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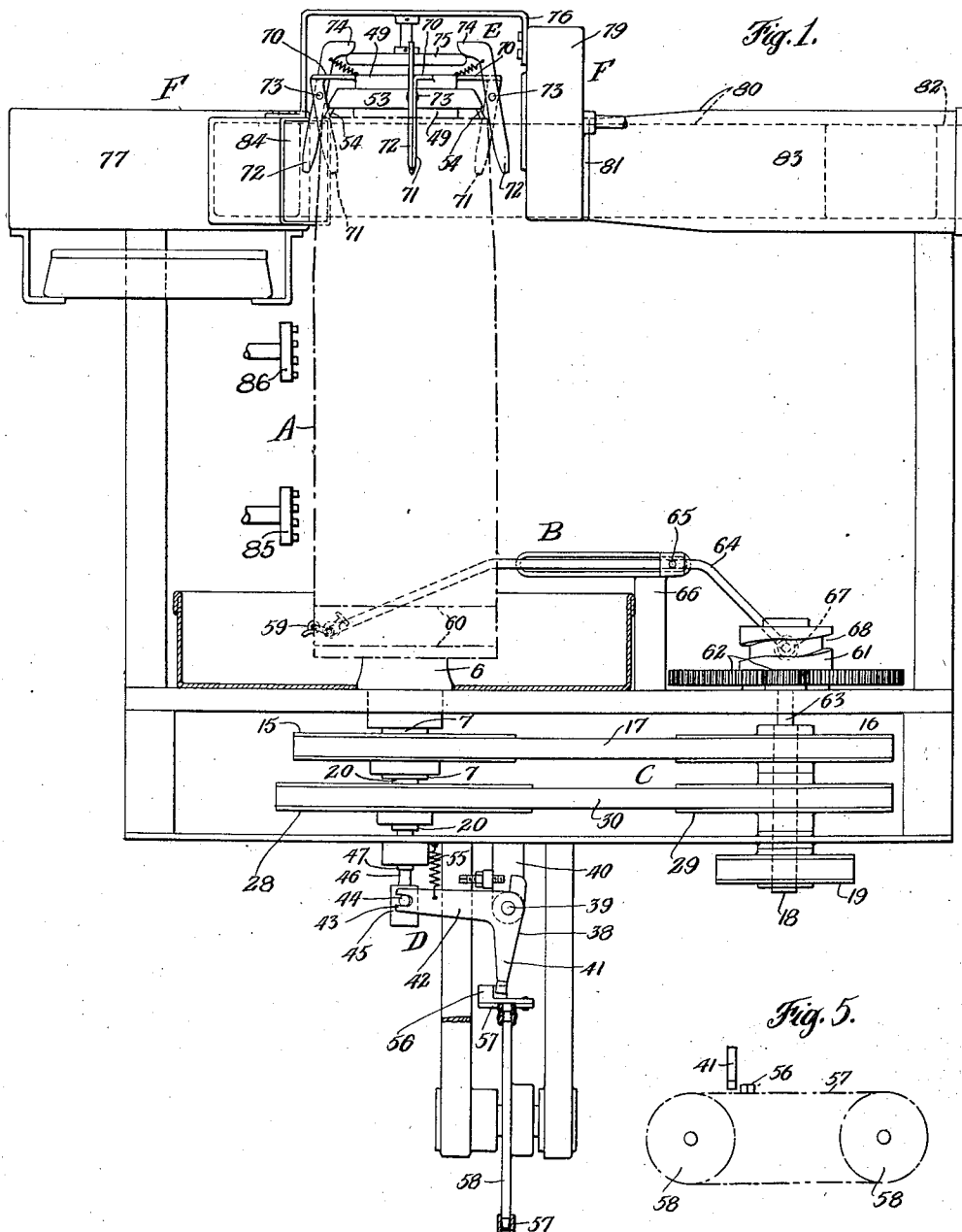
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ART OF RAYON MANUFACTURE

