Aug. 12, 1941. W. J. GUNDELFINGER 2,251,931

METHOD OF AND APPARATUS FOR CONTINUOUS PROCESSING OF RAYON THREADS

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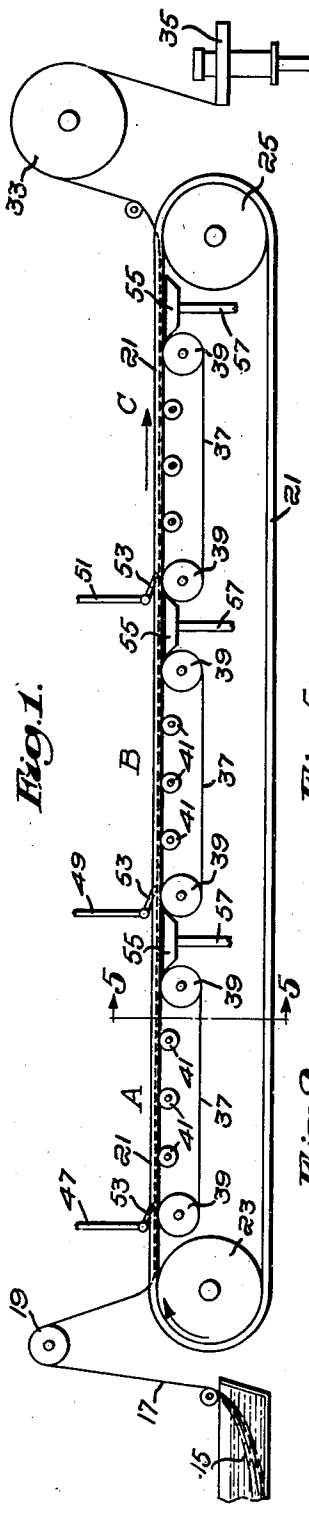


Fig. 1.

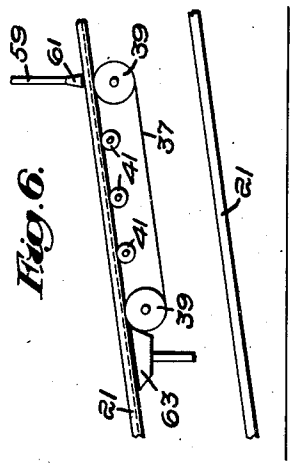


Fig. 6.

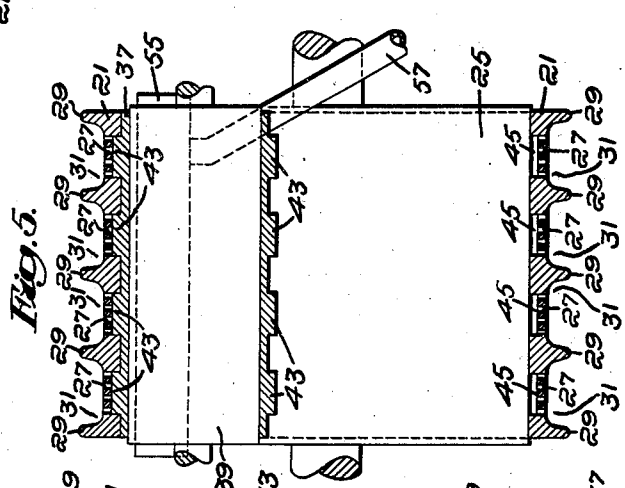


Fig. 5.

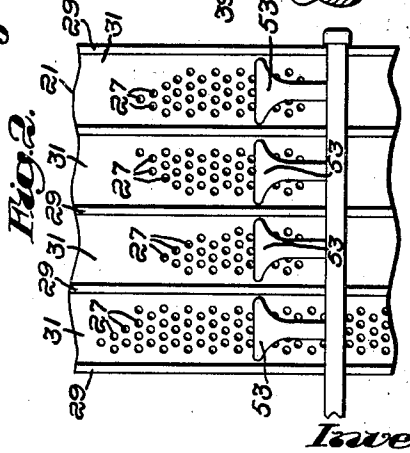


Fig. 2.

