APPARATUS FOR CONTINUOUS TREATMENT OF YARN

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This invention relates to the provision of apparatus for and method for continually spinning and processing yarn and the like. More particularly it relates to advancing and storing yarn in the like.

By the processes and apparatus of this invention shaped articles are advanced, stored and treated in a continuous fashion. By "shaped articles" is meant yarns, threads, monofil, ribbons, strands and the like. While the discussion below pertains in the main to the continuous spinning of viscose, it is understood that the apparatus described herein may be employed wherever a shaped article is to be advanced or stored.

It is well-known that yarn may be advanced in the form of a helix upon a variety of reels. These reels usually involve a considerable number of moving parts. A typical example is the reel in which yarn carrying bars move outward into contact with the yarn, then forward carrying the yarn in this movement, then inward out of contact with the yarn and finally backward to repeat position. Commercial use of advancing devices heretofore known, such as the illustrated reel, involves a large number of units and considerable maintenance cost. Reduction in both items is highly desirable.

An object of this invention is to provide a new advancing device and process. Another object of this invention is to provide an advancing device which involves simple construction and relatively few moving parts. A further object is the provision of an advancing device in which the article being advanced after contacting the device does not change its position relative to that of the device during advancement. A still further object is the provision of a new process for advancing, storing and winding shaped articles. Other and additional objects will appear hereinafter.

The objects of this invention are accomplished, in general, by winding the shaped article to be processed on a rotating, traveling cylinder, the cylinder being forwarded horizontally or vertically and preferably horizontally. The article is fed to the cylinder, and as the cylinder rotates and moves axially the article collects on the cylinder in the form of a helix which is carried forward. During this advancement the article is treated in one manner. The article is advanced a desired distance to a take-off point from which it passes to another rotating cylinder traveling in the same, or preferably, the opposite direction. Similar wind-up and advancement occur and the next processing step is accomplished on this cylinder. The procedure is repeated until processing is completed. The final product is then wound in suitable packages. The cylinders may be in a tier or a horizontal arrangement.

The apparatus, then, comprises a cylinder which has rotary and rectilinear movement. As it rotates, it travels in a path parallel to its longitudinal axis of rotation. In order to keep the supply of cylinders constant at the various article-contacting areas, a plurality of these rotating traveling cylinders is used. A transfer means is employed for supplying the cylinders at a controlled rate to the article receiving areas and for removing the cylinders from these areas in a controlled manner. This transfer means comprises, for example, an endless driven conveyor having a plurality of cylinder carriers fixed thereto. In the tier arrangement, this conveyor is in the form of an elevator and the cylinder carriers are actuated by a trip mechanism to clamp a cylinder at the cylinder receiving and forwarding unit near the receiving end of the article-contacting area or to receive a cylinder at the removal end of the area. In another arrangement involving horizontal transfer of cylinders, a slidable mounted traversing arm having a cylinder carrier attached to one end and, if desired, running on a semi-circular horizontal track is used to transfer a cylinder from a removal end of one article-contacting area to the receiving end of another article-contacting area. The traversing arm is actuated by trip mechanisms and is driven by a reversible torque motor. The trip mechanisms are devised to be actuated by the absence of a cylinder or by the presence of a cylinder depending upon the location of the device. When a cylinder is received to be transported to the article-contacting area or when the cylinder has just been removed from an article-contacting area, it is moved by a forwarding unit either to or away from the main line of cylinders, respectively. Such a unit may be, for example, a plurality of driven rolls cooperating with a plurality of adjustable rolls. This unit drives the cylinder at an accelerated rate so that it catches up to the main cylinder line or is removed from it rapidly. The cylinders are rotated and forwarded, for example, by passing them through a stationary casing having a rotatable inner ring which when rotating supports the cylinders, rotates them and moves them forward. This inner ring has mounted on it a plurality of driven rollers the axes of rotation of which are 90° to
the axis of the inner ring. These rollers which are driven move the cylinders forward through frictional means and travels as a single unit. Similar supporting means may be placed at various places along the main cylinder line which is made up of a plurality of cylinders the ends of which are digitized so that adjacent cylinders are joined together. By this method of joining, the main cylinder line rotates and travels as a single unit.