Filed April 25, 1939

3 Sheets-Sheet 1



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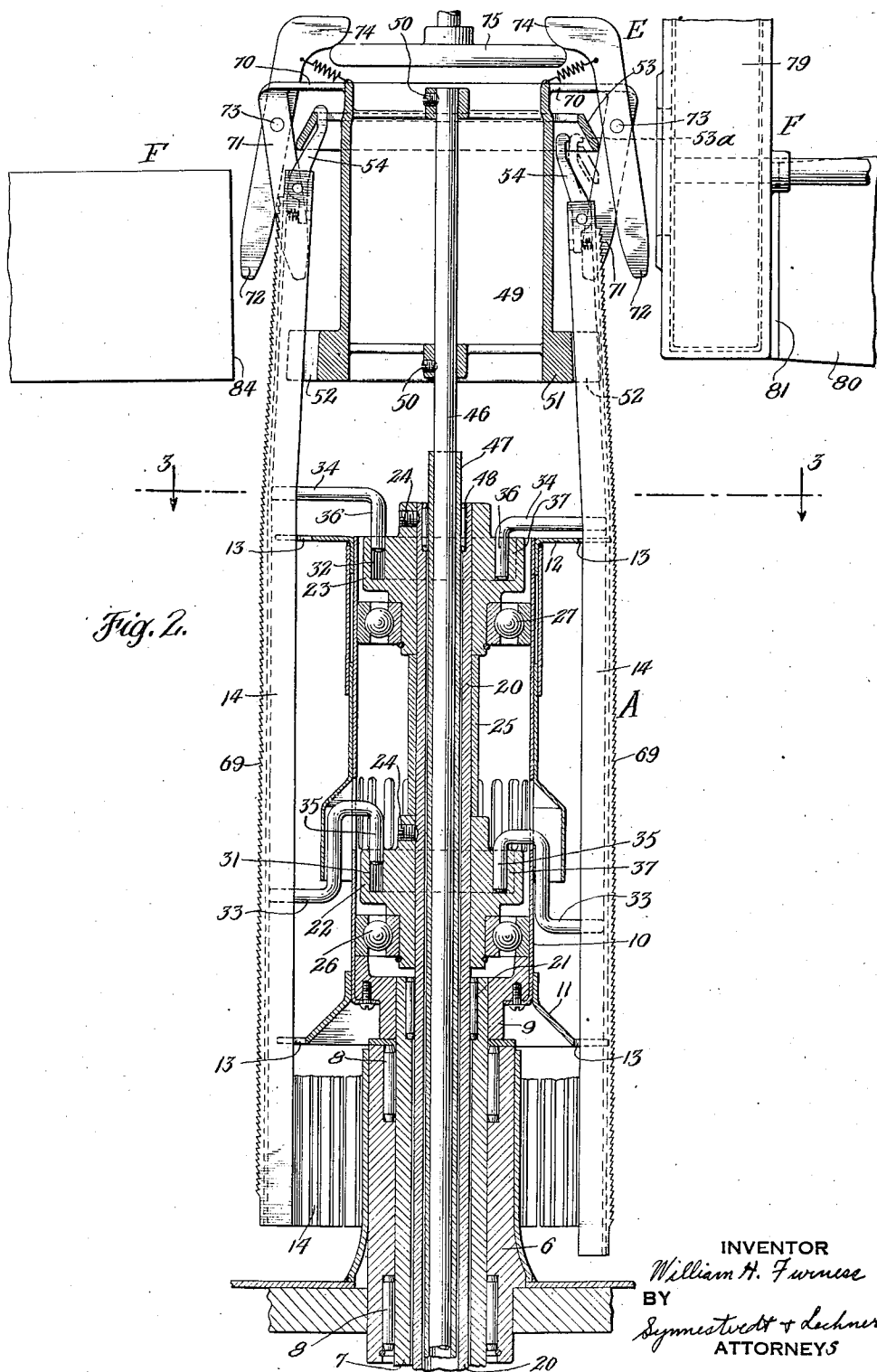
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