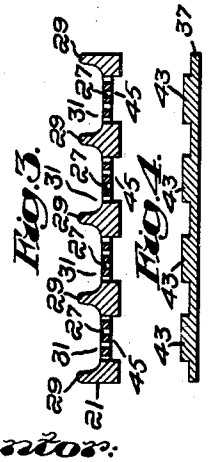


Fig. 3.

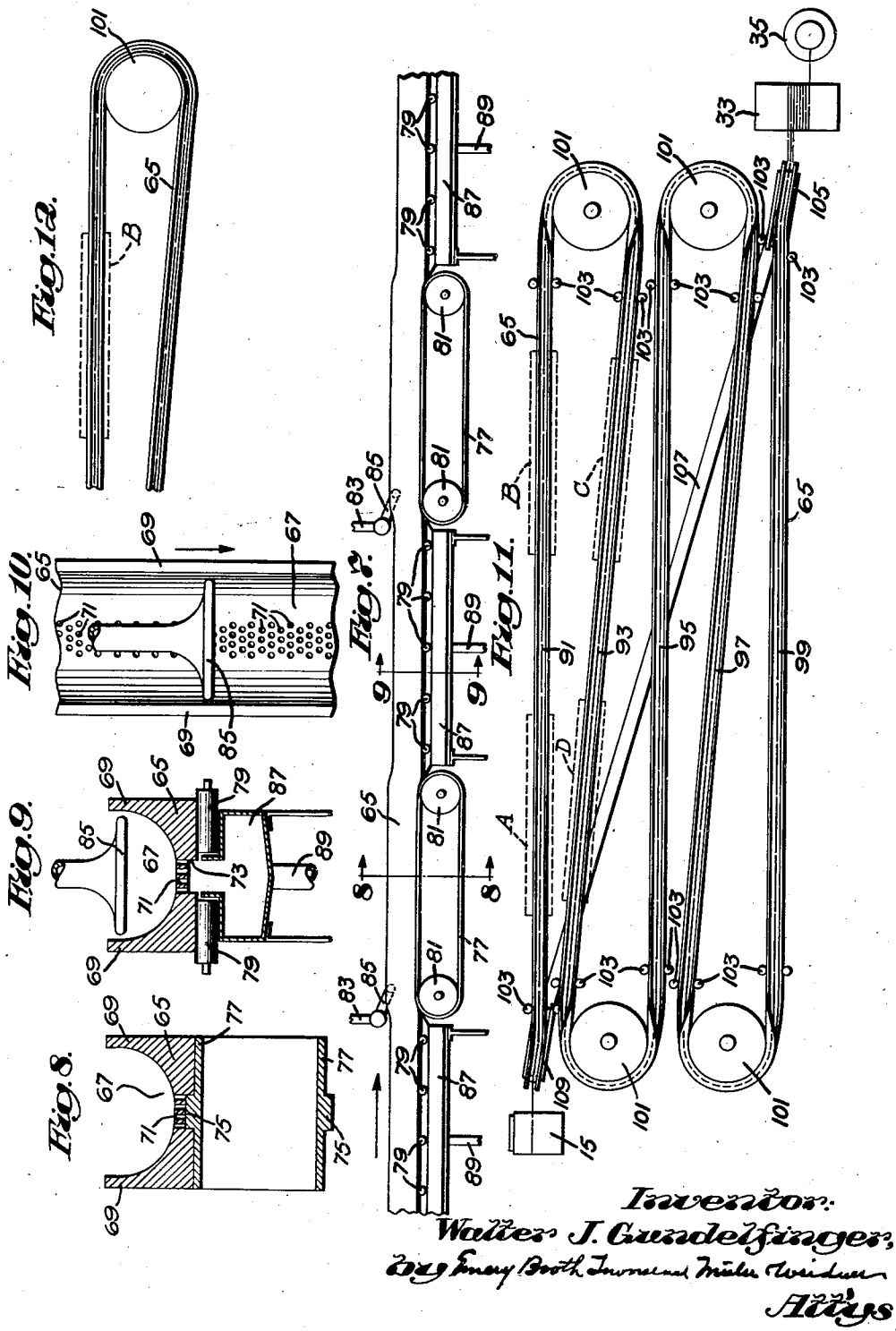
Fig. 4.

Inventor:
Walter J. Gundelfinger,
By Emery Booth Townsend Miller & Newton
Attys

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METHOD OF AND APPARATUS FOR CONTINUOUS PROCESSING OF RAYON THREADS

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2,251,931

METHOD OF AND APPARATUS FOR CONTINUOUS PROCESSING OF RAYON THREADS

Walter J. Gundelfinger, West Roxbury, Mass.

