

[54] WINDING APPARATUS AND PROCESS

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242/43

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[58] Field of Search: 242/18 A, 18 PW, 18 DD,
242/43, 25 A

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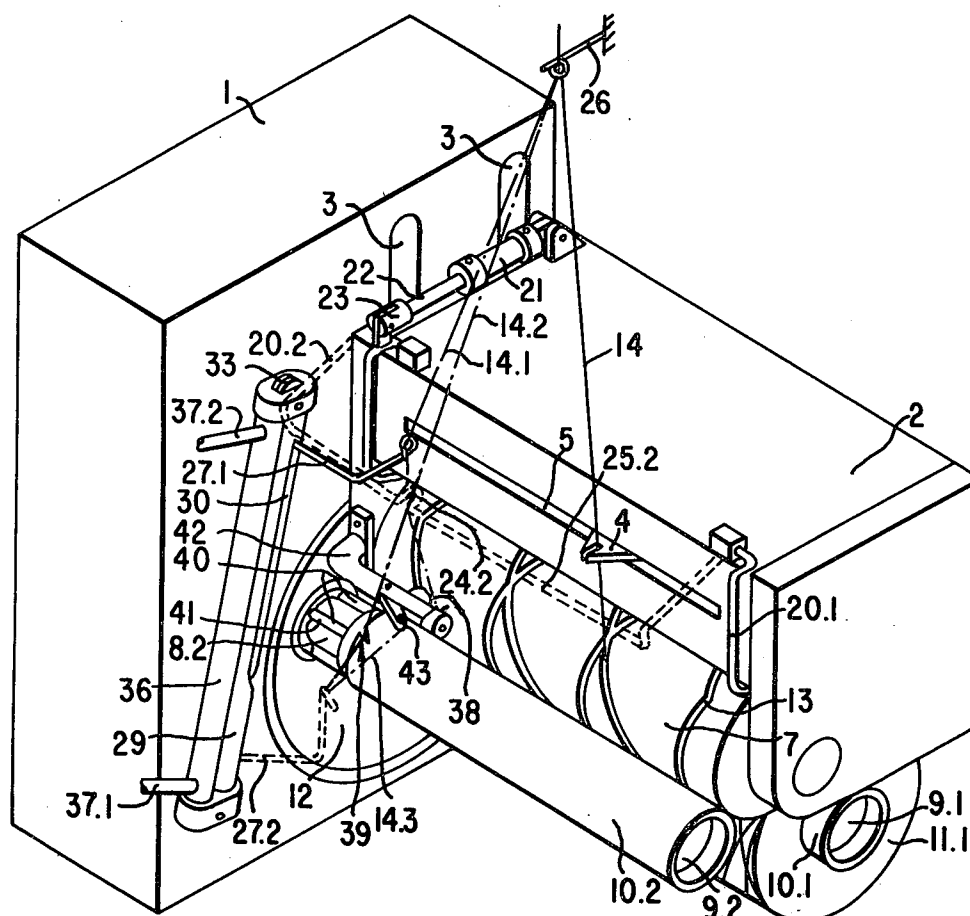
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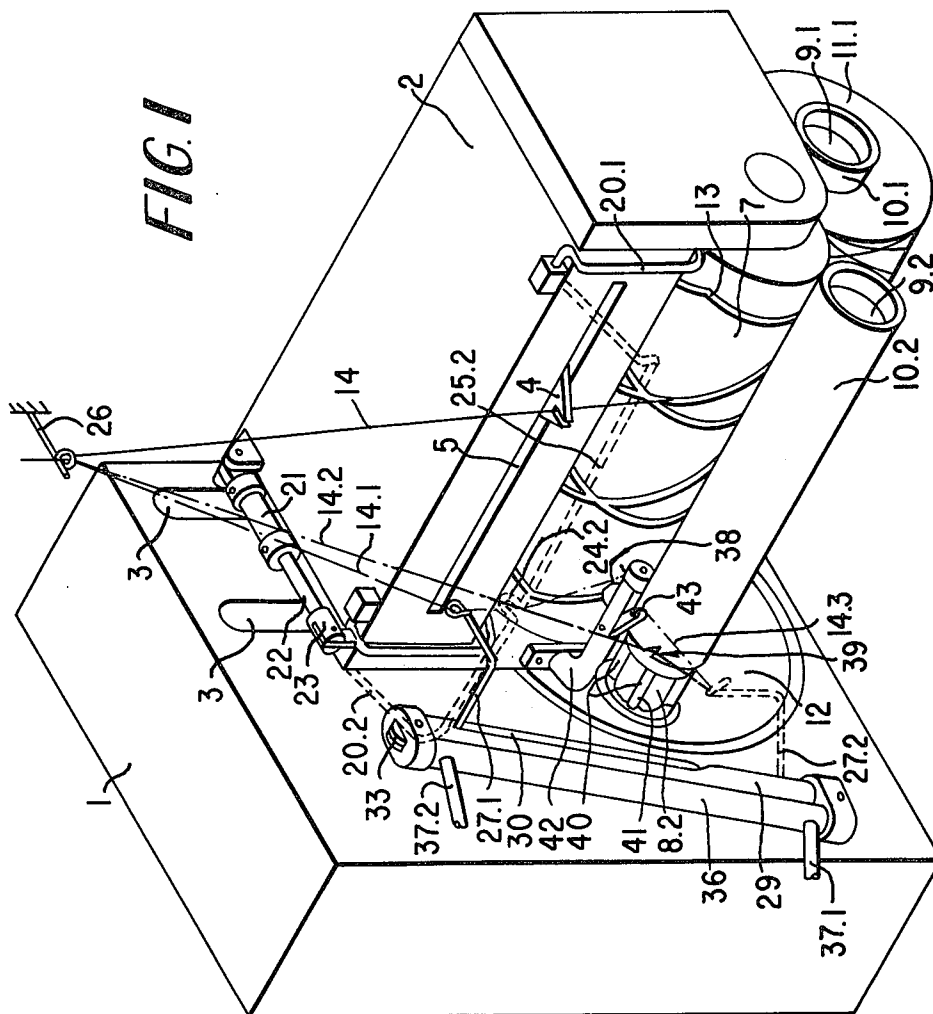
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[57] **ABSTRACT**

Apparatus for the loss-free winding of a continuously supplied thread to winding packages at a high winding speed, in which the thread is wound with transverse motion on a winding carrier into a bobbin which after reaching a predetermined bobbin size or winding time, without interruption of the winding process, is replaced together with winding carrier by an empty tube for receiving the thread. Before the transfer of the thread from a nearly wound bobbin to an empty tube the chuck carrying the empty tube of a bobbin revolver is turned into a position in which the wound bobbin remains driven by a drive roll and the empty tube is brought to about the peripheral speed of the wound bobbin. Also, process for loss-free winding during bobbin change involving guiding the thread in a traverse motion groove of the drive roller while forming a loop in the thread running onto the wound bobbin and initiating a new winding on an empty tube as aforesaid.

