardly through the passages 59 of the insert portion 34 for distribution through the communicating ports 46 to the adjacent package 14, and the balance of the liquid passes into the adjacently higher insert 30'. In Figure 8*a*, all the liquid reaching a joint passes the joint and then, upon entering the insert portion 34' of the next adjacently higher insert 30^2, the liquid in part follows the passages 59' for distribution through the communicating ports 46 to the adjacent rayon package, and in part passes to the upper portion 35' of the insert 30^2.

One of the advantages of package supporting inserts 30 and 30^2, of the constructions shown in Figures 8 and 8*a*, respectively, is that there are no openings between the ends of such inserts and the walls of the ends of the adjacent inserts with which they register or nest, such as the openings 23, Figure 1. Thus, the possibility of entangling the package thread in and by means of such openings 23 during the liquid treatment is prevented. This advantage is particularly evident when the cakes 14 are not wrapped in fabric or other protective coverings during the liquid treating operation. An especial advantage of the reversed end-to-end arrangement, shown in Figure 8*a*, is that by such structure uniform feed of water to the several rayon packages may be more certainly assured. In the form of device shown in Figure 7, and assuming that the treating liquid is fed into the supporting structure from the bottom, the pressure of the treating liquid might in some instances be strong enough so as to carry the treating liquid too rapidly by the ports 46 of the lower inserts 57 and 30 to permit these lower ports to pass their suitable share of the treating liquid, and so the lower cakes 14 would not be efficiently liquid-treated. Furthermore, a speeding up of the velocity of liquid flow would occur at the joint between each two contiguous inserts 30 by reason of the narrowing of the liquid chamber 65 within the supporting structure at these junction points. However, in the form of structure shown in Figure 8*a*, the liquid chamber 65 leading upwardly within the supporting structure is gradually narrowed from the bottom to the top of each insert 30^2 and then is widened at the point where the insert nests with the adjacently higher insert. Therefore, the treating liquid enters the supporting structure and each unit insert 30^2 thereof over a wider area, and hence more slowly, than it leaves each individual insert 30^2. That is, the velocity of the treating liquid is speeded up progressively through each insert 30^2 and slowed down as it enters each succeeding insert 30^2.

In the forms of supporting structure shown in Figures 7–11, the central ports 46', which are those adjacent the ends of the insert portions 34 and 34', are the essential ports for passing liquid between the interior and exterior of each insert 30 or 30^2. In fact, these ports 46' in themselves are oftentimes sufficient for satisfactory operation. By means of the peripheral recesses 47, these ports 46' have ready access to the entire inside face of the rayon packages 14, and by reason of the passages 59 and 59' in the inner face of the insert portions 34 and 34', ample liquid flow between the inner chamber 65 of the supporting structure and ports 46' is provided.

In the form of supporting structure shown in Figures 12 and 13, an arrangement similar to that shown in Figures 1 and 3 is provided except that the flanges 33 are spaced a distance apart sub-

stantially equal to the length of an untreated package 14 so that the liquid treatment effects no lengthwise elongation of the package 14 but only a transverse expansion of the package 14 in the opening 15 is permitted by this form of apparatus.

In Figures 14 and 15 is shown a construction similar to that shown in Figures 1 and 3 except that each package 14, before it is mounted for liquid treatment, and preferably when the package is in freshly spun condition, is loosely enfolded in a protective cover 55 which is wrapped about the whole package and is lapped exteriorly of the package 14 in substantially the formation shown in Figure 14. A protective covering 55 is used which permits ready passage therethrough of the treating liquid, being preferably formed of fabric such as cheese-cloth. When the packages 14 are transversely expanded and elongated lengthwise by the liquid treatment, the loose fabric wrapping 55 becomes taut to closely encompass the package, as shown in Figure 15. The fabric wrapping 55 when initially placed upon the package is loose enough so as to permit the package 14 to expand under the liquid treatment without a movement of the wrapping 55, or a shifting thereof, over the package surface.

The covering 55 is particularly of advantage, when liquid treating packages 14 according to my improved process with package supporting apparatus which form recesses, such as the openings 23, Figures 1 and 14, wherein the thread of the package 14 might become disarranged or entangled during processing, since the covering 55 prevents such disarrangement or entanglement of the thread in these openings.