The invention will be more fully understood by reference to the following detailed description and to the accompanying figures, in which like numbers designate like parts, and of which

Figure 1 is a sectional elevation taken through the various tiers of cylinders and at right angles to their paths of travel and showing the several floor levels and equipment associated with the process;

Figure 2 is a plan view of cylinders and adjacent driving mechanism and further illustrating elevators located in line with, and at each end of the travel path of the cylinders;

Figure 3 is a sectional plan taken on line 3—3 of Figure 6 showing a cylinder being transferred from the elevator to position in line with its path of horizontal travel;

Figure 4 is a sectional plan taken on line 6—6 of Figure 6 showing an off-coming cylinder being transferred to elevator carrier;

Figure 5 is a front elevation of one end of the machine as shown in Figure 2, some of the flights of cylinders being omitted;

Figure 6 is an end elevation thereof showing the endless conveyor, drives and transfer mechanisms;

Figure 7 is a side elevation of a transfer cylinder on a scale greater than shown in Figures 1 to 6;

Figure 8 is an end view thereof;

Figure 9 is an enlarged section on lines 9—9 of Figure 8, showing a cylinder wall and illustrating in detail the contours of the entering and receiving ends thereof;

Figure 10 is a section on line 10—10 of Figure 7 and of same relative scale as Figure 9;

Figure 11 is a section in line 11—11 of Figure 7 and of same relative scale as Figure 9;

Figure 12 is a sectional elevation taken transversely to a line of travel of a row of cylinders and illustrating the means for simultaneously rotating and advancing the cylinders;

Figure 13 is a vertical section taken on line 13—13 of Figure 12;

Figure 14 is an elevation similar to Figure 12, showing the supporting mechanism for the cylinders while being advanced through the machine;

Figure 15 is a vertical section taken on line 15—15 of Figure 14;

Figure 16 is a modification of the means for supporting the cylinders;

Figure 17 is a sectional elevation similar to Figure 12 and illustrating mechanism for washing and cleaning the cylinders during their advancement through the machine;

Figure 18 is a vertical section taken on line 18—18 of Figure 17;

Figure 19 is a fragmentary elevation of one end of a structure comprising the invention in another form;

Figure 20 is an end elevation of the device illustrated in Figure 19;

Figure 21 is a plan view of the structure shown in Figure 10 and illustrating the two ends thereof;

Figure 22 is a front elevation of the right hand end of Figure 21, and some of the cylinders as shown in Figure 19;

Figure 23 is an end elevation of Figure 22 and Figure 24 is a sectional elevation taken on line 24—24 of Figure 21 and shows the trip device in more detail.

In Figure 1 the thread, indicated by the broken line, is wound in the spinning bath 2 which contains numerous spinning jets 3 or spinnersets so that a plurality of threads is formed. While the description which follows is made in reference to the treatment and path of a single end it is to be understood that each thread formed in the long spinning bath 2 is treated similarly to and follows a corresponding path to the reference thread. The plurality of threads and spinning jets can be seen more clearly in Figure 2 which is a plan view of the apparatus.

The thread 1 passes from the spinning bath up to the cylinder 4 which can be the acid cylinder. This cylinder is rotating in a clockwise direction and is moving at the same time horizontally, say to the right. As the cylinder rotates, any desirable number of wraps of thread 1 are taken in keeping with the space allowed by the number of spinnersets in use before the thread end is passed downward to the next cylinder 5 which may be the preliminary wash cylinder. Thus, it will be seen that the thread goes on the cylinder at one point and due to the rotation and horizontal movement of the cylinder 4 it is taken off at another point some distance from the point of feeding. This distance can be varied between wide limits. Usually the width of the band on the cylinders will be adjusted so that proper processing is obtained during the time the yarn is on the cylinder. In each instance the rates of rotation, cylinder travel, yarn feeding and removal and processing are synchronized. Thus, the yarn leaving acid cylinder 4 has been adequately coagulated and regenerated by the acid treatment. On cylinder 5 the yarn is given a preliminary wash. Like cylinder 4 this cylinder is rotating in a clockwise direction but is moving in the opposite horizontal direction. The preliminary wash treatment may be any of the known washings designed to reduce or remove the acid used in coagulation. From cylinder 5 the yarn passes to cylinder 6 which may be for desulfuring. This cylinder rotates counterclockwise and moves in the same direction as cylinder 4. Intermediate washing of the yarn may be done on cylinder 7 which again reverses the horizontal yarn direction and is rotating counterclockwise. On cylinder 8, which rotates and moves like cylinder 4, the yarn may be given a bleach treatment. From 8 the yarn is passed to cylinder 9, rotating counter-clockwise and moving to the left. On this cylinder finish may be applied to the yarn. Preliminary drying is done on cylinder 10 rotating counter-clockwise and moving to the right. Final drying of the yarn is done on cylinder 11 rotating counterclockwise as it moves to the left. The yarn then passes to a take-up roller 12 then to a thread-guide 13, such as a pigtail guide, and finally to a wind-up package 14, such as bobbin cap twister.