20 Claims, 16 Drawing Figures





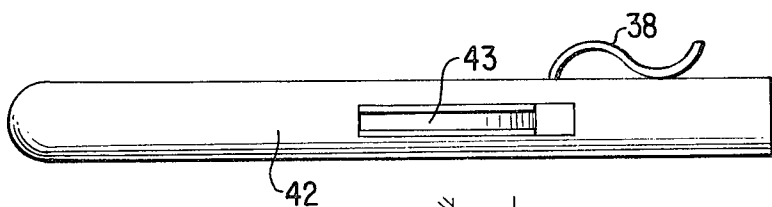


FIG. 16

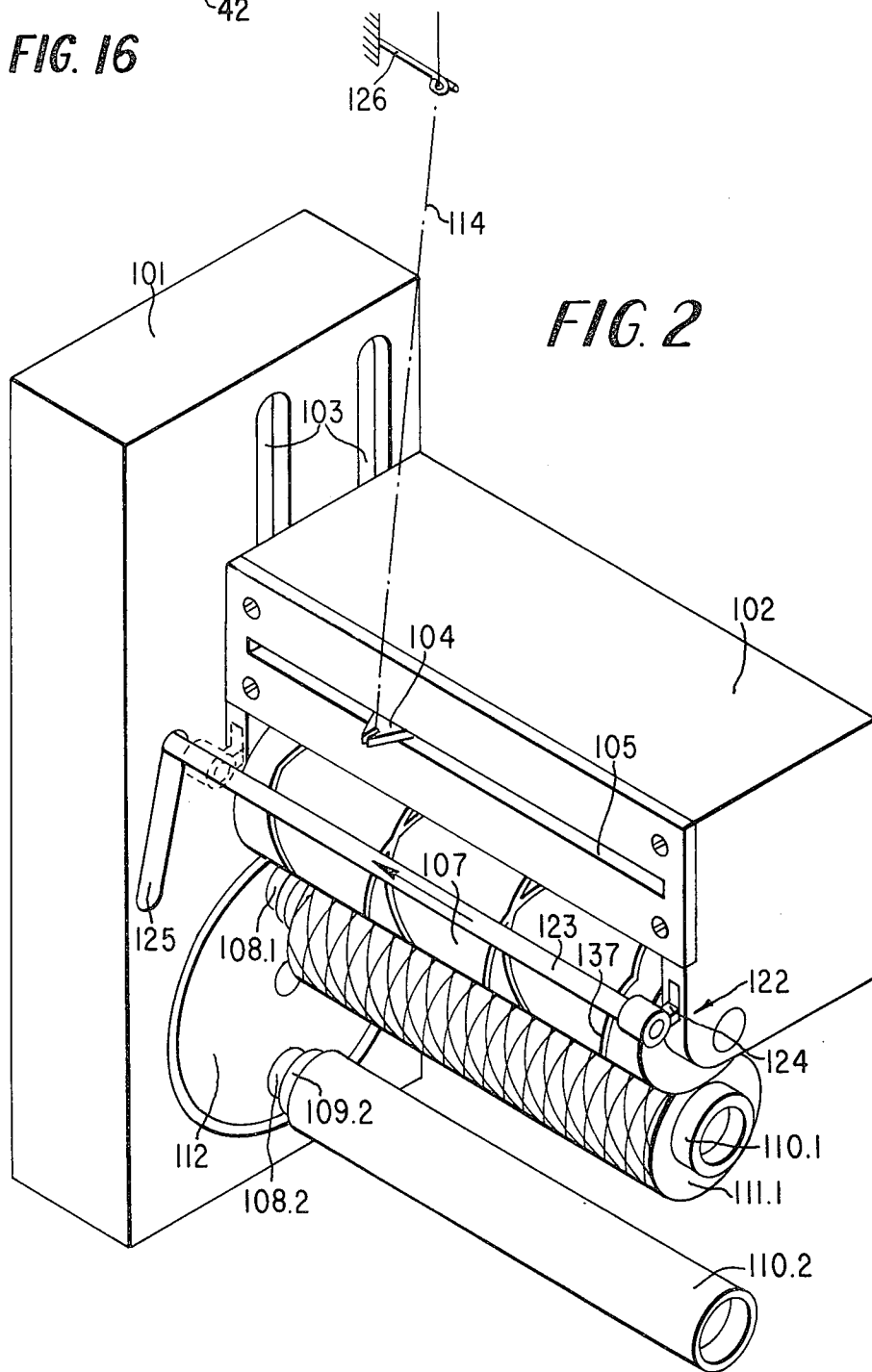


FIG. 2

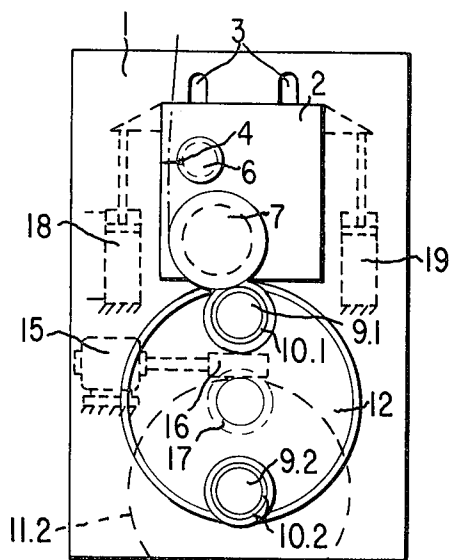


FIG. 3

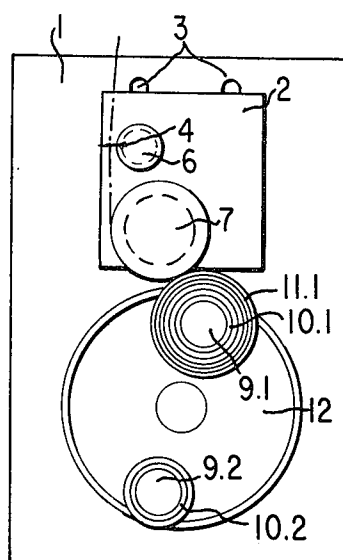


FIG. 4

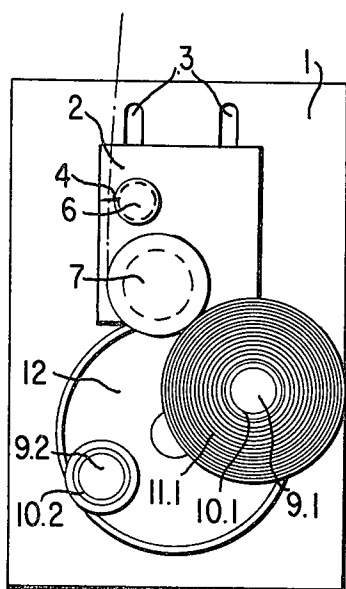


FIG. 5

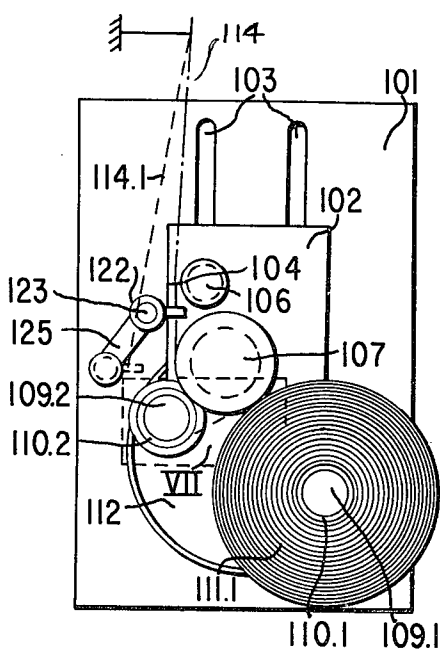


FIG. 7

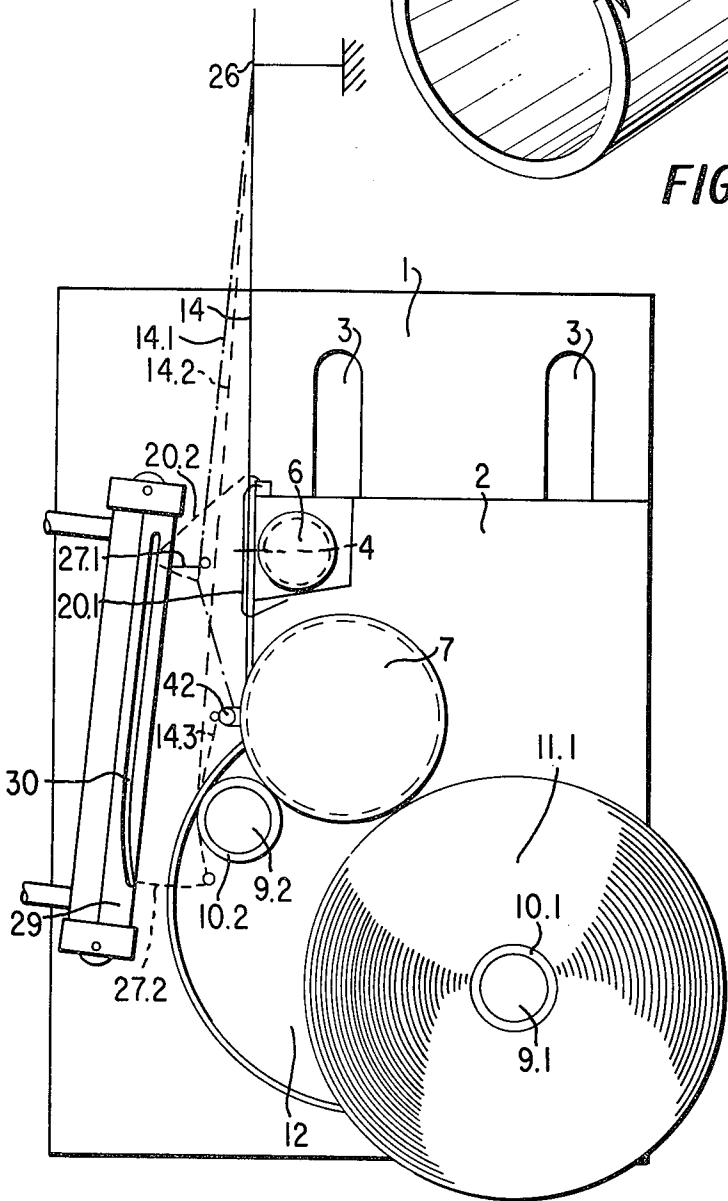
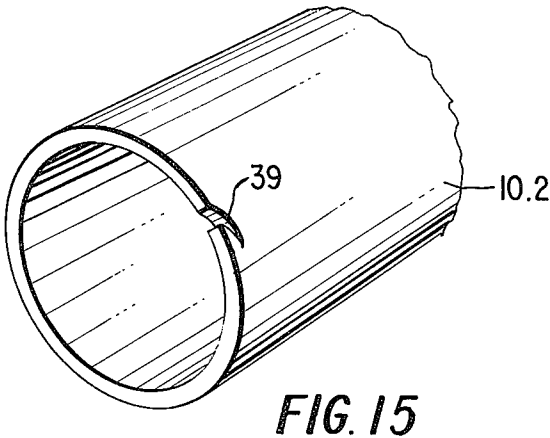
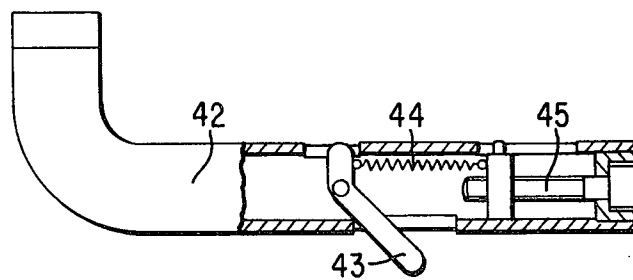
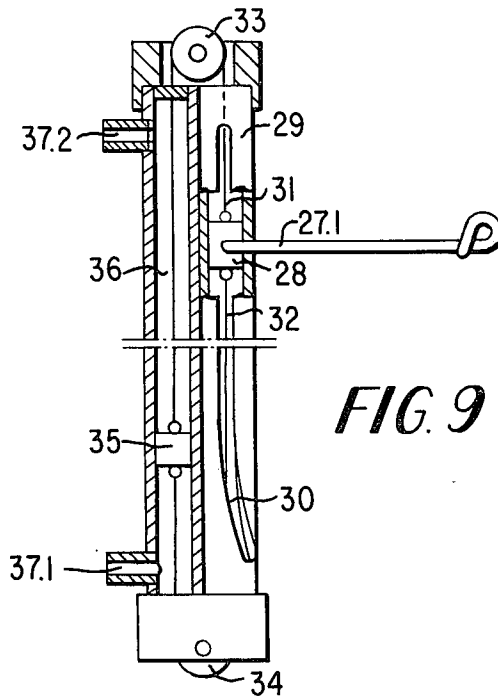
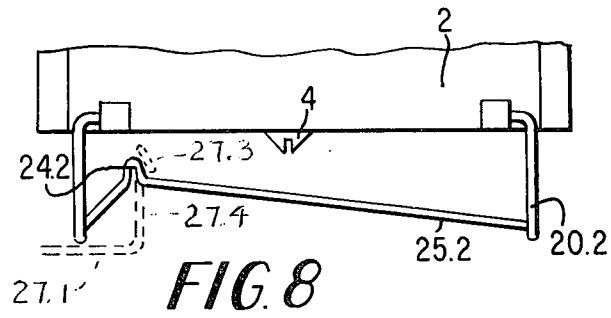


FIG. 6



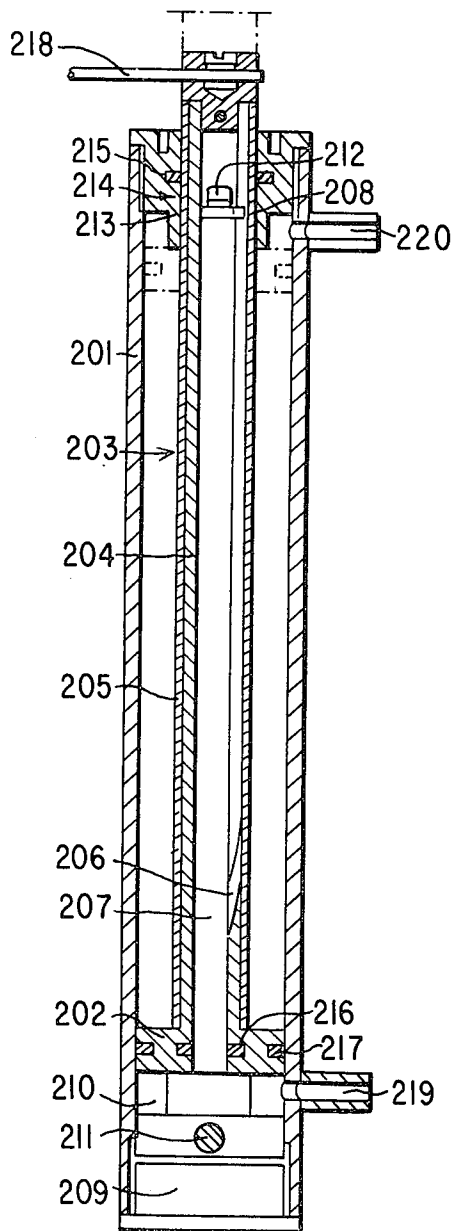


FIG. 10

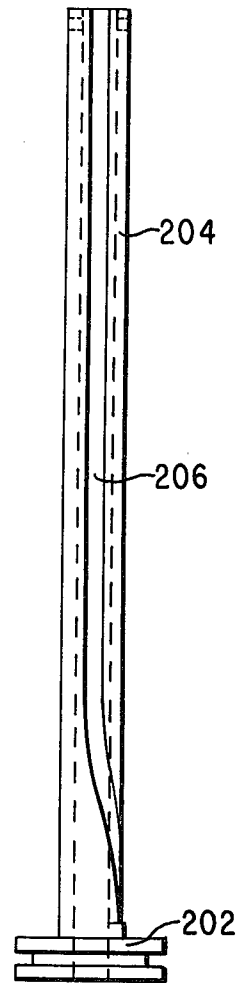


FIG. 11

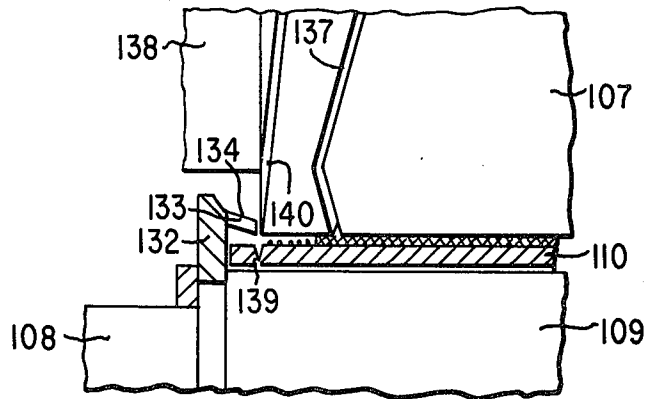


FIG. 13

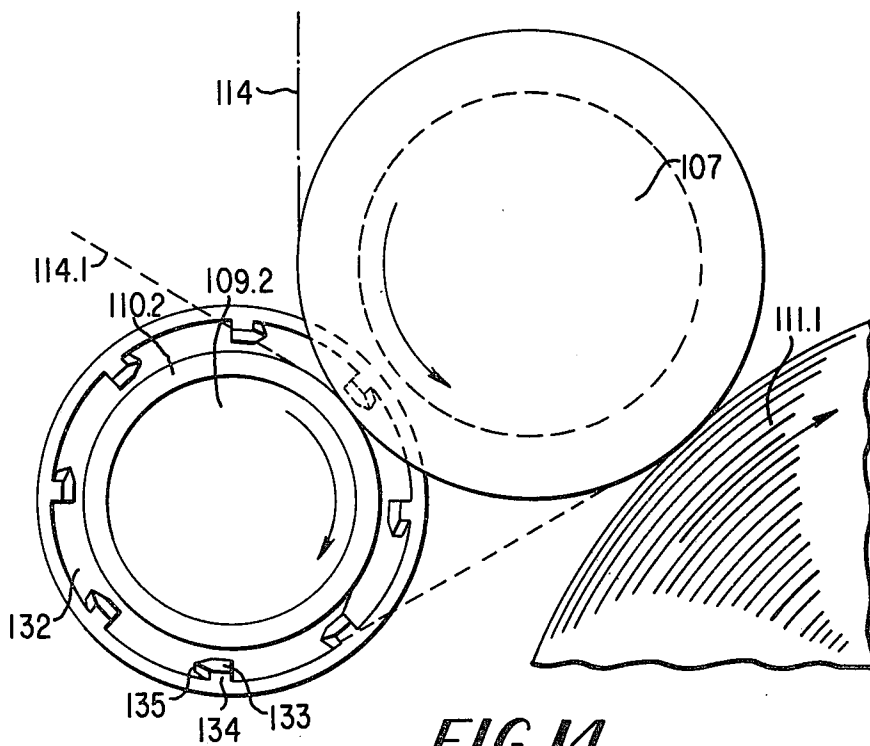


FIG. 14

WINDING APPARATUS AND PROCESS

The loss-free winding of continuously supplied threads has been described in earlier patents and applications. There were proposed for this purpose devices with bobbin revolvers which are described in their functioning (for example by U.S. Pat. Nos. 3,825,206). These devices all serve the purpose of carrying out the bobbin change as free of loss as possible — i.e., the finished bobbin is to be exchanged after a predetermined winding time or predetermined bobbin size for an empty tube, in which operation there are to be achieved changing times as short as possible, in order to produce little waste during the bobbin change. Such a problem, for example, is present for spin stretch machines, for yarn texturizing machines or for winding assemblies for high-speed spinning of chemical fibers (cf. *Chemiefasern/Textil-Industrie*, April 1973, pages 295–296). Synthetic threads are fed to the winders at a constant high speed and, possibly, high denier. Only a short time is required to complete each winding, which makes necessary a frequent bobbin change. The production in the spinning stage, however, cannot be interrupted. It is not feasible to reduce the speed of the fed-in thread in the interim, since interventions at the spinning apparatus lead to denier fluctuations and to undesirable instabilities of the spinning process.

