

May 8, 1934.

W. F. RICHTER

1,957,979

APPARATUS FOR WINDING ARTIFICIAL SILK FOR TREATMENT

Filed March 21, 1931

4 Sheets-Sheet 1

Fig. 1.

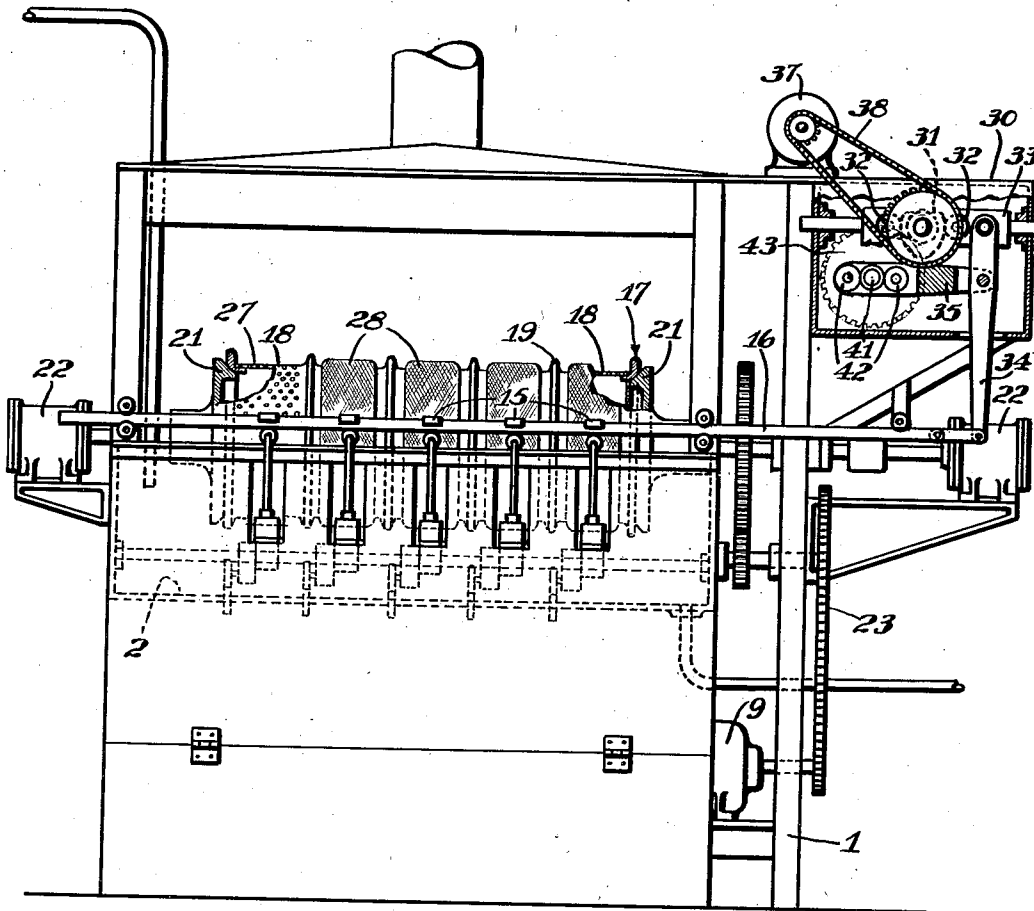
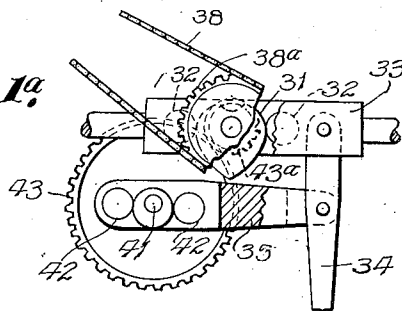