The rotation and direction of movement of the respective cylinders as described above is not essential. The cylinders may rotate in the same direction or any arrangement as desired may be used. A desirable arrangement is one which facilitates string-up of each cylinder; and
such an arrangement is one in which each cylinder is on a different floor level and a rotation sequence, as that described above, is adjusted so that each cylinder is rotating toward the operator on the particular floor level. Difference in rotation of the cylinders is readily accomplished in any convenient way. For example, the common vertical shaft drive 54 described below can be equipped with right and left hand cut gear at the appropriate place where a change of direction is desired. The direction of horizontal movement again is not critical. However, in the interests of saving space, maintaining simple construction and synchronizing cylinder supply it is preferred to have each cylinder moving in a horizontal direction opposite to the preceding and subsequent cylinders. By so doing the cylinder area is used most efficiently, for the yarn can be made to come off the last cylinder at a point approximately under the starting point on the first cylinder.

Appropriate fume, ventilating, air ducts, etc. are provided for. For example, a large fume duct 15 is mounted at the top of the machine frame 16 which supports cylinders and certain other apparatus. Likewise, ventilation ducts 21 are provided at the various floor levels. Auxiliary fume ducts such as 13 may be supplied. A preliminary drying exhaust duct 20 may be provided for as well as a final dryer exhaust duct 21. The preliminary drying and the final drying may be accomplished, for example, with hot air supplied by the motor driven fan 22 driving air over steam coils 23. The warm air passes over the yarn and is removed via exhaust ducts 20 and 21. Any convenient and conventional drying means may be used. Under those cylinders on which liquids are applied during processing suitable drip catch pans 26 and drip trough returns 25 are placed. Appropriate supply and removal lines are used. Further, around the cylinders are enclosures which have removable fronts to facilitate string-up.

A suitable device for starting the thread around the cylinder comprises a spring clip of such size as to permit it to extend a little more than half way around the cylinder. The end of the yarn is passed between the handle of the clip and is pulled tight in the thread holder. The clip is then placed around the revolving cylinder and then removed. After the desired number of turns is placed on the cylinder, the clip is then pulled down by the operator or by an automatic stop release and the clip, still carrying the end, is placed on the next cylinder or the end is started on the wind-up device. The spinning operation conducted at the top floor or the spinning floor level may be seen in Figure 2. The viscose or other material to be wet-spun is forced through a plurality of spinnerets 3 contained in the coagulating bath 2. This arrangement is not essential. The apparatus of this invention may be used to accommodate filaments prepared by dry-spinning techniques or the filaments may be taken from a plurality of supply packages. Figure 2 illustrates how each main cylinder line is composed of a plurality of cylinder sections. As shown, each yarn is wrapped around main cylinder line 4 a number of times to form a wrap 26. Similar wraps appear in the succeeding main cylinder lines 3, 7, 8, 9, 10 and 11 beneath cylinder 4. These wraps may vary in width, in the number of turns of yarn, in yarn spacing and in the distance between wraps. Generally, it is desirable to have wraps which maintain a continuous film of processing liquid over the width of the wrap at every point.