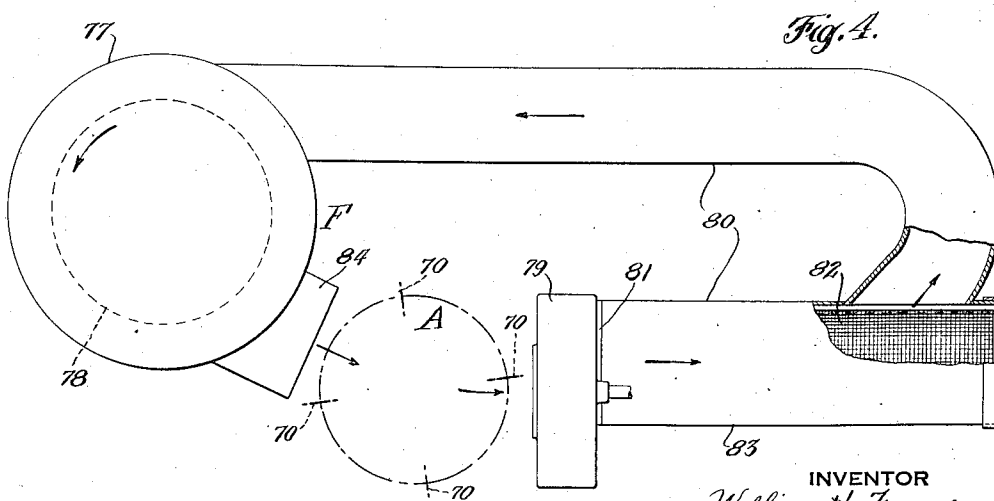
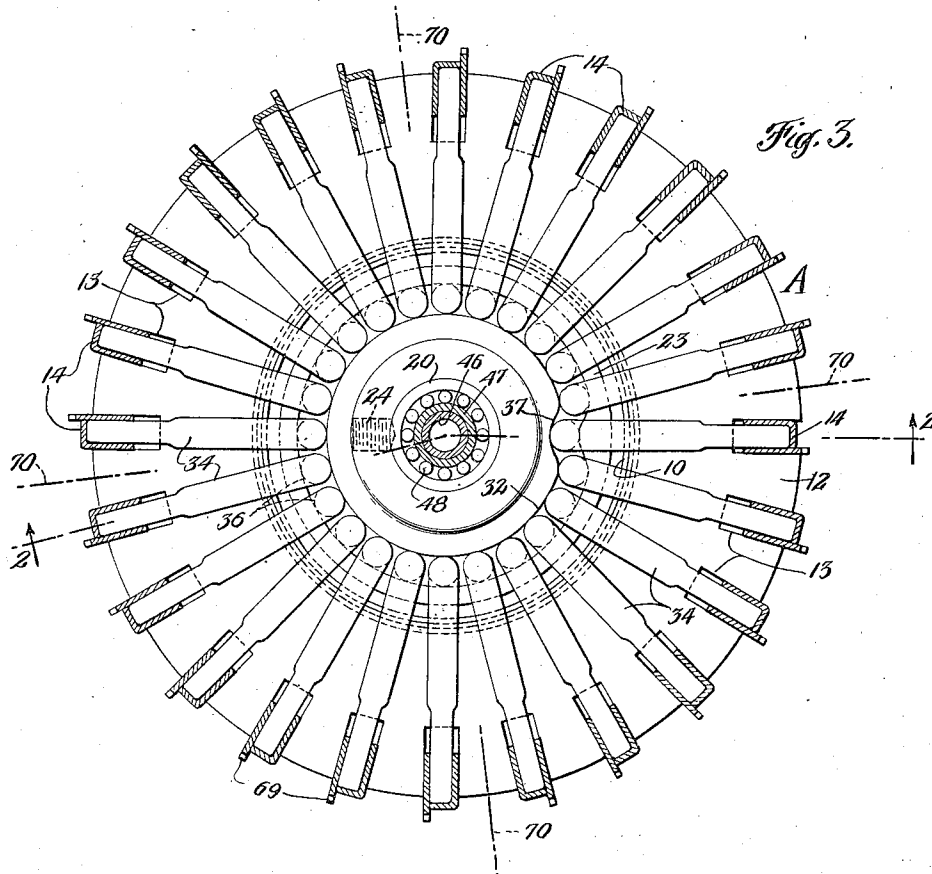
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ART OF RAYON MANUFACTURE