Fig. 1a



WITNESSES

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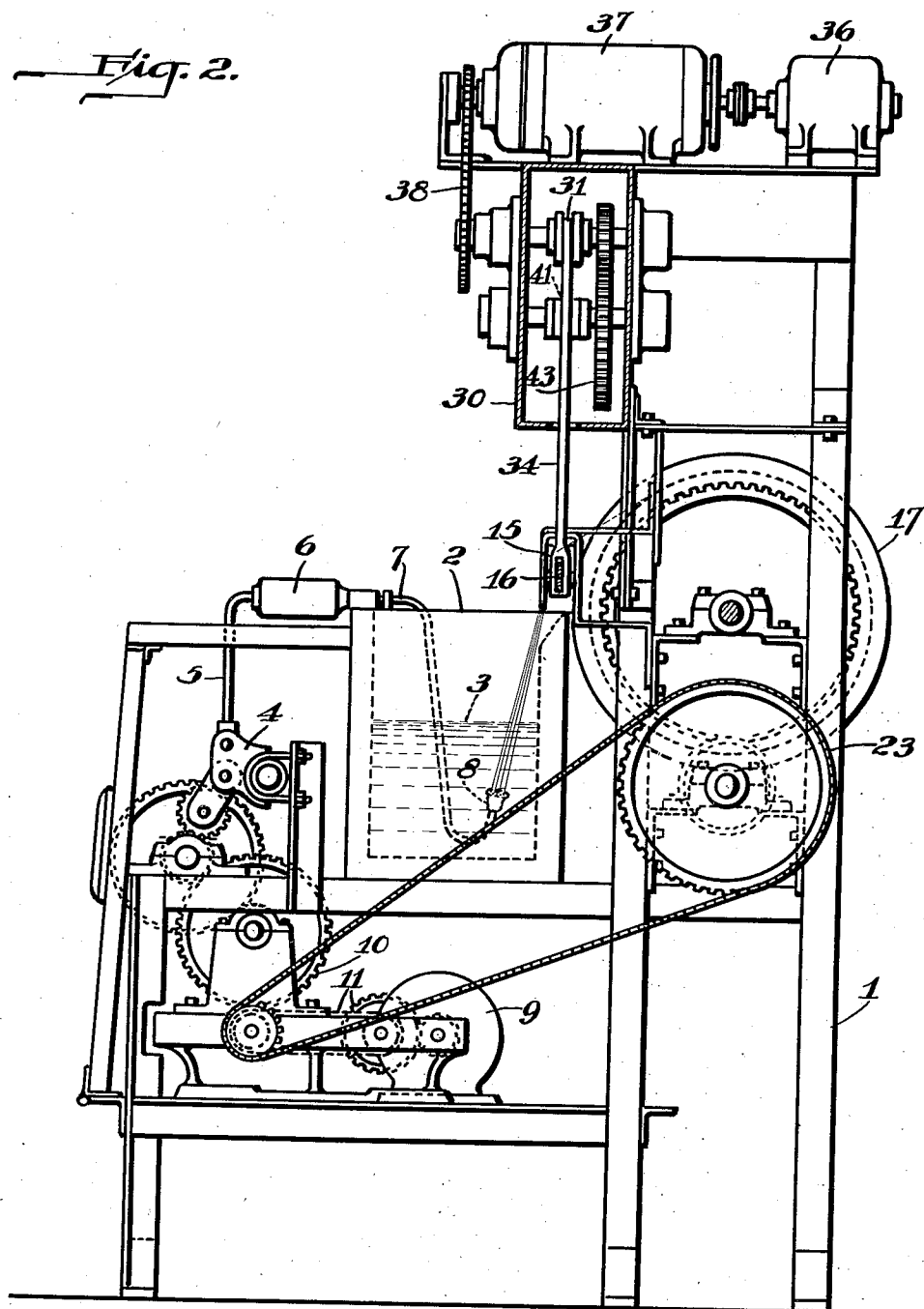
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4 Sheets-Sheet 2

Fig. 2.



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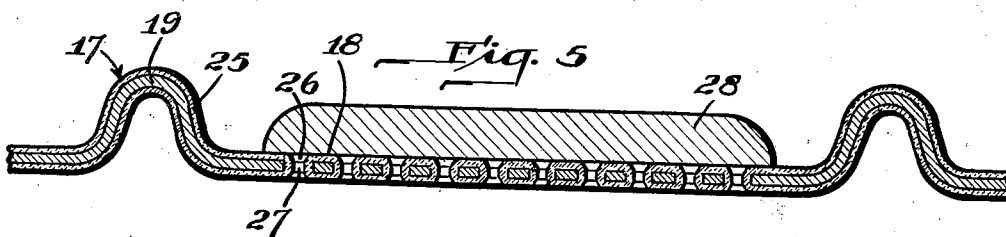
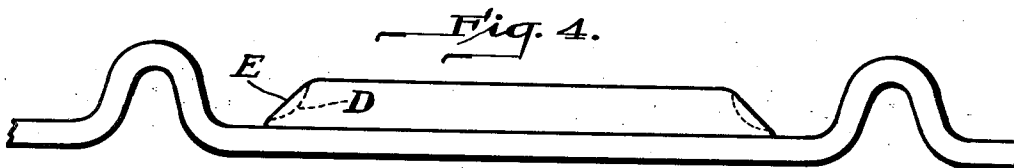
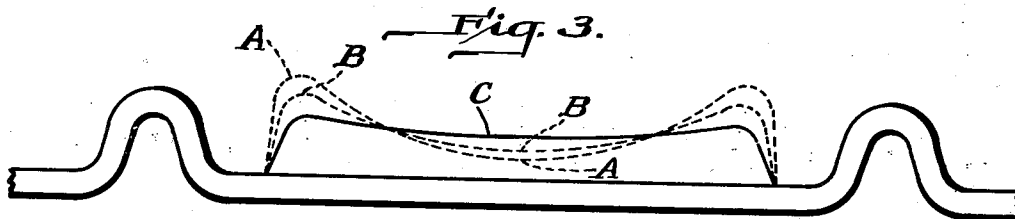
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APPARATUS FOR WINDING ARTIFICIAL SILK FOR TREATMENT

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4 Sheets-Sheet 3



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APPARATUS FOR WINDING ARTIFICIAL SILK FOR TREATMENT

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4 Sheets-Sheet 4

Fig. 6.