As soon as the threads accumulate at such a high speed that they can no longer be manually handled, a loss-free bobbin change is possible only if the readied empty tube is already brought to a peripheral velocity substantially corresponding to the thread speed before the thread is applied to the empty tube. Otherwise there exists the danger, especially if the almost finished bobbin is taken off from the friction roller during the acceleration process of the empty bobbin, that the thread tension will drop too much or collapse, and that backlashes will be formed and lead to thread breakages at the thread delivery mechanisms. For this it is a known practice according to U.S. Pat. No. 3,825,206 to provide an auxiliary drive which acts on the chuck with the empty tube while this chuck is in the rest or bobbin-change position.

It is also a known practice to bring the empty tube on the chuck into frictional driving contact with the drive roller while the full or nearly full bobbin still lies on the drive roller. This is an effective and low-cost arrangement, without motor auxiliary drive, to bring the chuck with the empty tube up to an increased peripheral speed before the thread running onto the full bobbin is severed and the empty tube is wound. It is disadvantageous, however, that the thread which continues to run onto the almost-full bobbin can no longer be traversed at the intended speed as soon as the empty tube is applied to the drive roller, because the thread is clamped fast in consequence of the contact pressure between drive roller and empty tube. The shifting over of the thread from the full bobbin to the empty tube, consequently, has to take place very rapidly, and there exists the danger that the empty tube has not yet reached the intended peripheral speed.

In another winding machine (French patent 1,412,096) there are carry-along rings on the chucks which have a larger diameter than the winding tubes. These carry-along rings pass first into engagement on the drive roller, so that between drive roller and empty tube there arises a gap in which the thread can be moved back and forth during the acceleration of the

empty tube. Here it is disadvantageous that the empty tube, in consequence of the increased diameter of the carry-along ring, cannot be brought up to the peripheral speed of the bobbin and there exists the danger that the thread will reverse between the empty tube and the thread delivery mechanism, i.e., lose its thread tension, sag and, consequently, tend to form backlashes at the delivery mechanism.

Another winding machine (Swiss patent 513,763) has a drive roller with an enlarged diameter carry-along ring. Here, too, there is formed a gap between empty tube and friction roller. This construction has the requirement that the chuck is axially slidable with the empty tube, which requires an increased constructive and mechanical expenditure.

It is an object of the invention to propose winding apparatus of the type described at the outset, in which the disadvantages described are overcome and by which it is possible to distribute the continuously fed thread on the almost full bobbin in an orderly manner, even though simultaneously an empty tube is applied to the friction drive roller to accelerate the empty tube to the desired peripheral speed. It is a further object of the invention to improve the changeover of the on-running thread from an almost finished bobbin onto the readied, already driven empty tube in an advantageous manner in order to carry out this operation without losses and with high reliability and reproducibly, as often as desired, and to produce winding bodies of good quality. The steps should entail operating cycles clearly following one another in time, so that the thread processing operations can be controlled by sequence or program controls, since this is an essential precondition for the automation of the bobbin change.

It is a further object of the invention to provide apparatus which is suited for winding the continuously fed threads at a high speed into winding packages and accomplishing the change-over operation without formation of waste—such as arises, for example with use of known thread storage arrangements or injectors for catching and applying the thread strands during the bobbin change. During the thread transfer, both the wound bobbin and also the empty tube are driven on their circumferences, so that the thread tension—with avoidance of winders or thread breaks—can neither collapse nor increase beyond a tolerable measure. Underlying this feature is the insight that, with interruption of the drive of the almost-wound bobbin, in consequence of the very strongly increased air resistance at a high peripheral speed, the full bobbin immediately is braked appreciably, in which process any retardation of the bobbin before the thread transfer—even only fractions of a second—has disadvantageous effects, e.g., in consequence of abating thread tension or the thread delivery, formation of winders on the friction roller.

In such a device, however, there also have to be solved the technical difficulties arising in the bobbin change and shifting over of the thread onto the empty bobbin. Thus, there is to be solved, further, the problem of providing means interacting functionally with the winding head and the thread-transfer arrangement, through which it is assured that thread strands of relatively high denier are positively severed after completion of the thread transfer, and that on each empty tube at the beginning of winding there is wound a predetermined thread reserve.

The problem is solved according to the generic concept of this invention by structures wherein the thread is conducted during the acceleration of the empty tube to the peripheral velocity of the friction roller by an endless thread guide groove, provided in the cylindrical surface of the friction roller for traversing the thread, which is still wound up onto the nearly full tube. During the bobbin exchange, the thread is guided into a defined position, preferably in the vicinity of the end of the traverse stroke and, by controlled thread guide means, is drawn out into a thread loop in such a way that the thread comes into the active zone of a thread-catching means on the empty tube moved in position for the thread take-over or on the tube chuck carrying the empty tube, where it is caught.

An advantageous embodiment of the invention for the execution of the thread shift-over process is characterized by a thread guide means swinging into the traverse plane between traverse thread guide and friction roller and on beyond, wherein the thread is lifted out of the reciprocating traverse thread guide, and under the action of the thread tension it is led off on an oblique plane into a defined position, preferably at the end of the traverse stroke. In this position the thread is shifted over to an auxiliary thread guide, which, in the drawing of the thread over a mandrel extending into the thread path—with execution of a prescribed development of movement—forms in the thread a loop whose section which runs to the auxiliary thread guide after opening of the loop, is brought in contact with a thread catching means on the empty tube. In further development of the invention the transfer of the thread to the auxiliary thread guide takes place by swinging back of the thread guide means into the starting position. Furthermore, it is advantageous if the thread, after coming into position against the empty tube, is severed between the thread catching means and the auxiliary thread guide. Here, the full bobbin, continuing to wind the thread, generates after the catching of the thread a thread tension which suffices to break the thread on the cutting means, optionally provided for this purpose. In the case of small thread deniers, especially in the case of textile deniers, this thread tension, as experience has shown, is sufficient to cause the thread to break, so that in this case it is possible to dispense with special thread severing means.

In a further advantageous development of the invention it is further provided that the thread applied to the empty tube is prevented from running back to the mid zone of the traverse stroke until an adjustable thread reserve is wound.

According to the invention, the thread is wound under controlled thread tension, until the transfer to the readied empty tube, accelerated to the peripheral velocity of the drive roller, is completed. Here the transfer process always proceeds under the same defined conditions. In the thread transfer there is utilized in an advantageous manner the fact that the thread speed which is greater than the peripheral velocity of the friction roller by a component corresponding to the axial traverse speed, allows during the brief discontinuance of the defined thread traverse the drawing out of a thread loop, while during this time the thread path between the last fixed thread guide and the friction roller is lengthened. Here there occurs also a compensation of the thread tension loss in consequence of the drop-

ping-out of the thread traverse which has a surprisingly favorable effect on the thread transfer.

The device for the execution of the transfer proceeds from a winding device with friction roller drive which is borne in a vertically movable head and parallel to a reverse thread spindle driving a reciprocating traverse thread guide. This device further has a rotatable bobbin revolver arrestable in predetermined positions, on which there are rotatably borne at least two tube chucks, which during the bobbin exchange can be brought simultaneously into position against the friction roller. For this the device has means for shifting over the continuously fed thread onto the empty tube provided for the thread take-over and accelerated to the peripheral velocity of the friction roller.

For such a device it is proposed according to the invention that on the cylindrical surface of the friction roller there is provided an endless thread guide groove with spirals running in opposite directions, uninterrupted at the stroke reversal ends of the traverse stroke, and extending over the length of the traverse stroke. There is provided further at least one thread guide means, whose course of movement is fixed in such a way that the thread is shifted through a temporary modification of the thread course into the active range of a thread-catching means.