In Figures 16 and 17, I show a form of an individual package insert 61 which is similar to that shown in Figure 5 except that its tapered outer surface 69 is intersected by lengthwise recesses 70. These recesses open into ports 68 passing through the wall of the insert 61 but are of a substantially greater width than the ports 68, as clearly shown in Figure 17. This insert 61 has an open top 62 whereby it may have liquid communication with an adjacently higher insert 61 through a circular recess 64 having an open top communicating with the interior of the insert 61. This recess 64 is formed in a bottom member 63 having an outwardly-extended flange 76 formed with an upwardly-extended peripheral bead 77. Thus there is formed a recess 71 within which the larger bottom end of a frustro-conical rayon package may be rested upon the flange 76. The inner wall of the recess 71 is rounded, as indicated by "78", to prevent intertangling of thread during the liquid treatment. The recess 64 is slightly larger in cross-section than the open top 62 so that there is formed an annular shoulder 72 against which the adjacently lower insert 61 may abut in a nested arrangement of a plurality of inserts 61 to form a lengthwise tier of inserts for mounting a plurality of rayon packages for liquid treatment.

In Figure 18, the insert 73 is not provided with exterior lengthwise recesses for distributing the treating liquid to the rayon packages or draining liquid therefrom but in lieu thereof the ports 74 through the walls of the insert 73 are enlarged at their outer ends 75.

In all forms of my improved package supporting structures, provision is made by means of expansion chambers 15 and 38 for a loosening of the package which may be slightly more than necessary. In other words, the final position of the inside face of the expanded package 36 might not be tightly against the exterior surfaces of the tubular columns of the insert but there might be a slight space, such as 38', Figure 8, between the inner face of the expanded package 36 and the adjacent exterior surface of the insert 30, 30', or 30^2. Such a space 38' as described will facilitate the removal of the expanded package 36 from the inserts.

By my improved process of treating rayon cakes, the following effects are produced in the cake package substantially in the order stated: first, the package 14, particularly when treating freshly spun packages in the gel state, elongates under liquid influence until it fills the space 15 or 44 and the top end of the package abuts the lower face of an insert flange 33; then, in a comparatively short time, possibly one or two minutes, by a few reversals of direction of flow of the treating liquid, involving a few package pulsations, the package is inwardly expanded and loosened up so as substantially to fill the space 15 or 38; and then, the liquid treatment is continued for such a period of time as is suitable for the particular treatment and/or the character of the package, this final treatment being preferably, although not necessarily, effected by a passage of the treating liquid from inside the package outwardly. Although, in order to obtain efficient results from my improved method of processing rayon packages, it is not necessary so to work my method, I prefer to cause the last direction of flow of treating liquid, in the final stages of treatment, to be from without the packages inwardly so that the last shape and condition of the package, before drying the latter, is a porous and highly slack one, and thus the drying may be effected under the most advantageous conditions for obtaining uniform contraction, during drying, of all parts of the package.

The movements of the package which are occasioned by my improved method of processing, including the pulsating thereof, and the consequent porosity of the package, give all portions of the latter full opportunity to contract when drying, in accordance with their several tendencies, without occasioning any strain in any portion of the package. By "pulsating" I mean the inwardly and outwardly to-and-fro movements made by the package and the constituent parts thereof.

The treating liquid which I provide adjacent both faces of the package tends to make the package become buoyant and to tend to float so that under the liquid treatment the package swishes back and forth similar to the movements of skein packages when the latter are treated with liquid in the manner well-known to those skilled in the art. By "float" is meant those movements of the package induced and maintained by the wetting and the pressure and the directions of movement of the treating liquid, limited longitudinally by the adjacent insert flange and limited outwardly by the nature of the package strands and inwardly by the exterior surface of the tubular columns of the package inserts which prevent any inward package movement in excess of the predetermined desired maximum inward movement.

Although for purposes of illustration I have described and shown my improved process and my improved rayon package supporting structure, with reference to the supporting and treatment of cake packages, the invention is applicable to the supporting and treating of various other forms of tubular packages, such as wound spools and wound bobbins, and whether or not the filaments

comprising the rayon thread are twisted when they are collected.

What I claim is:

1. A process of treating a thread of fine filamentous character in annular package form consisting in mounting a spun rayon package so that the same is free, under liquid treatment, to increase its wall thickness and decrease its density, by expanding inwardly and uniformly from end to end, and then floating the package in, and by the action of, a treating liquid applied thereto under pressure, while providing for a predetermined maximum length which the package can attain under the liquid treatment, and while limiting the range of the floating movements which the package can make under the liquid treatment to an amount less than would cause the washing down of the package and the dislocation of the thread layers.