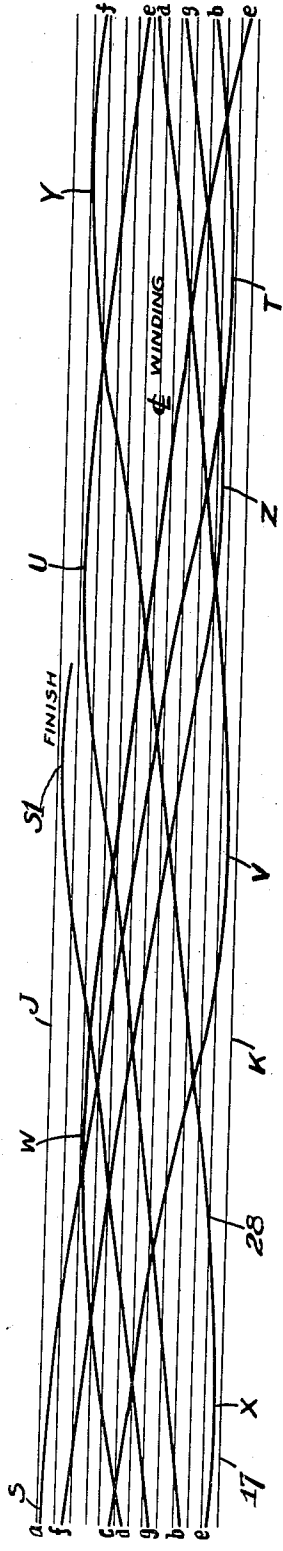


Fig. 7.

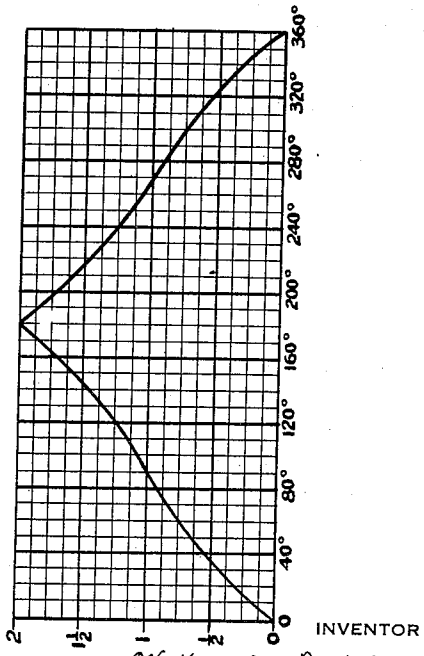
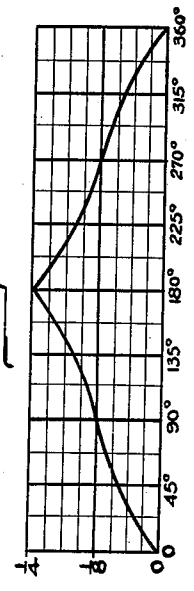


Fig. 8.



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UNITED STATES PATENT OFFICE

1,957,979

APPARATUS FOR WINDING ARTIFICIAL SILK FOR TREATMENT

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Application March 21, 1931, Serial No. 524,407

7 Claims. (Cl. 242-43)

This invention relates generally to mechanism for winding filaments intended for textile use, and particularly to a device for guiding a thread of filaments to form a body or cake of shape adapted to facilitate subsequent treatment of the thread.

It is among the objects of my invention to provide mechanism for winding or laying up thread in predetermined shape, that is simple in construction and rugged in operation.

Another object of my invention is to provide mechanism for winding rayon thread on foraminous drums in such manner that fluids utilized in treating the rayon may be distributed from the foramina uniformly through the cake to effect uniform treatment of the entire cake, to effect economies in the amount of fluid required, to shorten the time necessary for treatment, and with minimum damage to the thread.

A further object is to provide a winding device for laying up thread in a cake having a cylindrical mid-portion and convexly rounded end portions adapted to provide substantially uniform liquid permeability from end to end.

The apparatus provided by this invention comprises a drum having a foraminous mid-portion for receiving thread, and a guiding mechanism for laying up the thread on the drum, controlled to form a cake having a cylindrical mid-portion covering the foraminated portion of the drum, and convexly rounded end portions extending beyond the foraminated portion, the thread being so laid that all parts of the cake are uniformly pervious to fluids passed through the foramina from the interior of the drum. Cakes wound in this manner may be speedily and uniformly treated, as by washing with water or with other treating fluids that may be introduced into the drum and permitted to pass outwardly by gravity through the cake while the drum is rotated slowly.