In this connection it is possible to employ on each cylinder the continuous yarn carrying device described in my co-pending application Serial No. 776,819. This device comprises an endless belt which advances helically on the advancing device, such as a reel or the traveling cylinder of this invention. The belt is composed of an elastic or expandable material and it contacts all or a portion of the surface of the advancing device. The yarns are arranged side by side initially under high or low tension. The yarns advance along the advancing device with the belt acting as a direct carrier. The belt surface supports a continuous film of the applied liquid so that during processing the filaments are at all times covered by a continuous film of liquid. The filaments are held in their respective positions by virtue of their frictional contact with the belt. The belt may be used during drying steps in a similar manner. This modification permits the purification and drying of filaments under low tension. Appreciable tension is avoided. Further, no effort need be taken to maintain a film by proper spacing of filaments. The film is continuous even though the yarn turns in the plurality or in the band 26 are relatively far apart. Still further, this modification eliminates strain and wear on the yarn and leads to a substantial increase in yarn quality.

Shown in Figure 2 is a cylinder section 27 in elevator 28. This, like the other sections shown, has at its ends fingers 29 permitting the coupling of it to another in an interdigitating fashion. This construction is shown more clearly in Figures 7, 9, 10 and 11. Figures 7 and 9 show how the fingers are alternated so that the notch or recess 30 at one end can receive a finger 29 of an adjacent cylinder while the finger 31 directly at the other end fits into a recess of still another adjacent cylinder. A number of cylinder sections are shown in Figure 2 making up the main cylinder line 52 (which is any main cylinder line 4, 5, 6 etc.)

While smooth cylinders may be employed it is preferred to use cylinders which are corrugated or have ridges or elevations 32 as shown in Figure 8, an end view of a cylinder. The yarn or filament rides on these ridges practically in point contact with them. This is preferred since an optimum penetration or washing by the treating liquid is obtained. Of course, if a belt is used as described above, there is no need for the corrugated cylinder. When a belt is not used, the ridged cylinder is preferred to the smooth cylinder for the greater efficiency in processing obtained.

Actually, in the preferred ridged cylinders, the ridges are slightly raised and lowered alternately near the junction to prevent the yarn from being caught in the separation between two sections. Figure 9 shows the slight elevation 32 in the ridge near the digit 31. This elevation runs over a small area as shown in Figure 9. This elevation 32 and the alternating feature can be seen also in Figure 10 which is taken on line 10—310 of Figure 7. The normal height of the ridge 32 having the elevation 33 is shown in Figure 11 taken on line 11—111 of Figure 7. The periphery around the cylinder across the area remains constant so that yarn tension will not be affected along the entire length of the cylinder. The cylinders may be constructed of a large
variety of materials such as glass, enamelmware, extruded aluminum, formed stainless steel tubes, plastic materials such as molded Bakelite, etc. The cylinder construction may be of any type which permits satisfactory advancement and processing of the filaments and the proper coupling, rotation and advancement of the cylinders.

As can be seen in Figure 2, the cylinder 27 is at the top of elevator 28 and is ready for coupling. That is, it is ready to be joined to the main cylinder line 52 which is composed of a plurality of cylinder sections like section 27. A transfer mechanism in the elevator moves the cylinders into the drive mechanism 34 or means for simultaneously rotating and advancing the cylinders. The cylinders may be washed and cleaned in mechanism 35 as shown in Figures 17 and 18. As the cylinders move forward they are supported by mechanism 53 as shown in Figure 14. They are passed to the spindle point where they receive and carry yarn wraps 26. After moving away from the yarn wraps 26 they are passed to elevator 28 at the opposite end. If desired, additional driving and washing mechanisms may be located also at the off-coming end.

The elevators 28 are more fully described by Figures 3, 4, 5 and 6. The latter, an end view, shows an endless conveyor 35 or chain riding on sprockets 37 driven by motor 50 through shaft 59. The conveyor may be driven independently of shaft 59 and may be driven continuously or intermittently. Attached to the conveyor and moving with it are a plurality of cylinder carriers 38. The number and the distance between cylinder carriers 38 and the speed of the endless conveyor belt 39 are synchronized so that a fresh cylinder is available at any point when needed and so that a cylinder ready for ejection and transfer is removed with dispatch, being picked up immediately upon separation from the main cylinder line.