Application January 28, 1938, Serial No. 187,488

11 Claims. (Cl. 18—8)

This invention relates to the successive fluid processing of materials, being especially, though not exclusively, intended for the treatment of cellulose fibers or filaments such as rayon formed by any of the usual methods.

In the manufacture of rayon by the viscose process, for example, the dissolved cellulose, after being extruded through spinnerets into a regenerating medium, is withdrawn therefrom in filamentary form and the filaments before being completely finished are subjected to the necessary subsequent processing steps, such as washing, desulphurizing, bleaching, drying, twisting, etc.

It is a common practice after withdrawing filaments from the regenerating bath to assemble them in certain proportions in unit form, as on separate bobbins or in skeins or cakes, and by repeated handling or transfers perform the subsequent processing steps in a more or less discontinuous fashion. This not only adds to the cost of production but incurs the danger of a more or less impaired product through careless handling or through abnormal changes in the dimensions of the finished thread arising either from excessive shrinkage or excessive elongation following repeated transfers from one unit to another.

One object of the present invention is to provide a novel and improved process and apparatus for the continuous processing of rayon filaments, so that the filaments when and as first formed may be, without interruption, carried through the successive necessary processing steps, terminating, if desired, in the finished thread, resulting in a uniform treatment and processing of the threads throughout.

As contrasted with continuous processes heretofore proposed, the processing herein described provides for the conveyance of the fibers and their presentation to successive liquid processing baths with uniformity of tension, among the entire plurality of endless members and at any given stage or zone of the full process, without unintended modification, harmful disturbance or impairment while in the semi-plastic state in which they tend to remain until dried, and with the absence of conditions tending to impair or damage the fibers such as arise from excessive tension, or lack of uniformity therein arising from pressure or shrinkage. It furthermore provides for a more effective action of the liquid solutions on the fiber and the securing of complete liquid processing and under such conditions as permits a greater possible rate of travel of the fibers, resulting in greater productive capacity and reduced cost.

These and other objects of the invention will be best understood by the following description of one or more specific embodiments thereof, while the scope will be more particularly pointed out in the appended claims.

In the drawings:

Fig. 1 shows more or less diagrammatically in side elevation an apparatus embodying one form of the invention;

Fig. 2 is a plan view on a larger scale of the endless conveyer shown in Fig. 1 and illustrated in relation to one set of liquid supply nozzles;

Fig. 3 is a transverse section through the conveyer;

Fig. 4 is a similar transverse section through the secondary or sealing belt or apron;

Fig. 5 is a similar transverse section, on the line 5—5 in Fig. 1, where the conveyer is sealed against discharge of liquid by the sealing belt;

Fig. 6 illustrates diagrammatically a modified form of the invention;

Fig. 7 shows more or less diagrammatically in side elevation a portion of an apparatus embodying a modified form of the conveyer;

Fig. 8 is a transverse section on a larger scale, taken on the line 8—8 in Fig. 7;

Fig. 9 is a similar transverse section on the line 9—9 in Fig. 7;

Fig. 10 is a plan view of the conveyer shown in Fig. 7;

Fig. 11 shows diagrammatically in plan the path or course taken by the conveyer during the liquid processing of the filaments; and

Fig. 12 shows diagrammatically a modified method of guiding the conveyer.

Referring to the drawings, and first to the embodiment of the invention shown in Figs. 1 to 5 which for convenience will be described with reference to treating rayon filaments, the latter may be produced by any of the usual processes, as, for example, by the extrusion of the dissolved cellulose through spinnerets into a spinning or regenerating bath conventionally shown at 15. From this bath the filaments 17 emerge in a semi-plastic state, carried if desired up over a guide roll or godet wheel 19 are deposited on the top of an endless traveling conveyer 21 in the form of a specially constructed belt or apron. The conveyer is driven by any suitable means (not shown) in the direction indicated by the arrow in Fig. 1, passing first over the guide roll or pulley 23, thence to the roll 25 at the opposite end of its path, and then back to the roll 23, and having in this case a preferably horizontal path of travel.