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3 Sheets-Sheet 3



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2,277,753

ART OF RAYON MANUFACTURE

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Application April 25, 1939, Serial No. 269,881

9 Claims. (Cl. 18—8)

This invention relates generally to the art of rayon manufacture and is especially useful in the production of staple.

The general nature of my invention will be best seen from the following. In general there are now employed two methods of rayon manufacture. According to the first method, as the bundle of filaments is spun in the setting bath, it is drawn therefrom and laid up on a spool. The filled spool is known as a cake. The cake of filament is then subjected to a series of acid and water washes and finally drying, which ordinarily involves the unwinding and re-winding of the yarn repeatedly before it is in ultimate finished condition. This it will be seen is a discontinuous process. The second process employed is a continuous one in which the bundles of filaments as spun are led from the setting bath onto a revolving cage of sets of bars, which sets of bars have longitudinally reciprocatory and radial in and out movement by virtue of which the yarn is caused to advance along the cage in the form of a single helix. While on the cage the single helix is subjected to acid and water washes and in some instances drying. At the delivery end of the cage the yarn is drawn off and laid up on spools.

The cake process described requires repeated handlings, but has the advantage that a large yardage can be handled at a time, and, since there is no particularly limiting factor of time, the cakes can be chemically treated and washed with a relatively small volume of treating and washing liquids. The chemical treating and washing operations in such method are to be characterized more as soaking than as strictly washing operations. There is adequate time for effective removal of the various chemicals by soaking.

On the other hand, in the continuous process just described the machines must be operated at high speed in order to get any substantial yardage. The machines do not last very long under such conditions because of the great multiplicity of parts which are subjected to heavy wear by reason of their continuous reciprocatory motions under high rotary speeds. Moreover, the yarn remains on the cage for but a relatively short interval of time, in consequence of which large volumes of treating and washing liquids must be applied in order to secure effective removal of chemicals.

The present invention is an improvement upon the cake process. It is a continuous process but retains all of the advantages incident to the old cake process, such as greatly increased yardage

and minimum quantities of treating and washing liquids, but avoids the repeated handlings heretofore required in the cake process.

Generically considered, the present invention involves the idea of continuously spinning the filaments in the setting bath and continuously withdrawing the bundle of filaments from said bath and feeding it to a support or cage-like cylinder upon which it is laid in a cake, in the general manner now to be described.

The yarn is first laid on the support, at one end thereof, in the form of a cake, as for example by cross-winding brought about by a traverse guide. When the cake is built up to the desired thickness, the support and the cake are bodily shifted and the support returned to its initial position with the cake first spun remaining in the position to which it has been shifted. The next cake is now laid, overlapping the first cake. When the second cake is built up to the desired thickness, once again the support with the cakes thereon is shifted, the support returned to its original position, while the two cakes remain in the position to which they have been now shifted. The third cake is now laid, overlapping the second cake, and so on until the support has been filled in what is now a continuous or long cake composed of a succession of overlapping short cakes.

Assuming that the yarn to be spun is made according to the cupro-ammonium process, the first treatment zone would be one in which an acid solution is applied to remove copper and form soluble salts; the next treatment would be the application of a water wash or washer to remove the soluble salts and any acid; and the third treatment would be a drying one, the drying zone being located at the end opposite that upon which the first small cake is laid.

It will be seen that each cake remains in a definite location while the succeeding cake is being laid up, and so forth, in consequence of which each cake remains upon the support for a long period of time. In consequence of this the cakes are subjected to the acid and water washes for a relatively long period of time, affording an opportunity for thorough soaking, thus making it possible to thoroughly remove undesired chemicals with a minimum volume of treating liquids. Similarly there is ample time available for the drying operation.

Thus the general advantages of the cake system are retained, but the many handlings incident to the discontinuous cake system and the

equipment required therefor are largely reduced, if not eliminated.

Furthermore, the arrangement is one which minimizes wear on the parts of the machine, especially the reciprocating parts, since they are motionless during much of the time (except for the rotation of the cage). The machine may be made of large diameter and operated at relatively low R. P. M., avoiding centrifugal discharge of liquids.

When the first cake laid reaches the opposite end of the support, it may be unwound, but with the principle of operation described it is possible to produce staple continuously in finished condition, ready for the combing and subsequent operations required in the production of yarn from staple. This may be done by cutting the dried yarn at the opposite end of the support, simultaneously at a plurality of circumferential points, and collecting the cut yarn or staple as will later be described.

My invention also has for one of its objects the provision of a machine suitable for carrying out my improved methods.

How the foregoing, together with such other objects and advantages as may hereinafter appear or are incident to my invention, are realized, is illustrated in preferred form in the accompanying drawings wherein—

Figure 1 is a more or less diagrammatic elevational assembly view of one embodiment of my invention;

Figure 2 is a vertical section drawn on an enlarged scale through the main portion of the machine and taken substantially on the line 2—2 of Figure 3;

Figure 3 is a plan section taken substantially on the line 3—3 of Figure 2;

Figure 4 is a diagrammatic top plan view of the mechanism employed for drying and removing the staple; and

Figure 5 is a diagrammatic fragmentary view illustrating a detail of the mechanism.

The apparatus in general comprises a cage or cylinder A composed of a multiplicity of longitudinally extending bars arranged in circumferentially spaced relation; traverse guide mechanism B for laying thread on the cylinder A in cakes; drive mechanism, indicated as a whole by the reference letter C, for rotating the cylinder and its associated cam mechanism, and for effecting reciprocation of the traverse guide mechanism B; reciprocating mechanism D for effecting longitudinal movement of the bars of the cylinder; cutter mechanism E for cutting the thread into staple; and combined mechanism F for drying the thread and collecting the staple.