One type of specific apparatus for practicing my invention, to achieve the foregoing and other objects thereof that will be more readily apparent upon reading this specification, is described in detail hereinafter in conjunction with the accompanying drawings. In the drawings, Fig. 1 is a front elevation of a conventional rayon spinning machine, some parts being broken away to better show the winding mechanism which embodies my invention; Fig. 1a is a fragmentary view of the apparatus shown in Fig. 1, showing on an enlarged scale the traverse mechanism, parts being broken away for clarity of illustration; Fig. 2 is an end elevation of the mechanism

shown in Fig. 1, with the winding mechanism similarly exposed; Fig. 3 is an enlarged longitudinal section of a portion of the winding drum showing diagrammatically the sectional shapes of cakes formed by single cam winding mechanisms of different types; Fig. 4 is a view similar to Fig. 3 showing cakes formed by winding mechanisms having compound cams; Fig. 5 is a view similar to Fig. 3 showing in detail a section of the foraminous winding surface of the drum and a cake of rayon thread laid thereon in accordance with my invention; Fig. 6 is a development representing the winding surface of the drum and illustrating the manner in which the thread is wound thereon; Fig. 7 is a diagram showing the motion imparted to the winding mechanism by the primary cam during one revolution; and Fig. 8 is a diagram similar to Fig. 7 showing the motion imparted by the secondary cam during one revolution thereof.

The particular spinning apparatus shown in the drawings and described in this specification is of the type adapted to produce rayon by the viscose process. However, it should be borne in mind that the spinning apparatus is shown for purposes of illustration only, and that the winding mechanism which embodies my present invention may be applied to any type of spinning or other mechanism from which it may be desirable to wind thread in cakes of uniform permeability to adapt them to subsequent treatment.

Without going into the details of construction of the spinning apparatus shown in the drawings, it comprises in general a framework 1 upon which is supported a tank 2 containing a precipitating or coagulating bath 3 of suitable well known composition. A gear-type pump 4 forces viscose solution through a pipe 5 to a filtering device 6 from which it passes through a goose-neck 7 to a spinneret 8 beneath the surface of bath 3. The pump 4 is driven by a motor 9 through a suitable gear train 10 provided with a speed changing mechanism 11 for adjusting the speed at which the pump operates, all of which mechanism is mounted in the frame 1 near the tank 2.

The filament-like jets of viscose which issue from the spinneret 8 are coagulated by precipitating bath 3 and are gathered together into a thread that passes over a guide member 15 on a longitudinally movable guide bar or traverse rod 16 disposed above tank 2 in suitable guides on frame 1. After passing over guide member 15 the thread is collected on the surface of a winding drum 17 in what is known as a cake. The guide bar is placed as near to the drum as possible to

closely control the thread as it is wound in the cake.

As shown in Fig. 1, this form of spinning device includes a relatively long precipitating tank 2 in which a plurality of spinnerets 8, connected to respective individual pumps 4, are suspended. Likewise guide bar 16 is provided with a plurality of guide members 15, in this case five, for guiding thread to five winding surfaces 18, separated by flanges 19, on drum 17, which is rotatably supported in frame 1 by movable heads or clutching elements 21.

After the cakes have been formed upon the drum the movable heads 21 may be withdrawn by means of fluid pressure devices 22 to release the drum for removal and replacement by an empty drum. As shown, one of the movable heads 21 is connected by a suitable driving mechanism 23 to the speed changing mechanism 11 driven by motor 9 in such manner that the drum is rotated at a speed corresponding with the speed at which the viscose solution is delivered to the spinnerets 8.

The particular method of collecting and treating rayon thread upon the drum, and the details of its construction, are more fully set forth and claimed in my copending application Serial No. 505,749, filed December 31, 1930. As described in this copending application, the drum preferably is a cylinder of relatively thin metal provided with outwardly pressed flanges 19 which form individual winding surfaces 18. The drum is completely covered by a protective coating 25, for example rubber. As best shown in Fig. 5 the protective coating is molded to form cup-like depressions 26 in the midportions of the winding surfaces 18 each of which leads to and is concentric with one of a plurality of foramina 27 in the drum.

After a cake 28 of rayon has been formed on drum 17, water or other treating liquid is introduced into the drum, as more fully explained in the aforementioned copending application, and permitted to seep through the cake 28 as it issues from the interior of the drum through the foramina 27. Inasmuch as the freshly spun rayon yarn in cake 28 is very delicate, the liquid must be passed through it at low pressure to avoid breaking the filaments. In accordance with the invention of the copending application, treatment is accomplished with minimum damage to the thread by allowing the treating liquid to seep through the foramina under its static pressure head only. Satisfactory results are had ordinarily by filling the drum to about 75 per cent of its capacity. To provide for treating all portions of the cake equally, drum 17 is rotated at a slow speed, usually about fifteen revolutions per minute, preferably in the direction in which the thread was wound on it.

In order to effectively and expeditiously treat the yarn, the cake must be wound on the drum in such manner that the treating liquid may pass freely through it, but so that all portions of the cake will offer substantially equal resistance to the flow of the treating liquid. That is, each portion of the cake must come in contact with a predetermined amount of treating fluid, and no portion should be shaped to permit the passage of an excessive amount of fluid, nor, conversely, should any portion be so wound or positioned that little or no fluid comes in contact with it. For instance, the edges of cake 28 should not be wound against partitions 19, as is the usual practice in winding thread on spools, inasmuch as the threads adjacent to the partition would not be exposed to the treating fluids. Consequently, the edges

of the cake must be free from the partitions, and be self-supporting. Further, the self-supporting edges must be so wound that the individual threads of rayon will retain their original positions during subsequent handling and treating operations to avoid tangling, which would be troublesome when the thread is later unwound from the drum.