The conveyer, which is of flexible material and preferably of rubber or rubber composition, is rendered normally permeable for the escape and drainage of liquid from its top filament carrying face, herein by the provision of a series of perforations **27**, which however, as hereinafter described, may be closed to prevent drainage when a desired stage of liquid treatment is reached. The top filament-receiving face of the conveyer is furthermore given a liquid-retaining formation such as by the provision of raised longitudinal walls **29** forming one or more longitudinal channels **31** (herein four in number), in the bottom of which the drainage openings **27** are provided.

The individual units or members such as rayon filaments, either singly or in groups of any desired number, when and as formed, are laid in the bottom of each channel and are carried forward on and with the conveyor through the successive steps of the liquid treatment, the entire multiplicity such as 100 or more of the unit members across the width of the conveying means being withdrawn from the conveyer at the end of its path, and, thereupon, without interruption of their movement and as a part of the same continuous process, subjected to the action of a suitable drying apparatus, conventionally shown as the drying drum **33**, and to the action of a twister **35** or to other processes needed to complete the finished product, whereby the entire multiplicity of units or threads may at any given point or stage throughout the uninterrupted process as a whole be uniformly subject to the same treatment, status and operative condition. If desired, after leaving the conveyer and before reaching the dryer, the threads may be subjected to a liquid expressing action, as by passing them between press rolls (not shown).

For illustration, the apparatus herein described is conventionally shown as provided with three stages of liquid treatment, these being indicated in Fig. 1 at A, B and C. These may represent, for example, a washing treatment at A, desulphurizing at B, and bleaching at C. Any desired number, order or character of such liquid treatments may be utilized and any further stages may be added by lengthening the conveyer travel to meet the requirements in any particular case.

For simplicity of description, the initial liquid processing at A has been referred to as a water bath for washing, applied soon after the filaments reach the conveyer. In practice the filaments are preferably allowed to travel on the conveyer for an appreciable period of time, sufficient to provide complete coagulation or irreversibility before being washed. Or the treatment stage at A may be through an application of acid or other coagulating medium supplied in a relatively low concentration, as compared with that in the regenerating or coagulation bath **15**, to provide a fixation bath, the washing being deferred until a later stage. And such fixation treatment at A may, if desired, be followed by a similar treatment or treatments at one or more successive stages through the application of the coagulating medium in progressively weaker concentrations. Or, in lieu of providing for any fixation treatment for the filaments while they are traveling on the conveyer, the filaments, after leaving the regenerating or coagulating bath and before being delivered to the conveyer, may be caused to pass over the godet wheel **19** into and through one or more similar baths but serving as fixation baths of lesser concentration.

When the filaments on the conveyer reach any particular stage of the liquid treatment, the drainage openings **27** in the conveyer are automatically closed and the required processing solution or liquid, as, for example, water in the first or washing stage A, is immediately thereafter supplied to the top of the conveyer. Such liquid through the provision of the liquid-retaining formation of the conveyer provides a liquid bath of substantial body in which a complete immersion of the filaments takes place, and is maintained for a substantial interval and throughout a substantial distance in the travel of the conveyer, until the drainage perforations are again opened and the liquid allowed to escape.

Such closure of the drainage openings may be effected by various means, but herein at each stage of liquid treatment it takes place through the action of a secondary endless sealing belt **37**, also preferably of rubber or rubber composition. The sealing belt is guided over rollers or pulleys **39** and has such a path of travel that its upper run lies immediately beneath and against the lower surface of the upper run of the conveyer belt so that it is caused to travel by frictional contact with the conveyer belt.

The sealing contact of the belt **37** against the bottom of the conveyer belt may be assisted by the pressure rollers **41** which help to maintain a tight seal throughout the distance that the sealing belt underlies the conveyer belt. To insure the sealing effect of the belt **37**, the engaging face of the latter is provided with raised ribs **43** of rectangular cross section which are adapted to enter and interfit with correspondingly shaped grooves or channels **45** on the bottom of the conveyer belt and which extend longitudinally beneath the drainage perforations **27**, the interfitting relation of the two belts at the stage of liquid treatment being indicated in Fig. 5.