In this instance the cylinder is vertically mounted as by means of a bearing member 6 carried by a suitable base plate or table. A hollow shaft 7 is mounted in the bearing member 6 by means of anti-friction bearings 8, and has attached to its upper end a collar 9 to which is secured an upwardly extending cylindrical shell 10 carrying a flange-like member 11 at its lower portion and a flange-like member 12 at its upper portion. The flange-like members 11 and 12 are provided with a plurality of radial slots 13 at their peripheries in which the bars 14 of the cylinder are mounted with freedom for in and out radial movement and up and down longitudinal movement.

The hollow shaft 7 extends downwardly out of the bearing member 6 and has a pulley 15 secured thereon which is connected to a pulley

16 by means of a belt 17. The pulley 16 is mounted on a drive shaft 18 having a drive pulley 19 thereon connected to any suitable source of power.

A second hollow shaft 20 extends through and is mounted concentrically with the hollow shaft 7 as by means of anti-friction bearings such as shown at 21. The upwardly extending portion of the shaft 20 has two cams 22 and 23 secured thereto, as by means of set screws 24. These cams 22 and 23 are spaced apart vertically by means of a spacer sleeve 25. Antifriction bearings 26 and 27 are employed between the cams and the cylindrical shell 10. The lower end of the hollow shaft 20 projects downwardly beyond the lower end of the hollow shaft 7 and has a pulley 28 mounted thereon which is connected to a pulley 29 by means of a belt 30, the pulley 29 being mounted on the drive shaft 18 above referred to.

The cams 22 and 23 are provided with cam grooves 31 and 32 respectively of like configuration. A plurality of arms 33 and 34, extending inwardly from the bars 14 of the cylinder and having downwardly extending portions 35 and 36 entering the cam grooves 31 and 32 respectively are provided for transmitting in and out radial movement to the bars from the cams, it being noted that each bar has one of the lower arms 33 and one of the upper arms 34 secured thereto so that the bars will remain parallel in their in and out movement.

By referring particularly to Figure 3 it will be seen that the cam grooves of the cams are concentric with the central shafts with the exception of the portions 37 which curve inwardly. The circumferential extent of the portions 37 is such that only one bar 14 at a time is operated thereby. In other words, as the cams rotate, one bar after the other is moved inwardly and then immediately outwardly and then stays out until the cams have completed a revolution.

In connection with the operation of the cams it is pointed out that the pulleys 16 and 29 on the drive shaft 18 and the pulley 15 on the hollow shaft 7 are of the same diameter while the pulley 28 on the hollow shaft 20 is of larger diameter. Thus the shaft 20 with its cams 22 and 23 is rotated at a slower speed than the shaft 7 with its collar 9, shell 10, members 11 and 12 and the bars 14, with the result that the cams effect the desired in and out movement of the bars.

In addition to this in and out radial movement of the bars they are also moved longitudinally, i. e., up and down, by means of the reciprocating mechanism D illustrated in Figure 1 and comprising a bell crank lever 38 pivoted at 39 in a bracket 40 and having a downwardly extending arm 41 and a laterally extending arm 42. The arm 42 has a forked end 43 engaging a pin 44 carried by a collar 45 rotatably mounted but fixed against axial movement on a vertical shaft 46 extending upwardly through the hollow shaft 20. The shaft 46 is mounted in a sleeve 47 which in turn is rotatably mounted in the hollow shaft 20 as by means of anti-friction bearings such as shown at 48.

The shaft 46 has a head member 49 secured thereto at its upper portion, as by means of set screws 50. This head is provided with a lower flange 51 having radial slots 52 for receiving the bars 14, and an upper annular ring 53 adapted to cooperate with spring catches or latches 54

pivotaly mounted at the upper ends of the bars 14, as will presently appear.

The operation of the device as thus far described is as follows. With the cams 22 and 23 in the position shown in Figures 2 and 3, and with the reciprocating mechanism D in the position shown in Figure 1 all of the bars 14 with the exception of the right hand bar of Figure 2 are in their outward and upward position, the outward movement having been imparted thereto by the cams 22 and 23 and the upward movement by the reciprocating mechanism D, which under influence of the spring 55 (see Figure 1) caused the shaft 46, the head 49, and the annular ring 53 with its engaged latches 54 to move upwardly carrying the bars therewith.

The right hand bar 14 of Figure 2 however was moved inwardly by the portion 37 of the cams, with the result that its latch 54 rode inwardly off the top edge of the ring 53 to release the bar and permit it to drop downwardly to the position shown, it being noted that the cam grooves are sufficiently deep to enable this movement to take place.