This invention provides means for laying thread in a cake in such manner as to confer the foregoing qualities. The optimum shape of the cake provided by the invention is shown in longitudinal section in Fig. 5. The cake is wound, in accordance with my invention, with a substantially cylindrical mid-portion of width substantially equal to the width of the foraminous portion of winding surface 18, and with its end portions extending beyond the marginal foramina of the winding surface and convexly rounded. When wound in this shape the cake is self-supporting with the end portions so formed that the individual threads will not slip over one another and tangle during subsequent treatment.

The surface of the rounded end portions is at all points so spaced from the marginal foramina that the resistance to liquid flow from the foramina through the end portions is substantially uniform and is substantially equal to the resistance to flow through the cylindrical mid-portion of the cake. Inasmuch as there is less tendency for the treating fluid to flow horizontally than vertically through the cake, the extreme edge of the curved end portion is disposed relative to the marginal foramina at a distance less than the thickness of the cylindrical portion of the cake to compensate for this condition and provide uniform liquid permeability. Consequently, all portions of the cake are substantially equally pervious to liquids issuing from the foramina 27, and each turn of the rayon thread will be exposed to a substantially equal amount of the treating fluids. Further, after the cake has been suitably treated, the thread may be unpound from the drum 17 without difficulty.

This invention provides mechanism for moving the traverse rod or guide bar 16 longitudinally to cause the individual guide members 15 to move back and forth across the respective winding surfaces 18 of drum 17 with a cyclic non-uniform motion in such manner that cake 28 is laid up to the desired shape with the threads crossing each other to provide passageways between them for the treating fluids.

The mechanism for moving guide bar 16 is carried in a cabinet 30 at the side of frame 1. It comprises a rotatably mounted primary cam 31 of constant diameter that engages a pair of cam followers 32 on a crosshead 33, slidably mounted in the cabinet, to which is pivoted one end of an operating lever 34. The lever 34 is pivoted at its other end to one end of guide bar 16 and is fulcrumed on a second movable crosshead 35, mounted in cabinet 30 to slide parallel to crosshead 33, at a position about one-fourth of the length of the lever from its point of pivotal connection to crosshead 33. A suitable motor 36 is provided on the top of frame 1 for driving cam 31, and is connected to it by a suitable speed changing mechanism 37 and a chain and sprocket wheel drive mechanism 38.

To more readily understand the manner in which the optimum shape for the cake is attained, it is desirable to consider the results to be obtained if the mechanism were operated with the fulcrum crosshead 35 held stationary, and with

cams of various well known shapes utilized in the position occupied by primary cam 31. In the event that cam 31 is shaped to give a simple harmonic motion to guide bar 16, a cake of the form indicated by the dotted line A in Fig. 3 would be formed. The high humps at the edges of the winding A result from the fact that with a simple harmonic motion guide bar 16 moves slowly at the end positions of its travel. This permits an excessive amount of thread to be wound at the ends of the cake. Likewise, because of the rapid motion imparted to guide bar 16 during the mid-portion of its travel by the harmonic cam, a pronounced depression is formed at the mid-portion of the winding A.

The humps at the edges of the winding are further accentuated by reason of the fact that the thread does not follow the guide bar at once when it changes direction of motion. In order that the edges of the cake may be self-supporting, and to form a honey-combed cake that is pervious to fluids, guide bar 16 must be moved back and forth with sufficient rapidity to lay the thread on the drum angularly. In changing from an angular lay in one direction to an angular lay in the other direction the rayon thread must necessarily lay substantially circumferentially at the end portions of the cake. The guide bar 16 must then move some distance away from the end position before the effect of its movement will cause the thread to change from its circumferential position to an angular lay in the new direction. Consequently more thicknesses of thread are applied at the ends of the cake than at other portions.

If cam 31 has straight line or uniform motion characteristics, the objectionable features of the harmonic motion will be overcome, but the yarn will continue to pile up in a hump at the ends as shown by the dotted line B, because of the lag in responding to the change in direction of the guide bar. Because of the accumulation of yarn at the end portions of the cake B, the center or mid-portion is depressed, but to an extent somewhat less than the depression found at the mid-portion of the cake A.

By suitably proportioning cam 31 to give a motion to guide rod 16 that may be termed an inverse harmonic motion, that is motion which is rapid at the ends of the stroke and slow at the mid-portion of the stroke, the depression at the mid-portion of the cake may be substantially reduced. This is shown by the full line C in Fig. 3. However, it has been found to be impossible by means of a single cam to form a cake that has the desirable characteristics of cake 28, Fig. 5.