The necessary processing solution for each of the successive treatments is fed through main supply pipes **47**, **49** and **51**, respectively, to liquid delivery means, such as the nozzles **53**, one for each group at the beginning of each stage of liquid treatment, there being herein provided one for each channel **31**. These are capable of flowing onto the conveyer the necessary quantity of liquid to completely immerse the filaments and to provide a substantial body of liquid beyond the nozzles which overlies the filaments during the entire stage of liquid treatment and so long as the drainage openings remain sealed.

Preferably, to avoid strain on and disturbance of the filaments as they lie on the conveyer, the delivery nozzles are so directed and so constructed as to cause the liquid to flow gently on the filaments in the direction of travel of the conveyer, and the flow is so regulated and related to the rate of conveyer travel that the liquid constituting the immersing bath, while moving with the conveyer, is maintained thereon in as nearly a static condition as practicable.

This condition of immersion, under which the filaments are conveyed in a tensionless or substantially unchanged tension state and subject to no disturbance other than that arising from their complete immersion, continues until the drainage perforations **27** are again opened, which takes place where the sealing belt passes over the pulleys **39** and withdraws from the conveyer. At that point the liquid bath is quickly discharged, the liquid flowing out freely and draining through the open perforations **27** and passing into an underlying catch basin **55**

and therefrom through the pipe 57, which may lead to a sewer or to a return line for further utilization of the solution.

The continued travel of the conveyer brings the filaments to the next stage of liquid treatment, where, under similar conditions and by means similar to those described, there is provision for their immersion in the next stage of liquid treatment, as, for example, by a desulphurizing bath at B, this being followed by the drainage of the desulphurizing liquid into the next succeeding catch basin, and then by a similar liquid immersion and subsequent drainage of the liquid at the next stage of the liquid treatment, as by a bleaching bath at C.

It will be understood that following any stage of liquid treatment, wherever the washing of the filaments is required, the drainage of the liquid used in such treatment will be followed by immersion of the filaments in an immediately succeeding bath of washing water, and then by drainage of the latter before the next succeeding stage of the liquid treatment is provided.

It will be observed that not only may filaments, fibers, threads or films be completely processed in a continuous or endless manner from the point of regeneration, instead of through the utilization of discontinuous steps as by utilizing bobbins, skeins or cakes, but the liquid treatment is secured in the most effective manner as to successive stages, namely, by intermittent immersion and intermittent drainage, all taking place while the filaments are in motion. Also that in certain spaces through which the filament carrying face of the belt travels, and corresponding herein to the successive processing stages A, B and C, there is constantly maintained over the conveyer a substantial body or bath of liquid in which the filaments are completely immersed but which itself moves in the direction of filament travel, so that a bath treatment of the moving filaments is secured without having to resort to tension to draw the filaments through such bath.

The speed at which the conveyer is caused to travel may be varied within wide limits and may, if desired, be adjusted to cause a slight over-feed of the filaments onto the conveyer as they emerge from the regenerating bath so as to compensate for any shrinkage which may take place during desulphurizing, bleaching or drying. The period during which it is desired to maintain the filaments immersed at any stage of the liquid treatment may obviously be prolonged or curtailed as desired by increasing or curtailing the length of the sealing belts and the duration of their sealing contact with the conveyer.

In the case of the liquid processing of fibers or other materials where no disadvantage arises from a flow of the processing liquid counter to the travel of the material to be processed, as, for example, in the processing of staple rayon fiber, the described apparatus may be utilized according to the principles indicated in Fig. 6. In this case the traveling conveyer 21, which may be similar in construction to that already described, is caused to travel in the direction of the arrow of Fig. 1 but in a path which inclines upward instead of in a horizontal path, the drainage openings being closed as before where the conveyer belt is in contact with the sealing belt 37.

The processing liquid supplied by the feed pipe 59 may then be delivered to the conveyer through a nozzle or nozzles 61 at the end of each liquid processing stage, instead of at the beginning thereof, so that it flows down the channel or channels of the inclined conveyer counter to the direction of travel thereof and to that of the filaments or other materials.

The liquid is then discharged at a lower level into the catch basin 63 as soon as the perforations 27 are opened, there being maintained, however, over the portion of the conveyer face intermediate the supply and discharge of the liquid, a body of liquid in which the materials to be treated are immersed.

The specific construction of the endless belt conveyer as described, while adapted to perform all described functions, has the disadvantage common to all belt conveyers heretofore proposed for continuous processing of rayon filaments, to wit, the need of great length in the space required for its course of travel, particularly where the filaments thereon are to be subjected to any number of processing stages.