As the cams rotate this downwardly positioned right hand bar is moved outwardly and the same inward, downward and outward movement just mentioned is imparted to all of the bars, one after the other, so that when the cam has completed one revolution with respect to the bars all of the bars will be in their downward and outward position with the exception of the bar being operated on by the portion 37 of the cams. At this time the arm 41 of the bell crank lever 38 is rocked to the right by means of a lug 56 carried by an endless chain 57 running over a pair of sprocket wheels 58, one of which is driven in any suitable manner in the proper timed relation with respect to the cams.

This causes the shaft 46 to be moved downwardly carrying with it the head 49 and annular ring 53. The ring in moving downwardly causes the spring latches to snap over the upper edge of the ring, it being noted that since all of the bars with the exception of one are in their downward and outward positions their latches will be in the position indicated in dot and dash lines at 53a in Figure 2.

When the lug 56 passes the arm 41 the bell crank is again moved to the position shown in Figure 1 by the spring 55 so that the annular ring 53 moves upwardly and carries with it all of the bars which are in latched engagement therewith so that the bars will be in the position of the left hand bar in Figure 2. Continued rotation of the cams and the sprockets causes the above operations to be repeated.

While the above operations are taking place thread is being continually laid up on the cylinder A at its lower portion by means of the traverse mechanism B which is provided with a guide loop 59 for guiding the thread onto the cylinder to form cakes, as indicated by the dot and dash lines 60 in Figure 1. The width of the cakes is determined by the stroke of the mechanism B which comprises a rotatable cam 61 driven by means of gearing 62 connected to the upward extension 63 of the drive shaft 18, and a lever arm 64 pivoted at 65 in a support 66 and having a roller 67 at one end running in the cam groove 68, and carrying the guide loop 59 at its other end. The stroke of the reciprocating guide loop 59 may be adjusted by changing the location of the movable pivot 65 in the support 66.

The thickness of the cake is determined by

the number of revolutions the cylinder makes before the bars 14 are shifted upwardly. In this connection it is pointed out that while the cams 22 and 23 and the bars 14 are all rotating the difference in speed of the two, by reason of the pulley 15 being smaller than pulley 28, is such that when the cylinder has made one revolution the cams have only made part of a revolution. Since this only effects movement of some of the bars it will be seen that a number of revolutions of the cylinder must take place before all of the bars have been moved by the cams. The number of these revolutions determines the thickness to which the cake is laid up on the cylinder and this may be controlled by altering the relative sizes of the pulleys 15 and 28.

The upward movement of the bars by the reciprocating mechanism D above described causes the cake to be raised, and since the bars only move inwardly, downwardly and outwardly, one at a time, the thread is always supported by bars in their outward position so that the shifted cake is held in its new position and a new cake is started in formation therebelow. In this instance the stroke of the reciprocating device D is such with relation to the stroke of the guide loop 59 that the cakes are laid up in overlapping relation one after the other until the cylinder is filled with such overlapping cakes of thread. If desired the bars 14 may be provided with serrated edges 69 to prevent the cakes from slipping downwardly on the cylinder.

As pointed out above, in some instances the thread may be unwound from the upper end of the cylinder and laid up on spools, and in other instances staple may be produced continuously without unwinding the thread from the cylinder, and for this purpose I employ mechanism now to be described.

The head member 49 at its upper portion is provided with a plurality of radially extending arms 70, in this instance four being employed spaced at equal circumferential points, each carrying a downwardly extending member 71 which constitutes a fixed blade of a scissors, the other movable blade 72 being pivoted to the blade 71 at 73. The location of the arms 70 circumferentially of the cylinder is indicated in dot and dash lines in Figures 3 and 4. The spacing of these arms determines the length of the staple.

The movable blade 72 of each scissors is provided with an enlarged portion 74 at its upper end adapted to engage a member 75 held in fixed position at a point above the cylinder A, as by means of a support 76 illustrated in Figure 1. It is to be observed that since the scissors are carried by the head 49 they will rotate with and be moved up and down with the head as it is reciprocated by the device D above described, and when the head moves downwardly the enlarged portions 74 of the movable blades 72 ride on the fixed member 75 to move the blades 72 to actuate the scissors for cutting the thread into staple. The fixed member 75 is so adjusted that the amount of thread which is cut into staple each time they are actuated is equivalent to that being laid up on the cylinder by the traverse mechanism, so that the process is a continuous one.