The thread guide means are constructed, in a preferred development of the device of the invention, in such a way that there is provided on the winding head a thread guide bow movable out of a starting position and beyond the traverse plane of the thread running between the reciprocating traverse thread guide and the drive roller. The bow consists of at least one first elongated part inclined relative to the bobbin axis and a second notched part. The thread guide bow for each winding head has an auxiliary thread guide slidable in a guide track and temporarily interacting therewith. After having taken over the thread, the said auxiliary thread guide forms on its predetermined course of movement a thread loop by drawing and spreading the thread over a mandrel extending into the thread path. The thread loop section running to the auxiliary thread guide brings the thread in contact with a thread catching means on the rotating empty tube or on the tube chuck carrying the empty tube.

In an advantageous embodiment of the device the notched part of the thread guide bow is provided in the zone of the traverse stroke end. Further, the thread guide bow is borne on the winding head in such a manner that in its starting position it is lowerable behind the traverse plane in the slide piece of the winding head, so that it does not extend beyond the front plate of the head. In order to make it possible to carry out the swinging movement of the thread guide bow into the traverse plane and beyond it, with which the thread shift-over process is initiated, controllably in time and automatically, according to a further proposal there is provided a piston actuatable by a pressure medium in a cylinder, whose piston rod is articulated on the thread guide bow. Through the piston stroke there are fixed and limited the end positions of the thread guide bow.

For the control of the course of movement of the auxiliary thread guide it is proposed, furthermore, that there is provided a guide track formed in the wall of a cylinder. In the cylinder there can be arranged a piston carrying the auxiliary thread guide, which is rigidly joined with the auxiliary thread guide and is movable

by cable pistons, operated by pressure media, in the cable cylinder. The structure length is considerably reduced as compared to a use of conventional pneumatic or hydraulic cylinders, since there is eliminated the structural height required for the extension of the piston rod. It is disadvantageous in this construction, however, that in many cases of use, small amounts of pressure medium can emerge from the pressure medium cylinder in the places where the cables, which likewise are fastened to the piston, are guided out of the cylinder or into it. Through the uncontrolled loss of pressure medium and the associated change of the damping characteristics of the system, an exact control is rendered difficult, especially in the time of movement pattern. For the avoidance of this difficulty, therefore, it is alternatively proposed that the auxiliary thread guide be fastened to the piston rod of a pneumatic or hydraulic system, in which arrangement a piston rod provided at the circumference with a guide track is movable in the cylinder with execution of a course of movement determined by this guide track over a sliding block arranged in fixed position in the cylinder.

In the event that it is considered necessary, on the device according to the invention there are provided means for parting the thread after its engagement on the empty tube. Such means can be constructed as cutting edges of a thread catching disk which is arranged coaxially to the chuck shaft on the tube chuck and has hooks distributed on the circumference. Also a highly favorable solution is one in which severing cutters arranged on the tube chuck, preferably as prismatic bodies distributed on the circumference of the tube chuck shaft, are provided, whose edges parallel to the axis of the tube chuck are constructed as blades. Severing cutters of this type are especially advantageous, because they are active only when the thread lying on the blade is under increased thread tension. Since, according to the invention the thread is severed only after it is grasped by the thread catching means, in which process it is further wound, however, on the almost finished bobbin, the thread tension can be increased only until it suffices for the severing of the thread on the severing blades. The edges of the prismatic bodies, relatively blunt in themselves, are arranged there on the tube chuck shafts in such a way that they present no potential danger of accident for the operating personnel.

In a further embodiment of the object of the invention, for the formation of the thread reserve on the empty tube, there is provided a thread guiding member extending, in the thread transfer, into the thread running plane between the fixed thread guide and the empty tube, on which member there is fastened a pin deflected laterally under an adjustable spring force. This thread guide member is mounted in fixed position and preferably arranged on the sliding carriage of the winding head. The thread guide member prevents the thread applied to the empty tube from sliding back by reason of the thread tension in the shortest way to the traversing stroke middle, until the intended thread reserve is formed. The pin extending into the thread path, after overcoming the set-in resistance which essentially determines the length of the thread reserve, is moved into a position in which it lies axially parallel to the thread guide member, so that the thread now can slide away completely over the thread guide member and move back to the middle of the traverse stroke, where it is grasped by the reciprocating traverse thread guide.

The pin of the thread guide member snaps back after the sliding away of the thread automatically into the starting position and remains in this position until the next bobbin exchange.

The mandrel for the establishing and opening of the thread loop is preferably secured to the aforementioned thread guide member for the formation of the thread reserve and is present as, e.g., a wire bow bent in Z-form. On the obliquely set shank of this wire bow the section of the thread loop running from the auxiliary thread guide to the almost finished bobbin can slide off, whereby the thread loop is opened or spread. This is further promoted by the fact that the auxiliary thread guide is conducted on a track on which the oncoming section of the thread is positively drawn to the thread catching means on the empty tube.

As already mentioned earlier in the treatment of the means for severing the thread, the thread catching arrangement can also be constructed as thread catching disk arranged coaxially to the chuck shafts on the tube chucks with several hooks distributed on the circumference, against which the empty bobbin tube is axially slidable. There, the outer diameter of the thread catching disk is preferably larger than the outside diameter of the empty bobbin tube and the drive roller is correspondingly offset in diameter on its end facing the machine casing and adjacent to the thread catching disk.

Further, it is also possible to use with the invention a device in which, for example, two or more threads are to be wound simultaneously onto separate winding carriers mounted on the same chuck. This is the case preferably for textile threads. Onto each tube chuck, for example, two empty tubes are slipped in succession, onto which the threads are to be wound separately. In this case the means for transferring the continuously fed threads to the empty tube are provided as doubles or multiples for each winding head and are synchronized with one another. The thread guide groove on the surface of the friction roller is, furthermore, constructed in such a way that the traverse of the thread on the friction roller is shifted in a manner known in itself (U.S. Pat. No. 3,792,819) to a correspondingly shortened stroke. The means for severing the threads in the bobbin exchange after transfer of the thread to the empty tubes can be omitted.

The winding machine according to the invention makes it possible to maintain the winding of the thread onto the almost full bobbin after application of the empty tube to the friction roller for a still longer time. This has the advantage that for the starting of the empty tube, for example, by means of a friction roller, in contrast to the known devices of the state of technology, only gradual accelerations are required, since there is available sufficient time for the acceleration process. The empty tube, therefore, can be brought in contact with the friction roller with light and only slowly increasing contact pressure force. Thereby there is avoided the danger that the synchronous motor, which is normally used for the drive of the friction roller, will decelerate through abruptly occurring braking torques or that the synchronous motor, because of this danger, has to be oversized. The guiding of the thread in the thread guide groove of the friction roller has, furthermore, the advantage that, in the interaction with the pre-traverse through a reciprocating thread guide, bobbins with exact edges are produced.

Details of the invention and its advantages are described in detail in the following with the aid of the drawings for preferred embodiments.

In the drawings:

FIG. 1 is a perspective view of a winding head according to the invention;

FIG. 2 is a perspective view of another embodiment of a winding head;

FIGS. 3 to 5 are schematic views of individual operating phases of the bobbin revolver;

FIG. 6 is a side elevation of the embodiment of FIG. 1 in the thread transfer position for the bobbin revolver;

FIG. 7 is a side elevational view of the embodiment of FIG. 2 in the thread transfer position for the bobbin revolver;

FIG. 8 is a top plan view of the thread guide bow;

FIG. 9 is a side elevation, partly in section, of the cable pulley cylinder with the guide track for the movement of the auxiliary thread guide;

FIG. 10 is a diametric cross section of the cylinder with the guide track;

FIG. 11 is a side elevation of the piston rod of the control cylinder according to FIG. 10;

FIG. 12 is a plan view, partly in section, of the thread guide member for forming the thread reserve;

FIG. 13 is a fragmentary detail view of the chuck shaft with the thread-catching arrangement of the winding machine of FIG. 2;

FIG. 14 is a schematic detail of FIG. 7 to illustrate the thread shift-over step;

FIG. 15 is a fragmentary, perspective view of the end of an empty thread-winding tube with its thread catching notch; and

FIG. 16 is a front view of the thread guide member of FIG. 12.