In Figs. 7 to 11 there is illustrated a form of liquid-retaining, belt conveyer of such flexibility that it may be guided out of a straight-away path while carrying and retaining the filaments. This permits its direction of travel to be reversed to present the filaments for successive liquid processing in a series of relatively short courses, deflected from a rectilinear path, and which may lie either parallel to or closely adjacent each other, thereby greatly decreasing the space requirement in a longitudinal direction and reducing the visual attention required on the part of operatives in supervising the processing on account of the greater compactness of the apparatus.

Referring more particularly to Fig. 9, the conveyer 65 is in the form of a parti-tubular flexible member of rubber or other resilient material, provided with a single channel 67, side walls 69 and drainage openings 71 in the bottom of the channel. The channel is of a generally concave cross-section, with a more or less flattened bottom. The latter is herein shown smooth, but if desired may be provided with a plurality of closely adjacent, shallow, longitudinal grooves or corrugations in which the filaments are adapted to lie and by which they are carried. The under surface of the conveyer beneath the perforations 71 has a groove or recess 73 of rectangular cross section adapted to receive a correspondingly shaped raised rim 75 on the face of the sealing belt 77 (Fig. 8). Referring to Fig. 7, which shows in elevation two successive liquid processing stages for one course or run of the conveyer, the latter is caused to travel horizontally in the direction of the arrow and rests upon any suitable guiding means 79, which may be stationary anti-frictional guides on which the flat portion of the belt bottom slides or, as herein shown, may be anti-friction rollers.

The sealing belt throughout the liquid treatment stage of the conveyer travel engages the underside of the conveyer and closes the drainage openings, as indicated in Fig. 8, being guided over rolls 81 which may be so disposed as to press up and raise the conveyer belt slightly while in contact therewith to assure a better contact and seal.

The necessary processing liquid is flowed onto the filament carrying channel of the conveyer at the beginning of each stage of processing at the point where the belt has been sealed from the supply pipe 83 and the feeding device or nozzle 85, as in the case of the apparatus shown in Figs. 1 to 5. At the close of that processing stage the solution is drained from the channel through the perforations 71 into the catch basin 87 and discharged through the waste pipe 89, there being maintained, as before in the channel 67, throughout the processing stage while the perforations are closed, a bath of liquid in which the filaments are immersed but from which they are freed as soon as the drainage point has been reached.

In the course of travel of the conveyer, a group of filaments composed of any desired number having been applied thereto from the regenerating bath (conventionally indicated at 15 in Fig. 11), the conveyer is caused to travel with the filaments, channel face upward, through a series of any number of adjacent courses, which are indicated in Fig. 11 at 91, 93, 95, 97 and 99, the filaments being withdrawn at the end of the last course to pass onto the drying drum 33 and to the twister 35; or the conveyer with the threads may be caused to pass through a drying duct or channel before the threads are removed to the twister. The reverse in the path of travel of the conveyer is made possible by the flexibility and shape of the conveyer.

In each course or run of the conveyer there may be provided one or more liquid processing stages, as, for example, those indicated by dotted lines at A and B, in the first course designated as 91, C and D in the second course designated as 93, and similar processing stages may be provided in any desired number or of any desired character in the succeeding courses.

Due to the flexibility and elasticity of the parti-tubular conveyer and its capacity to flex about a vertical axis, the reversal of its travel might take place, as indicated in Fig. 12, by causing the conveyer to be guided and passed around a vertically disposed cylindrical guide roll 101 of suitable diameter by contact therewith through the outer face of one of its side walls 69, thereby maintaining the channel 67 at all times face upward.

In order, however, to avoid the tensioning of any of the filaments carried in the channel, which might be caused where the conveyer path becomes arc shaped in reversing its direction, the conveyer at such point of reversal is preferably given a partial twist and engages the vertically positioned guide rolls 101 by contact therewith at its bottom face, the channel then facing outward. To maintain the mouth of the channel uppermost throughout each straightaway course where the liquid processing is to take place there is provided any suitable system of guide rolls, such as are indicated at 103.