To illustrate the removing and supplying of cylinders in more detail, reference is made to cylinder section 39 in Figure 6 which section is about to be ejected. When the cylinder 39 is removed from the main cylinder line and is to go into the elevator system, it is received on a set of rolls. Three of these rolls are driven rolls 42 and are driven at the same peripheral speed as that of the main cylinder. The remaining of the rolls, three in number also, are asked rolled 43 and are free turning and are opposite to rolls 42. Figure 4 shows these rolls in a different view. The asked rollers 43 are positioned nearer the bottom of the cylinder section than the driven rollers 42. This is done to get more frictional contact with the asked rollers than with the driven rolls. Further, the asked rollers have a swivel base so that they may be set at any desired angle. The asked nature of the rolls allows for accelerating or retarding the rate of cylinder travel. These rolls 42 and 43, which may be more or less in number than indicated, cooperate to feed the cylinder section 39 away from the remaining main cylinder. Due to the asked nature of rolls 43 the section 39 moves rapidly away from the remaining cylinder which is still carrying yarn. Thus, it actually is made to travel faster than the remaining main line of cylinders which is still carrying yarn.

As shown in Figure 4, as cylinder 39 moves, it strikes a trip roller 44 which is tapered. In its accelerated movement on asked rolls 43 and driven rolls 42, cylinder 39 passes the trip roller 44 and contacts a stop 103 which is a rotatable disk. The striking of the trip roller 44 causes the electrical circuit (not shown) to the solenoid 105 to be closed. A plunger 104 is extended thereby and a rod 105, in slidable bearings in slots 106, is pushed to the left thereby compressing spring 107. This positions lever arm 41 in line with the roller lug 40 on the conveyor chain (see Figure 6). As the chain moves downward the lug 40 pushes lever arm 41 downward, this arm being pivoted at point 45. The shaft or rod 105 is rotated and arms 45 are made to rise and push cylinder section 39 off the rollers and it rolls by gravity down skids 41 into the carriage 55 which is descending. In event this carrier has a section already in it, a trip mechanism (not shown) prevents lever 41 from being actuated by lug 40. This mechanism may be operated by any convenient means and is generally actuated by the weight of the cylinder section in the carrier. The movement of the section 39 is shown in Figure 6 by the dotted lines 48 and 49.

As this cylinder section 39 continues around the elevator it at some time, as it travels upward, arrives at a level at which a new section is needed. As described by Figure 1, it proceeds away from the elevator, a trip roller drops when the cylinder end passes. A solenoid or similar means is actuated and the carrier 38 is caused to dump a new section of cylinder onto rollers 42 and 43. These cooperate in this position to advance the cylinder section 39 at a faster axial rate than the main cylinder until the section seats with the end of the main cylinder prior to entering the drive unit. After this section feeds into the drive unit, it is fed automatically with the remaining cylinder body.

In Figure 3, the end of the main cylinder line 52 has advanced a slight distance to the beginning of drive unit 34 and the open end still has some distance to travel before entering the unit. Carrier 51 is coming up and is carrying a cylinder section 39 in it. As the end of main cylinder line 52 clears the pivoted trip roller 44, an electrical switch to solenoid 105 is closed and plunger 104 is extended into the path of the dumping slide 118 which is attached to and ascending with the conveyor and carrier 51. The slide is so positioned that it takes carrier 51 to dump the cylinder section 39 out of the carrier down the skids 41 onto the rollers 42 and 43. These rollers rotate the cylinder section and move it horizontally toward and at a faster rate than the slowly receding main cylinder line 52. The section 39 moves the trip roller 44 back to its original position thereby opening the circuit to solenoid 105. Plunger 104 is retracted and subsequent carriers pass without dumping. Roller 44 is positioned so that the time for section 39 to reach it is not greater than the time required for the next carrier to rise into dumping position. Section 39 reaches the end of main cylinder line 52 and perfect seating of the ends is accomplished quite some time before the new section or the section with which it has joined reaches the contacting point. There is no interference with the advancement of the yarn. When the fingers of the section 39 and those of the nearest section of the main line are meshed, section 39 becomes a part of the main cylinder line 52 and is driven by means 34, shown in Figure 12, through washing mechanism 35, the supporting mechanism 53 to the exit side of the apparatus. The invention is not limited to the
method and means described for supplying and removing cylinder sections and any equivalent methods or means may be used. Further, any conventional well-known timing devices may be employed to regulate the speed of travel, and rate of supply and removal of cylinders.