2. A process of treating a thread of fine filamentous character in annular package form consisting in mounting a spun rayon package so that the same is free, under liquid treatment, to increase its wall thickness and decrease its density, by expanding inwardly and uniformly from end to end, and then floating the package in, and by the action of, a treating liquid applied thereto under pressure, while limiting the range of the floating movements which the package can make under the liquid treatment to an amount less than would cause the washing down of the package and the dislocation of the thread layers.

3. A process of treating a thread of fine filamentous character in annular package form consisting in mounting a spun rayon package so that the same is free, under liquid treatment, to increase its wall thickness and decrease its density, by elongating longitudinally, but in an amount less than it tends to elongate under liquid treatment, and by expanding inwardly and uniformly from end to end, and then floating the package in, and by the action of, a treating liquid applied thereto under pressure, while limiting the range of the floating movements which the package can make under the liquid treatment to an amount less than would cause the washing down of the package and the dislocation of the thread layers.

4. A process of treating a thread of fine filamentous character in annular package form consisting in mounting a spun rayon package so that the same is free, under liquid treatment, to increase its wall thickness and decrease its density, by expanding inwardly and uniformly from end to end, and then pulsating the package in, and by the action of, a treating liquid applied thereto under pressure and alternately in opposite directions to effect a floating of the package in the treating liquid, while limiting the range of the floating movements which the package can make under the liquid treatment to an amount less than would cause the washing down of the package and the dislocation of the thread layers.

5. A process of treating a thread of fine filamentous character in annular package form consisting in mounting a spun rayon package so that the same is free, under liquid treatment, to increase its wall thickness and decrease its density, by elongating longitudinally, but in an amount less than it tends to elongate under liquid treatment, and by expanding inwardly and uniformly from end to end, and then pulsating the package in, and by the action of, a treating liquid applied thereto under pressure and alternately in opposite directions to effect a floating of the package in the treating liquid, while limiting the range of the floating movements which the package can make under the liquid treatment to an amount less than would cause the washing down of the package and the dislocation of the thread layers.

6. A process of treating a thread of fine filamentous character in annular package form consisting in mounting a spun rayon package so that the same is free, under liquid treatment, to decrease its density both by elongating longitudinally, but in an amount less than it tends to elongate under liquid treatment, and by expanding inwardly and uniformly from end to end to increase its wall thickness, then applying a treating liquid to the mounted package, to elongate the package, and then pulsating the elongated package in, and by the action of, a treating liquid applied thereto under pressure and alternately in opposite directions to effect a floating of the package in the treating liquid, while limiting the range of the floating movements which the package can make under the liquid treatment to an amount less than would cause the washing down of the package and the dislocation of the thread layers.

7. A process of treating a thread of fine filamentous character in annular package form consisting in mounting a spun rayon package so that the same is free, under liquid treatment, to decrease its density both by elongating longitudinally, but in an amount less than it tends to elongate under liquid treatment, and by expanding inwardly a predetermined maximum amount, and uniformly from end to end, to increase its wall thickness, then placing the package in a state of flotation by subjecting the same in, and to the action of, a treating liquid, to elongate the package and to expand the same inwardly, and then pulsating the floating elongated and expanded package in the treating liquid, to complete the desired treating operation, by applying the treating liquid thereto under pressure and alternately in opposite directions.

8. A process of treating a thread of fine filamentous character in annular package form consisting in mounting a spun rayon package so that the same is free, under liquid treatment, to decrease its density both by elongating longitudinally, but in an amount less than it tends to elongate under liquid treatment, and by expanding inwardly a predetermined maximum amount, and uniformly from end to end, to increase its wall thickness, then placing the package in a state of flotation by subjecting the same in, and to the action of, a treating liquid, to elongate the package and to expand the same inwardly, then pulsating the floating elongated and expanded package in the treating liquid, by applying the treating liquid thereto under pressure and alternately in opposite directions, and then completing the desired treating operation by subjecting the package in the treating liquid to the action of the treating liquid applied to the inner face of the package.

9. A process of treating a thread of fine filamentous character in annular package form consisting in mounting a spun rayon package so that the same is free, under liquid treatment, to decrease its density both by elongating longitudinally, but in an amount less than it tends to elongate under liquid treatment, and by expanding inwardly a predetermined maximum amount, and uniformly from end to end, to increase its wall

thickness, then placing the package in a state of flotation by subjecting the same in, and to the action of, a treating liquid, to elongate the package and to expand the same inwardly, then pulsating the floating elongated and expanded package in the treating liquid, by applying the treating liquid thereto under pressure and alternately in opposite directions, then subjecting the package in the treating liquid to the action of the treating liquid by applying the latter to the inner face of the package, and then completing the desired treating operation and obtaining a highly porous final product by applying the treating liquid to the outer face of the package.