The conveyer, after passing through its last course such as that designated as 99 and after removal of the filaments, passes over and down about a guiding pulley 105 and thence back through the course indicated at 107 to the starting point of the process. There it passes first over the bottom and thence up over the top of the guiding pulley 109, being thence directed into the course represented at 91, where it is ready again to receive the continuous supply of filaments for the accumulation of the processing.

While the filaments have been shown as conveyed throughout their entire course of travel on a single endless conveyer, the latter may be formed in successive sections, each consisting of a separate endless conveyer, the filaments in their travel then passing directly from one to another conveyer in succession. This not only avoids an excessive length of any individual conveyer, where liquid processing is required over an extended distance, but also permits different rates of travel for adjoining conveyers, so that the rate of travel of the filaments at different stages may be varied, thereby to meet changeable conditions of tension under which the filaments are conveyed, as, for example, excessive shrinkage which might take place at some stage of the treatment.

Under the conditions herein described of complete immersion and intermittent drainage, a comparatively short period of time is required for each successive liquid treatment and for each washing, so that any desired number of treatment baths may be provided within a reasonable length of conveyer travel and with the latter running at a high rate of speed.

Numerous changes and modifications may be made in the process and apparatus as herein described, and various other applications of both the process and apparatus than those herein referred to may be made, all without departing from the spirit of the invention.

I claim:

1. An apparatus for the continuous liquid processing of rayon threads, comprising, an endless conveyer to which freshly formed threads are applied, the thread receiving portion of the conveyer having a liquid-retaining formation and being normally permeable to liquids to freely drain the liquid therefrom, means for subjecting the threads while traveling on said conveyer to a stage of liquid treatment by immersion in a continuously maintained liquid bath, the same comprising means continuously to deliver liquid to cover and immerse said threads for a substantial distance on the conveyer, and means to render said conveyer substantially impermeable to prevent drainage therefrom throughout said stage but to permit drainage to take place thereafter.

2. An apparatus for the continuous liquid processing of rayon threads, comprising, an endless conveyer to which a freshly formed thread is applied, the thread receiving portion of the conveyer having a liquid-retaining formation and being normally permeable to liquids to freely drain the liquid therefrom, means for subjecting the threads while traveling on said conveyer to a stage of liquid treatment by immersion in a continuously maintained liquid bath, the same comprising means continuously to flow liquid on said conveyer in the direction of the travel thereof and of said threads and to immerse said threads for a substantial distance on the conveyer, and means to render said conveyer substantially impermeable to prevent drainage therefrom throughout said stage but to permit drainage to take place thereafter.

3. An apparatus for the continuous liquid processing of rayon threads, comprising, an endless conveyer to which a freshly formed thread is applied, the thread receiving portion of the conveyer having a liquid-retaining formation and being normally permeable to liquids to freely drain the liquid therefrom and said conveyer having an upwardly inclined path, means for subjecting the threads while traveling on said

conveyer to a stage of liquid treatment by immersion in a continuously maintained liquid bath, the same comprising means continuously to deliver liquid to said conveyer at a relatively elevated point in the travel thereof to cover and immerse said threads for a substantial linear distance on the conveyer and to flow downward on the conveyer counter to the travel of the threads, and means to render said conveyer substantially impermeable to prevent drainage therefrom throughout said stage of liquid treatment but to permit drainage to take place thereafter at a relatively lower point in the travel of the conveyer.

4. An apparatus for the manufacture and continuous production of rayon threads, comprising, an endless traveling conveyer to which the freshly formed threads are applied, the thread receiving portion of said conveyer having a liquid-retaining channel formation with openings in the bottom of the channel to render the conveyer normally permeable to liquids, means for subjecting the threads at successive stages while traveling on said conveyer to immersion in separate liquid treatment baths comprising at each stage means to flow liquid onto the conveyer in the direction of travel of the threads to cover and immerse the latter, means to close the drainage openings in said conveyer for a substantial distance following the delivery of the liquid thereto to prevent drainage from said conveyer but to permit drainage to take place at a more advanced point in conveyer travel, the same comprising an impermeable endless traveling sealing belt having contact with the bottom of said conveyer and interfitting therewith throughout said distance to close said openings, whereby said immersion bath is maintained on said moving threads, and means to dry the thread and to twist and collect the same.