In order to collect the staple I have provided suction mechanism which I preferably associate with a heating device for drying the thread. This combined mechanism is indicated as a whole by the reference letter F and comprises an air chamber 77 located at one side of the upper portion of

the cylinder A, a heater 78 of any suitable type for heating the air in the chamber, a suction fan 79 located at the other side of the cylinder opposite to the chamber 77, an air connection 80 leading from the fan outlet 81 to the air chamber 77, and a readily removable perforated container 82 located in the portion 83 of the connection 80 in which the staple is collected.

In operation heated air from the outlet 84 of the air chamber 77 sweeps over the cylinder and the suction of the fan 79 draws the cut and dried staple into the fan and delivers it for collection into the container 82 while the air continues to pass through the connection 80 into the air chamber 77.

As has been pointed out hereinbefore, the cakes of thread are treated by applying an acid solution thereto as by means of nozzle means indicated at 85 in Figure 1, and as they progress along the cylinder they are washed by applying a water wash as by means of nozzle means indicated at 86, are dried at the upper portion of the cylinder, are cut into staple, and finally the staple is collected. I have therefore provided a very simple and effective method and apparatus for performing these numerous operations in a continuous manner.

It will be observed that the staple will be of unusually uniform quality among other reasons because the yarn is supported on the cage or cylinder during drying and until the actual cutting, under uniform tension, for which purpose the drying end of the cage is appropriately tapered.

The machine has been described for operation in a vertical position and is particularly suitable for such operation, especially in connection with cupro-ammonium yarn in which recovery of chemicals presents little difficulty. When the machine is operated in this position the liquids travel downward by gravity and hence I prefer to have the small cakes overlap one another to form a continuous long cake. The machine may be used as shown or it may have its bodily longitudinal stroke of greater amplitude than the stroke of the traverse which would produce a series of spaced non-overlapping cakes. However, when laying up spaced non-overlapping cakes I prefer to use the machine shown in my co-pending application, Serial No. 269,882, which simplifies recovery of chemicals even if the yarn is being manufactured by the viscose process wherein the chemical treatment is much more involved than is the case with the cupro-ammonium process.

I claim:

1. Apparatus for laying up thread in cakes comprising a vertically disposed rotating cage-like cylinder composed of a plurality of longitudinally extending movable bars arranged in circumferentially spaced relation and mounted for radial in and out and for up and down movement, a traverse guide for laying thread on said cylinder in cakes adjacent the lower end thereof, a spring catch carried by each of said bars at the upper end thereof, a ring-like member associated with said catches and mounted for up and down movement, cam means for imparting said in and out movement to said bars, and means for imparting said up and down movement to said ring-like member, said cam means and said last mentioned means being so coordinated that the ring-like member moves downwardly when the bars are in their downward and outward position to engage said catches, then moves upwardly carry-

ing the bars with it, that the bars then move inwardly one after the other to release the catches and permit the bars to drop downwardly and be moved outwardly and that said cycle is repeated.

2. Apparatus for laying up thread in cakes comprising a vertically disposed rotating cage-like cylinder composed of a plurality of longitudinally extending movable bars arranged in circumferentially spaced relation and mounted for radial in and out and for up and down movement, a traverse guide for laying thread on said cylinder in cakes adjacent the lower end thereof, a hollow central vertical shaft, vertically spaced cams mounted on said shaft to rotate therewith and having cam grooves therein, arms extending inwardly from said bars and having portions entering said cam grooves, said cam grooves being configured to move said bars radially inwardly and outwardly, a coaxial hollow rotatable shaft, means carried by said coaxial shaft engaging said bars to rotate them with freedom for in and out and up and down movement, means for rotating said central and coaxial shafts at different speeds to effect in and out movement of the bars by said cams, a reciprocable shaft mounted within said central hollow shaft with freedom for rotary movement, means for imparting reciprocatory movement to said shaft, a head member secured to the upper portion of said reciprocable shaft, said head member having slotted engagement with said bars and having an upper ring-like portion, and latch means carried by said bars at their upper portions, said ring-like portions being adapted to engage said latch means and lift the bars upwardly when said reciprocable shaft and head member are reciprocated upwardly, said latch means being released when the bars are moved inwardly by said cams whereby the bars move downwardly, and said bars being then moved outwardly by said cams to position the latch means to be engaged by said ring-like portion when it moves into its bottom position of reciprocation.