The winding machines according to FIGS. 1 and 2 consist of a machine casing 1 (101) connected with the machine frame (not represented) and a slide head 2 (102) which is movable in guides 3 (103) in vertical direction. The reference numbers in parentheses relate to the embodiment of FIG. 2, FIG. 7, FIG. 13 and FIG. 14. The sliding carriage 2 (102) carries a traverse thread guide 4 (104) as well as a friction roller 7 (107) driven by a synchronous motor (not represented). The traverse thread guide 4 (104) is guided in the horizontal slot 5 (105) and is driven by a reverse thread spindle 6 (106) represented schematically in FIGS. 3 to 7, which is borne axially parallel to the friction roller 7 (107). In the operating phrase represented of FIG. 1 the friction roller is in contact with an almost finished bobbin 11.1, from which the oncoming thread is to be transferred to an empty tube 10.2. The empty tube 10.2 is driven in this position by the friction roller 7 pressed on the surface of the tube. FIG. 2, in contrast, shows an operating phrase corresponding to FIG. 4, in which the bobbin 11.1 receiving the thread alone lies against the friction roller 107.

For the rotatable support of the bobbin and of the empty tube there are two tube chucks 9.1 (109.1) and 9.2 (109.2), which are mounted on the chuck shafts, i.e., shafts 8.1 (108.1) and (108.2) and are intended for the secure clamping of the winding carriers such as, for example, of suitable empty tubes 10.1 (110.1) and 10.2 (102.2). Suitable auxiliary tube chucks are known, for example, from U.S. Pat. No. 3,815,836. The chuck shafts 8.1 (108.1) and 8.2 (108.2) are rotatably jour-

nalled in the bobbin revolver 12 (112). The bobbin revolver 12 (112) itself is rotatable about a defined horizontal axis and arrestable in predetermined positions. Some of these operating phases are represented in FIGS. 3 to 6 and 7 for illustration and are described below.

In the execution of the winding arrangement according to the invention, the friction roller 7 (107) is provided with a thread guide groove 13 (137), so that the thread 14 (114) can be traversed in an orderly manner until the empty tube is accelerated to the peripheral velocity of the friction roller, and the shift-over process according to the invention can be initiated. The thread guide groove 13 (137) of the friction roller cooperates with the pretraverse guide unit 4, 5, 6 (104, 105, 106) and serves for the distribution of the thread into a cylindrical cross-wound bobbin. The reverse thread roller 6 (106) is attuned to the friction roller 7 (107) in such a way that the traverse thread guide 4 (104) guides the thread with sufficient lead to keep the thread in the thread guide groove.

Before the shift-over process according to the invention is described, there is still to be explained briefly the schematically represented operating phases of the winding process. For this in FIGS. 3 to 6 and FIG. 7 there are represented schematically the machine casing 1 (101), the slide head 2 (102) with the traverse thread guide 4 (104), the reverse thread roller 6 (106) and the friction roller 7 (107) as well as the bobbin revolver 12 (112) with the tube chucks 9.1 (109.1), 9.2 (109.2) and the empty tubes 10.1 (110.1) and 10.2 (110.2) inclusive of the bobbin winding 11.1 (111.1) that is being formed. Further there is shown in FIG. 3 the step switching motor 15, which, via the worm pinion 16 and the worm gear 17, brings about the rotary movement of the bobbin revolver 12 (112) from one operating phase to the next.

The position of the bobbin revolver according to FIG. 3 is suited for removing a finished bobbin 11.2 formed previously on the tube chuck 9.2 and for slipping an empty tube 10.2 onto the tube chuck. This position of the bobbin revolver is maintained, however, only until this operating step is completed, since the rapidly increasing diameter of the bobbin 11.1 formed on the empty tube 10.1 would cause a far deviation upward of the slide piece 2, which is undesirable because of the ordinarily limited structural height of the winding machine. For this reason—as shown in FIG. 4 and in FIG. 2—the bobbin revolver 12 (112) is turned onward by the aforementioned switching system (step switching motor 15, worm pinion 16 and worm gear 17) on reaching a certain bobbin winding diameter in counterclockwise direction (as viewed from the drive side), until it reaches the operating position represented in FIG. 5. For the adaptation of the contact pressure force in dependence on the growing bobbin winding diameter, the turning bobbin revolver can act upon suitable switching means (not represented) such as, for example, continuous or discontinuous switching cams for control valves, through which the pressure prevailing in the cylinders designated with the reference numbers 18 and 19 is adapted in such a way that there is yielded a snug contact between friction roller and bobbin without damage to the thread material. Cylinders 18 and 19 partially support the weight of the slide head to provide the desired pressure of the drive

roller against the empty tubes and bobbin windings thereon.

In FIG. 5 the bobbin revolver is shown in an operating phase in which the bobbin 11.1 is very nearly finished. This operating phase is maintained for the longest time interval of the bobbin cycle. Since the thread is ordinarily fed in at a constant rate and—aside from possible differences in denier and tension—winding bodies are desired with approximately equal thread length, the movement onward of the bobbin revolver 12 from the operating position represented in FIG. 5 is accomplished preferably by means of a timer. This timer is set in operation upon reaching the operating position according to FIG. 5 or earlier in the revolver's cycle, e.g., upon excursion from the operating position represented in FIG. 3.

After the approaching completion of the bobbin winding 11.1 the bobbin revolver 12 is turned into the position represented in FIG. 6 and FIG. 7, respectively, corresponding to FIG. 1. Here both the bobbin 11.1 (111.1) and also the empty tube 10.2 (110.2) lie against the friction roller 7 (107). The empty tube is accelerated gradually and largely free of jolts up to the peripheral speed of the friction roller.

In the operating phase according to FIG. 6 and FIG. 7, respectively, the bobbin revolver 12 (112) is arrested there for a short interval of time, so that sufficient time is provided to bring the chuck 9.2 (109.2) with the empty tube 10.2 (110.2) up to the requisite peripheral speed of the friction roller 7 (107). The thread 14 (114) which is still running to the wound bobbin 11.1 (111.1), however, can still be distributed further in an orderly manner during this time, since it lies in the endless thread guide grooves 13 (137) of the friction roller 7 (107) and, consequently, does not come in contact with the surface of the empty tube 10.2 (110.2). Therefore, it cannot become jammed between friction roller and empty tube.

After the empty tube 10.2 (110.2) has reached the peripheral velocity of the friction roller, the transfer of the thread from the full bobbin to the empty tube takes place. The thread shift-over process is explained in detail with the aid of FIG. 1. It is initiated, for example by a timer or a time relay (not represented), which are set in such a way that the empty tube 10.2 has reached, according to experience, the required peripheral velocity of the friction roller. Through the switching pulse of timer means such as pneumatic time relay or triggered by a delaying member, the thread guide bow 20.1 pivots outwardly and upwardly from the starting position (solid lines) into the traverse plane between the reciprocating traverse thread guide 4 and the friction roller 7 and onward into the end position, approximately corresponding to the broken line of the thread guide bow, which is designated in this position with 20.2. In the process it lifts the thread 14 out of the traverse thread guide 4. The swinging movement is achieved by action on the pneumatic cylinder 21 with compressed air, the piston rod 22 of which is secured to the thread guide bow by means of the joint 23. The stroke of the piston rod 22 establishes the end position 20.2 and the starting position 20.1 of the thread guide bow. The stroke is dimensioned in such a way that the thread guide bow is arranged in its starting position behind and below the traverse plane next to the slide head 2 of the winding head. As soon as the thread 14 is lifted out of the pre-traverse member 4, it is drawn in consequence of the

prevailing thread tension automatically to the changing stroke center and slides, in consequence of the oblique orientation of the thread guide bow with respect to the friction roller 7 on an inclined angle to the notched part of the thread guide bow at the traverse stroke end (FIG. 8). The thread is tensioned between the part 25.2 of the thread guide bow 20.2 (cf. also FIG. 6), inclined relative to the bobbin axis, and the fixed thread guide 26 on the machine frame. In the sliding movement along the thread guide bow 20.2 to the notched part 24.2, the thread is still guided by the thread guide groove 13 of the friction roller.

The swung-out thread guide bow 20.2 cooperates with an auxiliary thread guide 27.1 which in its starting position (drawn in solid lines) takes over the oncoming thread as soon as the thread guide bow is returned by corresponding compressed air action on the cylinder 21 into its starting position 20.1. The corresponding thread course is designated in the drawing with number 14.1 and is represented in dot-and-dashed lines. The auxiliary thread guide 27.1 is secured to the piston 28 illustrated in more detail in FIG. 9. The piston 28 is guided in a cylinder 29. It moves along a guide track 30 which is a longitudinal slot in the wall of the cylinder. The piston 28 is connected with the cables 31 and 32, which are guided over deflection rollers 33 and 34 and fastened to the piston 35 of the double-acting pneumatic cylinder 36. Through the controlled action on the pneumatic cylinder 36 with compressed air through the line 37.1 the auxiliary thread guide 27.1 is now displaced along the guide track 30.