In Figure 5 the relationship of the various drive means, washing means and supporting means 53 at the various floor levels may be seen. This view also shows the relationship of the various devices and the various main cylinder lines S2 to the elevator device with its endless conveyor 33 and the cylinder carriers 38. This view also shows a means for synchronizing the movements of the conveyor 39 and the main cylinder drive 34. This is done by utilizing a common driving means. Vertical drive shaft 54 has a plurality of bevel gears 55 which mesh with gears 56 of driving means 34. The bevel gears 57 cooperate with gears 58 which are driven through a motor 68. This or similar means insures the proper timing of the conveyor with the machine.

The device for driving and rotating the cylinder is shown in Figures 12 and 13. The unit consists of a stationary outer casing 61 which has a race 62 containing ball bearings on which an inner ring 63 rides as it revolves. The casing 61 may consist of two halves held together by bolts 64. The ring 63 has gear teeth 65 cut into it around its circumference. These teeth mesh with the teeth of drive gear 66 retained in bearings integral to the casing. This gear rotates the ring. The gear 68' is driven by gear 68 on drive shaft 54, the gear 68 meshing with gear 56 affixed to the same shaft as is gear 58. The outer casing also has in internal worm thread 68 cut in it concentric to the races. Mounted on the ring 63 and rotating with it are three rollers 67 which are mounted in bearings contained in the ring so that the axis of rotation of the rollers 67 is in line with the axis of the ring. The axle 69 of each roller carries a worm gear 70 which meshes with the internal worm thread 68 in casing 61. As the ring 63 revolves worm gear 69 turns and the rollers 67 are thereby caused to rotate. These rollers are so arranged that the cylinder is on rollers 67 at the same time as is gear 66. The frictional contact between the rollers 67 and the ring 63 is griped between the rollers as shown in Figure 12, and is held concentric with the ring. The cylinder, which revolves with the ring, is forced to move axially by the frictional contact with the rollers 67. The cylinder may be plain faced or it may be ridged. As shown in Figure 12 the ridges 32 and the rollers 67 do not interfere with each other since the rollers do not run over the ridges. A more positive control of the axial motion may be had, if desired, by using cylinders having rack teeth and rollers having gear teeth meshing with the rack teeth. Normally, the frictional contact described is satisfactory and is preferred for the simplicity of structure and economy it provides. The whole driving unit 34 may be supported by arms 74 rigidly secured on the frame 16.

In Figures 14, 15 and 16 a means 53 for supporting the rings is shown. A bracket 71 is appropriately supported on or anchored to frame 16. The bracket 71 has three rollers 72 which support the ring 73 which is similar to the ring 53 contained in the drive unit 34. These rollers are mounted in any suitable manner on bracket 71. The free running and revolving rings 73 rotate. Inside ring 73 are three rollers 74 mounted at a 90° angle to the axis of the cylinder contained in the main cylinder line 52. Rollers 74 are mounted on axles 76 contained in
wound and from there the yarn passes to succeeding cylinders for further regeneration, carbon disulfide removal, etc. The number of cylinder levels used depends on the treatments being applied to the particular thread. After leaving the last cylinder the yarn is directed to a drybox into the air stream in tube 85 into a waste bag 88. A gap 90 is located at the dryer level. When the process has been properly started the yarn is seized at the gap 90 and is carried by means of a vacuum string-up tool or a small constant torque motor string-up device to a dryer not shown. The dryer may be any of the conventional dryers known in the art. The drying apparatus disclosed in copending application of Conaway and Hitt Serial No. 720,630 filed January 3, 1947, issued as U. S. Patent No. 2,456,893 January 17, 1949, is particularly effective and desirable. The dryers referred to in that application can also be employed to advantage in the modification first described, that is, that shown in Figure 1 and related figures. By using the curved plate dryers, the height of the machine can be considerably reduced with resultant savings in floor space. The tube 88 may also be used as a dryer by inserting a high voltage resistance in the tube. From the dryer, the yarn passes to a spindle 91 driven by the winding machine 92. Suitable packaging is thereby produced. As shown in Figure 10, washing means 95 and driving means 94 are located at the end of the machine. These and the transfer device used in this modification are more clearly shown in Figures 21, 22, 23 and 24.