3. Apparatus for laying up thread in cakes comprising a rotating cage-like cylinder composed of a plurality of longitudinally extending movable bars arranged in circumferentially spaced relation, means for laying thread on said cylinder in cakes adjacent one end thereof, means for imparting movement to said bars in directions to advance the formed cakes of thread along said cylinder, cutter means at the other end of said cylinder, means for mounting said cutter means at spaced points circumferentially of said cylinder to rotate with the cylinder, and means for actuating said cutter means to cut the thread into staple while the cylinder is in rotation.

4. Apparatus for laying up thread in cakes comprising a rotating cage-like cylinder composed of a plurality of longitudinally extending movable bars arranged in circumferentially spaced relation, means for laying thread on said cylinder in cakes adjacent one end thereof, means for imparting movement to said bars in directions to advance the formed cakes of thread along said cylinder, cutter means at the other end of said cylinder, means for mounting said cutter means at spaced points circumferentially of said cylinder to rotate with the cylinder, means for actuating said cutter means to cut the thread into staple while the cylinder is in rotation, and means for applying heated air to the thread on said cylinder adjacent said other end.

5. Apparatus for laying up thread in cakes

comprising a rotating cage-like cylinder composed of a plurality of longitudinally extending movable bars arranged in circumferentially spaced relation, means for laying thread on said cylinder in cakes adjacent one end thereof, means for imparting movement to said bars in directions to advance the formed cakes of thread along said cylinder, cutter means at the other end of said cylinder, means for mounting said cutter means at spaced points circumferentially of said cylinder to rotate with the cylinder, means for actuating said cutter means to cut the thread into staple while the cylinder is in rotation, and a suction device having a suction chamber positioned at said other end of the cylinder for collecting the staple.

6. Apparatus for laying up thread in cakes comprising a rotating cage-like cylinder composed of a plurality of longitudinally extending movable bars arranged in circumferentially spaced relation, means for laying thread on said cylinder in cakes adjacent one end thereof, means for imparting movement to said bars in directions to advance the formed cakes of thread along said cylinder, cutter means at the other end of said cylinder, means for mounting said cutter means at spaced points circumferentially of said cylinder to rotate with the cylinder, means for actuating said cutter means to cut the thread into staple while the cylinder is in rotation, and a combined mechanism for drying the thread and collecting the staple comprising a hot air chamber having an air outlet located at one side of said other end of said cylinder, a suction device at the opposite side of said end of the cylinder, a connection from said suction device to said air chamber and perforated means in said connection for collecting the staple delivered thereinto by said suction device.

7. Apparatus for laying up thread in cakes comprising a rotating cage-like cylinder composed of a plurality of longitudinally extending movable bars arranged in circumferentially spaced relation, traverse means for laying thread on said cylinder in cakes adjacent one end thereof, rotating cam means providing, in one revolution thereof, for movement of said bars one after the other radially inwardly away from the thread on the cylinder, then longitudinally in one direction, and then radially outwardly to re-engage

said thread until all of the bars have been so moved with the exception of one bar, said one bar being moved radially inwardly and longitudinally only during said revolution, and means for moving all of said outwardly moved bars longitudinally in the opposite direction simultaneously while said one bar remains in its aforesaid inward and longitudinal position, said one bar being moved radially outwardly at the start of a succeeding revolution of said cam means.

8. Apparatus for laying up thread in cakes comprising a rotating cage-like cylinder composed of a plurality of longitudinally extending bars arranged in circumferentially spaced relation, a traverse guide for laying thread on said cylinder in cakes adjacent one end thereof, rotating cam means for imparting inward radial movement to said bars one after the other, said bars being mounted for freedom of longitudinal movement in one direction after they have been moved radially inwardly by said cam means, said rotating cam means being also adapted to impart outward radial movement to said bars one after the other after they have moved in said longitudinal direction, means engaging said bars after they have been moved radially outwardly by said cam means for moving them simultaneously in a longitudinal direction opposite to the aforesaid longitudinal direction, and means for actuating said bar engaging means once for each revolution of said cam means.

9. A continuous thread handling method comprising laying up thread on a plurality of longitudinally extending bars circularly arranged in the form of a cylinder which consists in rotating said cylinder, in guiding thread onto said cylinder adjacent one end thereof in cakes of predetermined width, in moving said bars in directions to advance the cakes therealong in steps from said end of the cylinder to the other end, the amplitude of each step movement being such that the cakes are laid onto the cylinder one after the other in overlapping relation, in cutting the thread while on said cylinder simultaneously at a plurality of circumferentially spaced points adjacent the end of said cylinder opposite said first mentioned end to produce staple, and in collecting said staple.

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