To reduce or distribute the humps formed at the ends of the winding as a result of the reversal of the guide at this point, I have developed a mechanism for shifting the range of travel of the guide bar 16. This mechanism utilizes primary cam 31 of the most desirable shape, which by itself gives an inverse harmonic motion to guide bar 16 and forms a cake indicated by C in Fig. 3, and it cooperates with a secondary cam 41. The secondary cam engages a pair of cam followers 42 on crosshead 35 that serves as a fulcrum for operating lever 34.

The diameters of the cams 31 and 41 and the lengths of the lever arms with which they move guide bar 16 are such that cam 31 is capable of moving the guide bar through substantially 85% of its total range of travel, and cam 41, if acting alone, would move the guide bar through substantially 15% of its total range of travel. Thus, if both cams were turned simultaneously and in

phase, guide bar 16 would be caused to move over the entire range of its travel. If, on the other hand, the cams 31 and 41 were operated in synchronism and 180° out of phase, guide bar 16 would move through only 70% of its total range of movement. In the mechanism shown, the cams 31 and 41 are interconnected by a gear train which operates cam 41 at a speed somewhat more than one-fourth of the speed of cam 31. The gear train referred to comprises a gear 43 mounted on the shaft carrying cam 41, and it is driven by a pinion 43a keyed on the shaft which carries sprocket wheel 38a and cam 31, as shown especially in Fig. 1a. Consequently the phase relation of the cams changes continuously in such manner that the actual length of stroke of rod 16 is approximately 85% of its total range of movement. Further, the range of action shifts back and forth across the winding surface of the drum as the phase relation of the cams changes, in a manner presently to be explained more fully.

If cam 41 is of the plain eccentric type, it will shift the range of action of the guide rod 16 in such manner that the winding is distributed in accordance with the dotted line D in Fig. 4. As shown, the motion given to guide rod 16 by the cooperative action of inverse harmonic cam 31 and an eccentric or harmonic cam 41 results in a cake having practically no humps at its end portions and with the mid-portion filled to substantially cylindrical shape. However, the end portions of the cake B are not in suitable shape to provide for uniform treatment of the rayon, inasmuch as they are concave and the concave portions do not offer sufficient resistance to the flow of liquid thereby permitting an excess of treating fluid to pass through between the threads at that portion of the cake.

By utilizing a cam 41 having straight line characteristics the shape of the end portions of the cake may be made substantially tapering as illustrated by the line E in Fig. 4. This shape is also objectionable in that the end portions are not uniformly pervious to the treating liquids.

If now secondary cam 41 is shaped to have inverse harmonic characteristics similar to the shape found most desirable for the primary cam, the shape of the cake can be modified to have rounded ends and cylindrical mid-portion illustrated by the cake 28 of optimum shape shown in Fig. 5.

The characteristics of the particular cams 31 and 41 which in combination have been found to produce the optimum form of cake are shown in the diagrams in Figs. 7 and 8, respectively. From the curves there shown, it may be seen that the cams 31 and 41 each impart to the guide bar a cyclic motion that is slower in the mid-portion of the travel than at the end portions. The resulting motion which the cams 31 and 41 acting together impose upon the guide bar is, of course, different from that imparted by either cam, and also different from the sum of the motions imparted by the two cams, inasmuch as the phase relation between the cams changes continuously.

In a particular embodiment of my invention the total length of stroke through which the primary cam is capable of moving the guide rod 16 is 6.5 inches. In this structure secondary cam 41 is capable of moving guide rod 16 through a stroke of 1.06 inches. The tooth ratio of the gear train 43 connecting cam 31 and cam 41 is 42 to 166, which is approximately a ratio of 1

to 4, but with a slight variation of ratio to cause a continuous shifting of the phase relation between the two cams.

The relation between the speed of rotation of drum 17 and the speed at which the guide rod moves across the winding surface are not definitely interconnected in any way. However, in the apparatus described the winding drum, which is sixteen inches in diameter, is rotated at sixty-four revolutions per minute, and the primary cam 31 is rotated at thirty-nine revolutions per minute.

In the developed layout of a few turns of thread on drum 17 shown in Fig. 6, the cycle of operation may be traced through four revolutions of the primary cam 31, during which time the drum has turned about six and one-half revolutions. The various turns of the thread on the drum are designated by the lower case letters *a* to *g* inclusive, the letters at each end of the diagram representing corresponding points that have been arbitrarily chosen as the beginning of the particular turn designated by each of the letters respectively.

If now we consider both the primary and secondary cams to be at their extreme positions in one direction, guide 15 will be at the extreme end of its range of movement and the thread will be guided onto the drum to form the extreme edge J of cake 28, as indicated by the position S in the diagram. When one-half revolution of cam 31 has been completed, cam 41 will have made substantially one-eighth of a revolution, and the thread will have passed diagonally across the face of the winding surface to a position T that is at some distance from the other edge K of the cake. At the end of one revolution of the primary cam the thread will have moved back across the face of the drum to a position U which is not at the edge J of the winding, but is somewhat removed therefrom for the reason that cam 41 has in the meantime made approximately one-fourth of a revolution. On the next half revolution of cam 31, the thread is brought to the position V, somewhat closer to the edge K of the cake than it was at the position T, inasmuch as cam 41 has now made approximately three-eighths of a revolution. During the next half revolution of the primary cam, that is at the end of the second revolution, the secondary cam has completed approximately one-half of a revolution, so that the two cams are substantially 180° out of phase and the thread is placed at a position W which is inwardly from the edge J of the cake a distance substantially equal to the width of the rounded end portion thereof.