In the transfer mechanism, which moves the spindles in a horizontal plane, a central vertical spindle 93 is driven by a reversible torque motor 102. The top end of the spindle 93, held by bearing support 111, has a head 94 in which is a hole 95 at a 90° angle to the spindle axis. Through this hole extends an arm 96. This arm which is slidable mounted in hole 95 is attached to a transfer carrier 97 which may ride, if desired, on a semi-circular, horizontal track 98 with a straight run 99 extending on either side, as shown in plan Figure 21. If desired, a support 112 may be used for the track 98. The cylinder section runs into the transfer mechanism on asked rollers 100. These cause the section to be advanced faster and the section is separated from the main cylinder line 52. At a centered position the cylinder strikes a trip 101 which cooperates with switch 113 through arm 114 and spring 115. The motor 102 is actuated thereby through microswitch 112 and the spindle rotates and the arm 96 carries the transfer device 97 in which the cylinder section is contained around the track to the entering position, shown by dotted lines in Figure 21. There the cylinder section rides on the asked rollers 100 so that the case 97 in effect backs off the cylinder section as it feeds into the drive unit 34. The cage 97 continues to be urged forward while the cylinder section joins the main line 52, the notches of the cylinder section becoming securely engaged with those of the main line. When the end of this section has been sufficiently advanced by the drive unit 34 the last cylinder section on the opposite end has advanced to the trip roller 101 on that side and actuates it so that the transfer drive motor 102 is reversed and the case 97 is returned to receiving position. Simultaneously the cylinder section part ejected is picked up by the cage 97 on the left hand end of the machine and is moved to be fed at the receiving point on the left hand end, shown by dotted lines in Figure 21. The cycle is thus completed and is ready for repeat. Timing is maintained and insured by any of the conventional timing devices. In any event, one set of cylinder sections cannot gain or lose on lateral advancement over the other. As shown in Figure 21 it passes to the air stream in tube 85 into a waste bag 88. A gap 90 is located at the dryer level. When the process has been properly started the yarn is seized at the gap 90 and is carried by means of a vacuum string-up tool or a small constant torque motor string-up device to a dryer not shown. The dryer may be any of the conventional dryers known in the art. The drying apparatus disclosed in copending application of Conaway and Hitt Serial No. 720,630 filed January 3, 1947, issued as U. S. Patent No. 2,456,893 January 17, 1949, is particularly effective and desirable. The dryers referred to in that application can also be employed to advantage in the modification first described, that is, that shown in Figure 1 and related figures. By using the curved plate dryers, the height of the machine can be considerably reduced with resultant savings in floor space. The tube 88 may also be used as a dryer by inserting a high voltage resistance in the tube. From the dryer, the yarn passes to a spindle 91 driven by the winding machine 92. Suitable packaging is thereby produced. As shown in Figure 10, washing means 95 and driving means 94 are located at the end of the machine. These and the transfer device used in this modification are more clearly shown in Figures 21, 22, 23 and 24.