In the process it draws the thread 14.1 over a wire bow 38 bent about in Z-shape extending into the thread path and forms in the thread strand a loop, which is opened in the further movement of the auxiliary thread guide 27.1 along the guide track 30. The thread section fed from the auxiliary thread guide 27.1 to the almost finished bobbin 11.1 slides there down the obliquely arranged shank of the wire bow 38 until there is reached the position of the thread 14.3 represented in broken lines, while the thread section 14.2 running from the fixed thread guide 26 to the auxiliary thread guide 27.2, through the rotary movement provided of the auxiliary thread guide—in consequence of the course of the guide track 30 in the cable cylinder 29—is brought in contact with the thread catching means 39 on the empty tube 10.2. The oncoming thread 14.2 is positively caught on the empty tube, and the thread section between the thread-catching means 39 and the auxiliary thread guide 27.2 (end position drawn in broken lines) is brought into the zone of action of the severing cutters 40, which are present as prismatic bodies distributed on the circumference of each tube chuck shaft, whose edges parallel to the axis of tube chuck are constructed as cutting edges 41. The thread still being wound clamped on the thread catching means 39 and wound from the finished bobbin 11.1 receives an increased thread tension and is severed by the blades 41 of severing cutters 40. By action on the tube 37.2 with compressed air the auxiliary thread guide is then driven back into its starting position 27.1, where it remains until the following bobbin change.

In the meantime the thread 14.2 caught on the empty tube 10.2, and running onto this has a tendency, by reason of the prevailing thread tension to move back to the middle of the traverse stroke. It is prevented from this, however, by the fixed thread guide member 42, which

is mounted on the slide head 2 of the winding head, and penetrates the thread course plane between the fixed thread guide 26 and the empty tube. The thread guide member 42 is represented in detail in FIG. 12. In this there is provided a pin 43, which is laterally deflected under an adjustable spring force. For the adjustment of the spring 44 a screw 45 is installed in the tubular thread guide member 42. During the overcoming of the resistance by the laterally deflected pin 43, under delayed movement of the thread to the traverse stroke center, the thread reserve is wound. Thereupon, the thread is immediately drawn to the middle of the traverse stroke, where it is grasped by the traverse thread guide 4, now to be distributed in orderly manner to form a cross-wound bobbin. The thread guide member 42 described with the pretensioned pin 43 for the forming of the thread reserve on the empty tube is used preferably for the winding of technical threads, especially carpet yarn, since here higher thread forces can be brought up for moving the pin 43—counter to the spring force—than is possible with textile threads of lower denier.

According to FIGS. 2 and 7, the winding machine for shifting over the thread from the full bobbin 111.1 to the empty tube 110.2 provided for the thread take-over has an auxiliary thread guide 122. This consists of an axially movable rod 123, at the end of which there is a pin 124. The pin 124 is bent toward the machine casing 101 at its end facing the sliding carriage 102. The rod 123 of the auxiliary thread guide 122 is shiftable parallel to the axes of the chuck shafts in the guide 125. When the empty tube 110.2 in FIG. 7 has reached the peripheral velocity of the friction roller there takes place the transferring of the thread from the full bobbin 111.1 onto the empty bobbin 110.2. For this, the rod 123 is moved axially in the direction toward the machine casing 101 (cf. arrow direction in FIG. 2). There the curved pin 124 comes in contact with the thread 114, in which process this is taken out of the traverse thread guide 104 as well as, at the latest at the outer reversal place, out of the winding-line thread guide grooves crossing itself in opposite direction of the drive roller 107. The auxiliary thread guide 122 conveys the thread to the extreme end 138, offset in diameter, adjacent to the machine frame 101, of the drive roller 107 to beyond about the end of the empty tube 110.2 (cf. FIG. 13). Now the auxiliary thread guide is driven parallel along the guide 125. Thereby it deflects the thread, draws a loop and brings it into the path drawn in broken lines in FIG. 7. The special feature of this thread course is that the thread touches the chuck 109.2 earlier than the drive roller 107.

According to FIG. 13 there is secured coaxially to the chuck shaft 108 and to the tube chuck 109 a thread-catching disk 132. This thread catching disk has several projecting hooks 133 distributed on the circumference. The diameter of the thread catching disk inclusive of the hooks 133 is greater than the diameter of the bobbin tube 110, so that the drive roller 107 there has an end 138 offset correspondingly in diameter. Between the projecting hooks 133 and the empty tube 110 there remains a radial interspace, into which the thread guided to the end of the drive roller 107 by the pin 124 has to drop in order to be caught in the V-shaped notch 139 of the empty tube 110. In order to promote this, the outer edges 134 of the hooks 133 and of the thread catching disk 132 are beveled. They hereby prevent,

moreover, the thread from being wound on the circumference of the thread catching disk. The thread—as represented in FIGS. 6 and 14—is grasped by at least one of the hooks 133 and tensioned between the empty tube 110.2 and the finished bobbin 111.1. The hooks 133 have—as represented in FIG. 14—cutting edges 135, which point in the turning direction of the bobbin revolver or of the tube chucks and with which the thread 114.1 tensioned between the finished bobbin 111.1 and the bobbin tube 110.2 is severed. By axial return movement of the auxiliary thread guide 122 into the starting position there can be deposited on the edge of the bobbin tube 110.2 a thread reserve of several turns. The thread reserve is formed as the thread runs in the groove 140, the depth of which is deepest at the thread's entrance and decreases to zero at the exit, positioned shortly prior to the point of axial overlap with the endless thread guide groove 137. The thread is thereupon caught by the traverse thread guide 104 and by the thread guide groove 137 and distributed on the empty tube to form a cross-wound bobbin. The drive of the bobbin revolver is again set in operation after the thread transfer and the bobbin revolver is turned further into the position according to FIG. 3 where the fully wound bobbin is exchanged for an empty tube.

In FIG. 10 and FIG. 11 there is shown still another embodiment for the control of the course of movement of the auxiliary thread guide 27.1 according to FIG. 1, in which, in an advantageous manner, there are avoided compressed air losses, for example at the places where the cables 31, 32 pass through the end walls of the cylinder 36 in FIG. 9.

In the cylinder-piston system represented the cylinder is designated with reference number 201. In the cylinder the annular piston 202 is moved axially of the cylinder by a fluid pressure medium. The piston 202 is carried by the piston rod 203, which is constructed as a double-walled, cylindrical tube. Into the inner tube 204 of the piston rod 203 there is slotted the guide track 206, which is constructed in correspondence to the requisite path of movement of the thread guide means 218 and is adapted to the geometric dimensions on the bobbin revolver. The inner tube 204 with exactly calibrated inside and outside diameter is tightly surrounded by a coaxial outer tube 205. The piston rod 203 with the working piston is slidable without play from the one end position to the other (dot-and-dashed) on the rod mandrel 207. The mandrel 207 is centered coaxially in the cylinder 201 and consists preferably of a single part, which is made integral with the plug 209 (cf. FIG. 10).

The plug is screwed into the cylinder, sealed there in a known manner (not represented in detail) and secured by the pin 211 against axial and rotary movements. In the zone of the annular channel 210 serving for the pressure medium distribution, which is connected with the pressure medium connection 219 on the cylinder, the plug 209 is turned to a smaller diameter and forms with its remaining shoulder a stop for the axial movement of the annular piston 202 on the mandrel 207. On the opposite end of the mandrel 207 there is fixedly fastened by the screw 212 a sliding follower block 208. In the movement of the piston 202 and of the piston rod 203 the sliding follower block 208 interacts with the guide track slot 206 on the inner tube 204 of the piston rod as the sliding block 208 engages in the longitudinal guide track 206 with snug fit. Here, the an-

nular piston 202 with the piston rod 203 and the thread guide means 218 fastened to it rigidly executes a defined and positively controlled movement.

The cylinder 201 is closed at its other end likewise with a plug 213, screwed in for example, through the axial bore 214 of which the piston rod, centered on the mandrel 207, is reciprocable. For the sealing known sealing elements are used, for example, piston rings or special forms of sealing rings or the like, which are suited for sealing with simultaneous sliding. The seals on the piston rod are seal rings 215 and 216. They are seated in the plug 213 and in the annular piston 202, respectively. The piston ring 217 seals the piston wall-cylinder wall clearance. The pressure fluid is supplied and exhausted to and from the cylinder 210 via connector tubes. In FIG. 11 the piston rod tube 203 is shown with the annular piston 202 fastened to it. The inner tube 204 is slotted to provide the longitudinal guide track 206 having a spiral end portion. The outer tube 205 was omitted in this figure.