At the end of the next half revolution of cam 31 the thread will be brought to the position X which is close to the edge K of cake 28, but is removed therefrom a short distance by reason of the fact that cam 41 has by this time made substantially five-eighths of a revolution and cam 31 cannot coincide with it. At the completion of the third revolution of cam 31, the secondary cam will have made substantially three-fourths of a revolution, thus placing the thread at a position Y about midway between the starting position S and the inner position W. The next half revolution of the primary cam will place the thread in position Z, which is removed a considerable distance from the other edge K of the winding, but does not define the extreme inner edge thereof, inasmuch as the cams 31 and 41 are not 180° out of phase at this point, secondary cam 41 having completed approximately seven-eighths of a revolution. When primary cam 31

completes its fourth revolution, the secondary cam will have made slightly more than one complete revolution and the thread will lie at a position S1 that is not quite at the edge J of the cake, and that is removed angularly from the starting position S by an amount that depends upon the ratio of the speed of revolution of the drum to the speed of revolution of the cams.

At the end of eighty-three revolutions of cam 31, cam 41 will have turned exactly twenty-one revolutions. Hence the cams 31 and 41 will pass through a position corresponding to the starting position, in which they are again in phase, and the thread will again be laid at the extreme outer edge J of the winding in a position corresponding to the initial position S. However, the thread will, in all probability, not fall directly upon the position S, but will be removed angularly therefrom, inasmuch as there is no definite synchronization between drum 17 and the cam mechanism.

In the meantime the other edge K of the cake 28 will have been defined, as the cams 31 and 41 will have synchronized with both cams in a position 180° from the position chosen as the starting point. This will occur when cam 31 has made forty-one and one-half revolutions and cam 41 has made exactly ten and one-half revolutions, at which time the thread will be laid at a position on the extreme outer edge K of cake 28.

The inner edges of the rounded end portions, or the division points between the end portions and the cylindrical mid-portions are defined by threads that are laid when the two cams 31 and 41 are approximately 180° out of phase. In the particular mechanism utilized to illustrate my invention, gear train 43 is so proportioned that the cams happen to be exactly in phase at the two positions corresponding to the extreme positions of travel of the guide bar 16, but they are not exactly 180° out of phase at the positions corresponding to the positions of guide bar 16 in forming the edge of the cylindrical portion of the winding. However, the particular phase relation of the cams at the extreme edges of the winding shift is immaterial so long as the mechanism is proportioned to place the edges of the curved portion in the desired positions.

With this particular device the edge of the cylindrical portion, adjacent to the edge J, will be defined when cam 31 has made two revolutions and cam 41 has made substantially one-half of a revolution. The other edge of the cylindrical portion, adjacent to the edge K, will be defined when cam 31 has made thirty-nine and one-half revolutions and cam 41 has made substantially ten revolutions. The thread laid when cam 31 has made forty-three and one-half revolutions and cam 41 has made substantially eleven revolutions will also lie at the edge K of the cylindrical portion. Likewise, when cam 31 has made eighty-one revolutions and cam 41 has made substantially twenty and one-half revolutions the thread will again lie at the edge of the cylindrical portion adjacent to the edge J.

Although for purposes of description I have chosen a starting position in which the cams 31 and 41 are exactly in phase, it is apparent that, in view of the repeating nature of the operating cycle, the winding operation may be started at any position and without regard to the particular relation of the cams. Likewise it is not necessary to start all of the spinning devices which furnish thread to the various winding surfaces at the

same time, but it is desirable that an equal thickness of thread be wound on each section of the drum to facilitate treatment.

As clearly shown in Fig. 6, the various turns of the thread are laid on drum 17 in a non-uniform angular relation. Because the drum speed is not definitely related to the speed of the cams, the interlaced threads do not coincide with each other in consecutive layers and consequently the complete winding is very homogeneous. The rounded edges of the cake are so formed by interlaced threads that they retain their shapes during subsequent treatment and may be readily unwound. Further, the cake is of such open or honey comb structure with each thread separated from the others except at points where they cross, that an especially even distribution of treating fluids throughout the entire cake is obtained during the treating operations.

From the foregoing description of my spinning and winding apparatus, and the discussion of its mode of operation, it is apparent that I have invented apparatus for forming thread into cakes on a foraminated drum in such manner that all portions of the cake may be uniformly washed or otherwise treated by fluid passed into it from the interior of the drum through the foramina.

It will be understood that the invention is not restricted to the particular application exemplified and described herein, but that it is applicable broadly to the winding of thread upon holders for subsequent treatment. For instance, it is equally applicable to the pot spinning process now commonly used in making viscose rayon. In such case the pot spun cakes are wound upon the drum in the manner described hereinabove, and the thus-wound thread is then treated or cured. A suitable mode of treating the thus-wound thread is that described in the aforesaid copending application.