10. A process of treating a thread of fine filamentous character in annular package form consisting in mounting a spun rayon package so that the same is free, under liquid treatment, to increase its wall thickness and decrease its density, by expanding inwardly and uniformly from end to end, then pulsating the package in, and by the action of, a treating liquid applied under pressure to the interior and exterior faces of the package alternately to effect a floating of the package in the treating liquid, while limiting the range of the floating movements which the package can make under the liquid treatment to an amount less than would cause the washing down of the package and the dislocation of the thread layers, the final liquid application being made at the exterior face of the package to produce a final package in highly porous condition.

11. A process of treating spun rayon packages of annular formation consisting in assembling a plurality of such packages in a closed vertical tier in an enclosing vessel having an overflow above the level of the top of the package tier and exteriorly of the package tier, the packages being assembled so that they are free, under liquid treatment, to increase their wall thickness and decrease their density, by expanding inwardly and uniformly from end to end, and then pulsating the packages in, and by the action of, a treating liquid passed under pressure into and out from the vessel below the level of the bottom of the package tier and applied alternately to the inner and outer faces of the packages to effect a floating of the packages in the treating liquid, while limiting the range of the floating movements which the packages can make under the liquid treatment to an amount less than would cause the washing down of the packages and the dislocation of the thread layers.

12. A process of treating spun rayon packages of annular formation consisting in assembling a plurality of such packages in a closed vertical tier so that the packages are free, under liquid treatment, to increase their wall thickness and decrease their density, by expanding inwardly and uniformly from end to end, and then pulsating the packages in, and by the action of, a treating liquid applied under pressure to the inner and outer faces of the packages alternately to effect a floating of the packages in the treating liquid, while limiting the range of the floating movements which the packages can make under the liquid treatment to an amount less than would cause the washing down of the packages and the dislocation of the thread layers, the velocity of the liquid flow being repeated varied as the liquid passes through the interior of the tier of packages.

13. A process of treating spun rayon packages of annular formation consisting in assembling a plurality of such packages in a closed vertical tier so that the packages are free, under liquid treatment, to increase their wall thickness and decrease their density, by expanding inwardly and uniformly from end to end, and then pulsating the packages in, and by the action of, a treating liquid applied under pressure to the inner and outer faces of the packages alternately to effect a floating of the packages in the treating liquid, while limiting the range of the floating movements which the packages can make under the liquid treatment to an amount less than would cause the washing down of the packages and the dislocation of the thread layers, the velocity of the liquid flow being alternately speeded up and slowed down as the liquid passes through the interior of the tier of packages.

14. A process of treating a thread of fine filamentous character in annular package form consisting in mounting a spun rayon package, while loosely covered with a protective liquid-permeable covering, so that it is free, under liquid treatment, to increase its wall thickness and decrease its density, by expanding inwardly and uniformly from end to end, and then pulsating the package in, and by the action of, a treating liquid applied thereto under pressure and alternately in opposite directions to effect a floating of the package in the treating liquid, while limiting the range of the floating movements which the package can make under the liquid treatment to an amount less than would cause the washing down of the package and the dislocation of the thread layers.

15. A process of treating a thread of fine filamentous character in annular package form consisting in mounting a spun rayon package so that the same is free, under liquid treatment, to increase its wall thickness and decrease its density, by expanding inwardly and uniformly from end to end, and providing package-relocating accommodations adapted to seat the ends and inner face of the package when expanded, such package-relocating accommodations limiting the inward expansion of the package to an amount less than would cause the washing down of the package and the dislocation of the thread layers, and then floating the package in, and by the action of, a treating liquid applied thereto under pressure.

16. A process of treating a thread of fine filamentous character in annular package form consisting in mounting a spun rayon package so that the same is free, under liquid treatment, to increase its wall thickness and decrease its density, by expanding inwardly and uniformly from end to end, and providing package-relocating accommodations adapted to seat the ends and inner face of the package when expanded, such package-relocating accommodations limiting the inward expansion of the package to an amount less than would cause the washing down of the package and the dislocation of the thread layers, and then pulsating the package in, and by the action of, a treating liquid applied thereto under pressure and alternately in opposite directions to effect a floating of the package in the treating liquid.

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