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In the transfer mechanism, which moves the spindles in a horizontal plane, a central vertical spindle 93 is driven by a reversible torque motor 102. The top end of the spindle 93, held by bearing support 111, has a head 94 in which is a hole 95 at a 90° angle to the spindle axis. Through this hole extends an arm 96. This arm which is slidable mounted in hole 95 is attached to a transfer carrier 97 which may ride, if desired, on a semi-circular, horizontal track 98 with a straight run 99 extending on either side, as shown in plan Figure 21. If desired, a support 112 may be used for the track 98. The cylinder section runs into the transfer mechanism on asked rollers 100. These cause the section to be advanced faster and the section is separated from the main cylinder line 52. At a centered position the cylinder strikes a trip 101 which cooperates with switch 113 through arm 114 and spring 115. The motor 102 is actuated thereby through microswitch 112 and the spindle rotates and the arm 96 carries the transfer device 97 in which the cylinder section is contained around the track to the entering position, shown by dotted lines in Figure 21. There the cylinder section rides on the asked rollers 100 so that the cage 97 in effect backs off the cylinder section as it feeds into the drive unit 34. The cage 97 continues to be urged forward while the cylinder section joins the main line 52, the notches of the cylinder section becoming securely engaged with those of the main line. When the end of this section has been sufficiently advanced by the drive unit 34 the last cylinder section on the opposite end has advanced to the trip roller 101 on that side and actuates it so that the transfer drive motor 102 is reversed and the cage 97 is returned to receiving position. Simultaneously the cylinder section part ejected is picked up by the cage 97 on the left hand end of the machine and is moved to be fed at the receiving point on the left hand end, shown by dotted lines.
ing means, means for withdrawing the yarn from said unit at a fixed point in said frame to main-
tain a fixed length of helix on said unit, and means for uncoupling from said unit sections
from which yarn has been unwound and forwarding these sections for reuse.
3. In an apparatus for advancing and processing yarn and like continuous structures on a
cylinder a plurality of cylinder sections coupled in axial juxtaposition to form a cylinder, means
for supporting said cylinder so as to be rotatable and axially displaceable comprising a supporting
frame, a rotatable ring supported thereby coaxially with said cylinder, and rollers supporting
said cylinder mounted in said ring with the axis of rotation of each roller perpendicular to a
plane which includes the axis of the ring and means for rotating and advancing the coupled
cylinder sections through a yarn-bearing zone in one direction only.
4. Apparatus as defined in claim 3 in which
said rollers are provided with driving means for
rotating the rollers to displace said cylinder in
an axial direction.
5. Apparatus as defined in claim 3 in which
said ring is provided with driving means for
rotating the ring to rotate said cylinder.
6. Apparatus as defined in claim 3 in which
said rollers are rotated through worm and worm
wheel gearing by rotation of said ring.
7. Apparatus for simultaneously rotating and
axially displacing a cylinder so that a reference
point thereon will describe a helix which com-
prises a stationary supporting casing having an
internal worm thread, a ring revolvably sup-
ported within said casing means for revolving
the ring in a single direction, a plurality of rollers
mounted in said ring in position to support
said cylinder with the axis of rotation of each
roller perpendicular to a plane which includes the
axis of revolution of the ring, and each roller be-
ing mounted on an axle on one end of which is
a worm gear meshing with said internal worm
thread of said casing to produce rotation of the
rollers when said ring is rotated.
8. In apparatus for advancing and processing
yarn and like continuous structures in which the
structure is wound as a helix on a cylinder for
treatment and unwound from the cylinder after
treatment, means for providing the equivalent
of an endless cylinder which comprises a plurality
of cylinder sections of substantially uniform
diameter having digitated ends adapted to mesh
with one another in axial relationship for cou-
pling sections to extend the cylinder preparatory
to receiving the yarn for treatment and adapted
for ready uncoupling after the structure has
been unwound from the cylinder and means for
rotating and advancing the coupled cylinder sec-
tions through the yarn treatment zone in one di-
rection only.
9. Apparatus as defined in claim 8 in which
said cylinder sections are provided with longi-
itudinal ridges adapted to support the yarn and
facilitate treatment.
10. Apparatus as defined in claim 9 in which
said longitudinal ridges vary in height adjacent
to the ends of the sections to help prevent yarn
being caught between coupled sections.
11. Apparatus as defined in claim 8 which in-
cludes means for uncoupling from one end of said cylinder, means for conveying said
sections to the opposite end of the cylinder and
means for coupling said sections to the latter end
of the cylinder.
12. A process for advancing and processing
yarn and like continuous structures which com-
prises continuously winding yarn on a rotating,
sectionalized cylinder which is simultaneously
moved longitudinally in one direction only to form
a yarn helix, treating the yarn while on the
moving cylinder, continuously unwinding the
helix after the yarn has been treated, and remov-
ing sections of the moving cylinder from which
the yarn has been unwound and placing them on
the opposite end of the cylinder in position to
receive windings of untreated yarn.

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