The take-over of the thread guiding function by the auxiliary thread guide 27.1 is illustrated in FIGS. 1, 6 and 8. After the guide bow 20.1 has moved to the extended position 20.2 shown in FIG. 8, the thread runs along the sloping rod segment 25.2 toward the notched segment 24.2. The running thread drops into the notch while the thread guide loop 27.3 at the end of the thread guide 27.1 lies almost directly above the notch of segment 24.2. The loop 27.3 is positioned at this stage, relative to the thread path 14.2 (see FIG. 6), so that the thread, as it drops in the notched segment 24.2, lies against the right hand side (as viewed in FIG. 8) of the rod or wire segment 27.4 of the guide 27.1. As it enters the notch, the thread also enters the guide loop 27.3 and is caught therein. When the thread guide bow swings back to start or home position (the solid line position of bow 20.1 in FIGS. 1 and 6), the thread continues to run through loop 27.3 and remains therein until the thread is severed or cut as aforescribed.

The individual structural details described in the foregoing embodiments are by no means to be taken as a restriction of the object of the invention. On the contrary, these can be exchanged for other suitable means providing to the intended functions.

The invention is hereby claimed as follows:

1. In a process for the loss-free winding of a continuously supplied thread into bobbin windings at a high winding speed, in which the thread is wound with traverse motion on a winding carrier into a bobbin winding, wherein after reaching a predetermined bobbin winding size or after a predetermined winding time, the wound bobbin is replaced, without interruption of the winding process, by an empty tube for receiving the supplied thread, in which, before the transfer of the thread from an almost wound bobbin to an empty tube or to a rotatable chuck carrying the empty tube, said bobbin and said tube are turned by a bobbin revolver into a position in which the almost wound bobbin remains driven on the periphery by a friction drive roller and the empty tube is brought to about the peripheral speed of the almost wound bobbin by contact with said roller, the improvement comprising guiding the thread in traverse motion by running it through an endless thread guide groove in the cylindrical surface of the friction roller during the acceleration of the empty tube to the peripheral velocity of the friction drive roller while winding the thread on said almost wound bobbin,

guiding the thread during this bobbin exchange into a defined position, and drawing out the thread running onto the almost wound bobbin by controlled thread guide means into a thread loop in such a way that the thread comes into a zone of action of a thread catching means on the rotating empty tube or on the rotating chuck carrying the empty tube and is caught.

2. A process according to claim 1, wherein the thread is lifted by a thread guide means swinging away from the friction roller into and past the traverse plane of the thread path between the traverse thread guide and the friction roller to lift the thread out of a reciprocating traverse thread guide, sliding the lifted thread under the action of the thread tension of the winding process along a guide surface inclined relative to the roller axis to said defined position which is located at the end of the traverse stroke, and in this position transferring the thread to an auxiliary thread guide, running the transferred thread over a member positioned in the path of the thread as it is moved in a controlled course of movement by the auxiliary thread guide to form a loop in the thread, and bringing the segment of the running thread in said loop which runs toward the auxiliary thread guide into contact with a thread catching means on the empty tube.

3. A process according to claim 2, wherein the transfer of the thread to the auxiliary thread guide takes place upon movement of the thread guide means back through the traverse plane into non-thread-engaging position.

4. A process according to claim 1, and severing the thread after catching thereof on the empty tube or the chuck in the thread segment running between the thread catching means and the auxiliary thread guide.

5. A process according to claim 2, wherein the thread applied to the empty tube is prevented from running back to the center of the traverse stroke until a thread reserve winding is wound on the empty tube.

6. In an apparatus for the loss-free winding of a continuously supplied thread into bobbin windings at a high winding speed, said apparatus including a friction drive roller rotatably journaled on a vertically movable head, a reverse-thread spindle driving a reciprocating traverse thread guide, said spindle being rotatably journaled on said head with its axis of rotation parallel with the axis of rotation of said drive roller, a rotatable bobbin revolver stoppable in predetermined positions, at least two tube-supporting chucks rotatably journaled on said bobbin revolver in positions wherein, through rotation of the bobbin revolver in a bobbin exchange step, an empty tube on one chuck and the wound bobbin on another chuck simultaneously may be brought into driving contact against the friction roller, and transfer means for transferring the continuously running thread onto the empty tube after it has been accelerated to a high peripheral velocity by the drive roller, the improvement which comprises the friction drive roller having in the bobbin-driving surface a continuous, spiral thread guide groove extending over the length of the traverse stroke, running in opposite directions, and continuous through the stroke reversal ends of the traverse stroke, and said transfer means including at least one third guide means movable during the thread transfer by said transfer means in a predetermined course of movement wherein the running thread is deflected into the range of action of a thread catch-

ing means on the chuck bearing the empty tube or on the empty tube itself.

7. An apparatus according to claim 6, a thread guide bow supported on said head and movable into and through the traverse plane of the running thread segment between the reciprocating traverse thread guide and the friction roller, said bow having a first thread guide segment inclined relative to the bobbin axis and a second, notched segment restraining traverse movement of the thread, auxiliary thread guide means movable in guide means, a mandrel adjacent said auxiliary thread guide means, and said guide means guiding the movement of said auxiliary thread guide means first into thread-engaging position when the thread is running in said notched segment, and thereafter guiding said auxiliary thread guide means with the thread engaged therein into a position wherein the running thread forms a loop, one segment of which runs from said auxiliary thread guide means and thereafter across said mandrel, and the other segment of which is deflected into engagement with said thread catching means.

8. An apparatus according to claim 6, wherein the notched segment of the thread guide bow is positioned adjacent a stroke reversal zone of the traverse stroke.

9. An apparatus according to claim 7, wherein the thread guide bow is mounted by means for moving said bow from a starting position below said head and behind said traverse plane outwardly through said traverse plane of said running thread.

10. An apparatus according to claim 7, wherein the thread guide bow is pivotally supported by means for swinging the thread guide bow through the traverse plane of the thread running between the traverse thread guide and the friction roller, and a piston operable in a cylinder by fluid pressure means, the piston rod of which is articulated on the thread guide bow to swing it through said traverse plane.

11. An apparatus according to claim 6 wherein said transfer means includes an auxiliary thread guide, a cylinder having a longitudinal guide track in a wall thereof, a piston movable in said cylinder, said auxiliary thread guide being mounted on said piston, a pair of cables extending longitudinally in said cylinder and connected to opposite sides of said piston, and fluid pressure operated means for moving said piston and cables longitudinally in said cylinder.

12. An apparatus according to claim 6, said transfer means including an auxiliary thread guide mounted on a piston rod which is reciprocable in a cylinder, guide track means extending longitudinally on said rod and configured to rotate the rod as it moves longitudinally, fluid pressure means for reciprocating said rod in said cylinder and fixed means in said cylinder interacting with said guide track means to cause said rod to revolve

in accord with the configuration of the guide track means as it reciprocates in said cylinder.

13. An apparatus according to claim 12, said piston rod being a double-walled cylindrical tube, the inner tube of which bears the piston and is slit longitudinally to provide said guide track means, and said inner tube being encased in a coaxial outer tube sealing said double-walled tube against losses of the fluid pressure medium.

14. An apparatus according to claim 13, wherein said piston rod is reciprocally supported substantially without play on a cylindrical mandrel inside said inner tube, and said fixed means being mounted on an end of said mandrel inside said inner tube.

15. An apparatus according to claim 6, cutting means for severing the running thread after winding engagement thereof on the empty tube, said cutting means being cutting edges on a thread catching disk which is arranged coaxially with the chuck shaft of the tube chuck and having hooks distributed on the circumference.

16. An apparatus according to claim 6, cutting means for severing the thread after its winding engagement on the empty tube, said cutting means being thread-severing cutters distributed on the circumference of the tube chuck shaft and having thread severing edges parallel to the axis of the tube chuck.

17. An apparatus according to claim 6, and a thread reserve forming means embodying a thread guide member adjacent one end of the chuck-mounted tube, thread path guide means to run the thread onto said thread guide member, a deflectable pin mounted on said guide member, and adjustable spring loading means for temporarily holding said pin against deflection by the thread running against said pin to form said thread reserve on said one end of said tube.

18. An apparatus according to claim 17, thread guide means for the establishing and opening of a thread loop by said transfer means, said thread guide means being mounted on the thread guide member and comprising a bent wire bow.

19. An apparatus according to claim 6, said thread catching means comprising a thread catching disk coaxial with the chuck shaft and mounted on the tube chuck, and a plurality of thread-catching hooks distributed on the circumference of said disk, and the empty bobbin tube being axially slidable on said chuck into abutting engagement with said disk.

20. An apparatus according to claim 19, the outer diameter of the thread catching disk being greater than the outside diameter of the empty bobbin tube, and the drive roller having a lesser diameter at its end which is directly opposite said disk.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 3,913,852

DATED : October 21, 1975

INVENTOR(S) : Erich Lenk et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the Heading, insert -- Foreign Application Priority Data
March 31, 1973 Germany P23 16 218
October 24, 1973 Germany P 23 53 202 --

Signed and Sealed this

Eighth Day of November 1977

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

LUTRELLE F. PARKER
Acting Commissioner of Patents and Trademarks