5. An apparatus for the continuous processing of rayon threads, comprising an endless traveling conveyer to which the freshly formed threads are applied, said conveyer being in the form of a flexible, parti-tubular member having an open liquid-retaining channel, with drainage openings in the bottom of the channel to render said conveyer normally permeable to liquids, means for subjecting the threads at successive stages while traveling on the conveyer to immersion in separate liquid treatment baths maintained on and supported by the conveyer and comprising at each stage means to flow liquid on the conveyer to cover and immerse the threads, and means simultaneously to close the drainage openings to render said conveyer substantially impermeable and to maintain said immersion bath for a definite stage of liquid treatment but to permit drainage from said conveyer immediately thereafter.

6. An apparatus for the continuous processing of rayon threads, comprising an endless, traveling, flexible conveyer to which the freshly formed threads are applied, said conveyer having an open liquid-retaining channel and being normally permeable to liquids, means for guiding said conveyer while carrying said threads in a generally horizontal but non-rectilinear path to provide a plurality of courses out of line with relation to each other, thereby to decrease the longitudinal space requirements of said apparatus, means for subjecting the threads at successive stages while traveling on the conveyer to immersion in separate liquid treatment baths maintained on and supported by the conveyer and comprising at each stage means to flow liquid on the conveyer to cover and immerse the threads, and means simultaneously to render said conveyer substantially impermeable and maintain said immersion bath for a definite stage of liquid treatment but immediately thereafter restore the permeable condition of said conveyer and to drain the bath therefrom.

7. An apparatus for the manufacture and continuous production of rayon threads, comprising means for regenerating a cellulose solution in the form of threads, endless conveyer means to which the freshly formed threads are applied, said conveyer means having a liquid-retaining formation and being normally permeable to liquids to freely drain the liquid therefrom, means for subjecting the threads while traveling on said conveyer to a stage of liquid treatment by immersion in a liquid bath maintained on and supported by the conveyer means, the same comprising means continuously to deliver liquid to cover and immerse said threads for a substantial distance on the conveyer means, and means to render said conveyer substantially impermeable to prevent drainage therefrom throughout said stage but to permit drainage to take place immediately thereafter.

8. In an apparatus for the continuous processing of rayon threads, the combination of an endless conveyer for conveying said threads from the point of regeneration to a point of discharge, said conveyer comprising a flexible, parti-tubular member having a single, open, channel adapted to receive a group of threads, a bottom wall adapted to engage anti-friction guiding devices, the bottom of said channel being provided with drainage openings, means for subjecting the threads to immersion in a liquid treatment bath while carried on said conveyer comprising means to deliver liquid to cover and immerse said threads in said channel, and means to render said conveyer substantially impermeable to prevent drainage from said conveyer for a substantial distance in the travel thereof but to permit drainage to take place immediately thereafter.

9. In an apparatus for the continuous processing of continuous rayon threads, the combination with a traveling endless conveyer adapted to receive threads as and when freshly formed and to convey the threads by a continuous, uninterrupted movement, of means for delivering liquid to said conveyer to provide at each of a plurality of zones, and for a substantial linear distance in the conveyer travel, a liquid bath in which the threads are completely immersed, means for retaining the liquid constituting such bath on the conveyer whereby the liquid travels on and with the conveyer and with the threads and the bath is maintained throughout any given zone, and means for withdrawing from the conveyer said liquid only at the end of such zone.

10. The method of liquid processing rayon threads, which consists in progressively conveying said threads as freshly formed through a path of travel, causing said threads to receive continuous solid support during their travel through said path, providing at each of certain zones and for a substantial distance in the path of travel a bath of processing liquid in which the threads are completely immersed and covered, supporting and progressively carrying with the threads for a substantial zone of travel the mass of liquid constituting such bath, and withdrawing the liquid constituting such bath from the sol-

idly supported threads only at the end of each zone of liquid processing.

11. An apparatus for the continuous processing of rayon threads, comprising traveling conveyer means presenting a channel formation on the face of which the threads lie and on which they are supported and continuously rest while being subjected to successive zones of liquid treatment, means for passing said supporting conveyer means with the threads thereon through a succession of courses of travel out of line with relation to and closely approaching each other, means for supplying processing liquid to the channel formation of the traveling conveyer means to form a bath of processing liquid completely immersing the threads, means for maintaining said liquid in said channel formation through one of said zones, and means for draining the liquid from said channel formation immediately after passage through said zone.

WALTER J. GUNDELFINGER.