Although I have described one specific embodiment of my invention, giving particular proportions and sizes of parts which have been found suitable in practical operation, it is to be understood that this detailed discussion of my apparatus is merely for the purpose of accurately setting forth a practical embodiment thereof. It will be apparent to others skilled in the art to which this invention relates that various modifications may be made in the sizes and proportions of the apparatus and in the general arrangement of the parts involved without departing from the spirit and scope of this invention as defined in the appended claims.

I claim:

1. In a rayon winding apparatus, the combination with a winding drum and a movable guide disposed in working relation with the drum, of means for moving the guide to wind rayon upon said drum and comprising a primary cam, a secondary cam, and gearing positively interconnecting the cams to cyclically change their phase relation, said cams and gearing coacting to wind the rayon angularly in intercrossing layers into a cake having a substantially cylindrical mid-portion and convexly rounded end portions of radii less than the thickness of the mid-portion of the cake to provide a cake which is uniformly pervious throughout to treating fluids.

2. In a rayon winding apparatus the combination with a rotatably mounted drum and a movable guide disposed in working relation with the drum, of means for moving the guide to wind rayon upon said drum and comprising a primary cam, a secondary cam, and gearing positively in-

terconnecting the cams to cyclically change their phase relation, the cams being shaped to cooperate with said gearing to move said guide with a cyclic non-uniform motion which is slower at the mid-portion of the travel than at its ends to wind the rayon into a cake composed of intercrossing layers of non-uniform angular relation and having a substantially cylindrical mid-portion and convexly rounded end portions of radii less than the thickness of the mid-portion of the cake whereby to provide a cake which is uniformly pervious throughout to treating fluids.

3. In a rayon winding apparatus the combination with a rotatably mounted drum and a guide movably mounted with respect to the drum, of an inverse harmonic cam operatively connected to said guide to move it longitudinally of the drum over a range less than the length of the drum, a second inverse harmonic cam cooperating with the first-named cam to extend the range of action of the guide, and means cooperating with said cams to change their phase relations and wind the rayon in angularly disposed intercrossing layers into a uniformly pervious cake having a substantially cylindrical mid-portion and convexly rounded self-supporting end portions.

4. In a rayon winding apparatus, the combination of a rotatably mounted drum having a foraminous winding surface, a winding guide mounted for movement longitudinally of the drum, primary and secondary cams each operatively connected to the guide to move it cyclically with respect to the drum, and phase-changing mechanism associated with said cams cooperating therewith to impart to the guide a non-uniform motion which is slower at its mid-portion than at its ends and thereby to wind the rayon into a cake composed of angularly intercrossing layers disposed in non-uniform angular relation and having a substantially cylindrical mid-portion and convexly rounded end portions the radii of which are less than that of the mid-portion and whose edges are disposed with respect to the marginal foramina to provide a cake which is uniformly pervious throughout.

5. In a rayon winding apparatus the combination of a rotatably mounted drum having a foraminous winding surface, a guide mounted for movement longitudinally of the drum, and mechanism for winding the rayon angularly on the drum comprising an inverse harmonic cam operatively connected to the guide for traversing it over a distance less than the length of the drum, and a second inverse harmonic cam operatively connected to the guide to extend the range of travel of the guide, and gearing associated with said cams to change their phase relation and shift the guide in a cyclic non-uniform travel which is slower at the mid-portion than at the ends of travel to wind the rayon into a uniformly pervious cake composed of angularly intercrossing layers disposed in non-uniform relation and having a substantially cylindrical mid-portion and convexly rounded self-supporting end portions the edges of which are disposed beyond the marginal foramina.

6. In a rayon winding apparatus the combination with a rotatably mounted drum and a guide member mounted for movement longitudinally of the drum, of guide-member actuating means comprising two cams operatively connected to said guide, and mechanism associated with said cams progressively changing their phase relation to actuate the guide with a cyclic non-uniform motion slower in travel at the mid-portion than

at the ends to wind rayon upon said drum in angularly intercrossing layers into a cake having a substantially cylindrical mid-portion and convexly rounded end portions, the cake being uniformly pervious throughout.

7. In a rayon winding device, a drum having a foraminous mid-portion, a guide mounted for reciprocation longitudinally of said drum surface for winding rayon yarn upon the drum, and reciprocating means connected to said guide including a rocker arm, cam mechanism actuating said rocker arm, and driving mechanism actuat-

ing said cam mechanism to move the guide with a cyclic non-uniform motion to lay rayon yarn supplied to the guide onto the drum into angularly intercrossing layers and form a cake having a cylindrical mid-portion of width substantially equal to the width of the foraminous portion of the drum and having convexly rounded end portions of such shape and thickness that the cake is uniformly pervious to fluid issuing from the foramina in the mid-portion of the drum.

WILLIAM F. RICHTER.

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25	100
30	105
35	110
40	115
45	120
50	125
55	130
60	135
65	140
70	145
75	150