

[54] **METHOD OF AUTOMATICALLY CHANGING WINDING TUBES AND WINDING APPARATUS FOR IMPLEMENTING THE AFORESAID METHOD AND IMPROVED SPOOL DOFFING MECHANISM**

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Related U.S. Application Data

[60] Division of Ser. No. 350,793, April 13, 1973, Pat. No. 3,856,222, which is a continuation-in-part of Ser. No. 76,181, Sept. 28, 1970, abandoned.

[30] **Foreign Application Priority Data**

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[52] U.S. Cl. **242/18 A; 242/18 R; 242/18 DD; 242/41**

[51] Int. Cl.²..... **B65H 67/04**

[58] Field of Search..... 242/18 A, 18 R, 18 PW, 242/18 DD, 41, 35.5 R, 35.5 A; 57/52, 53

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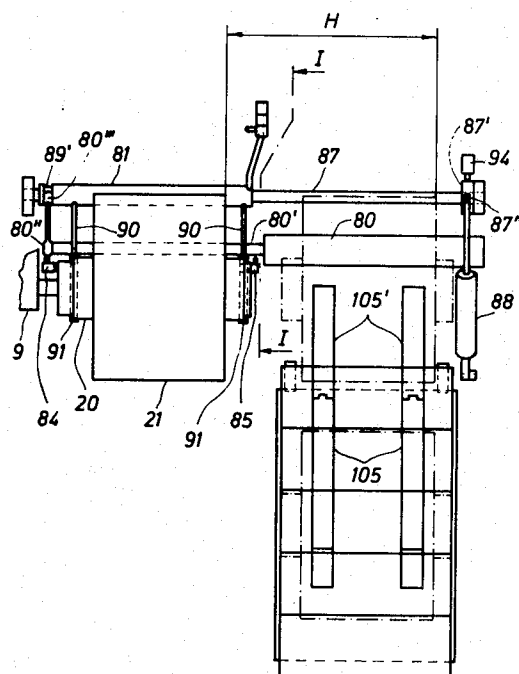
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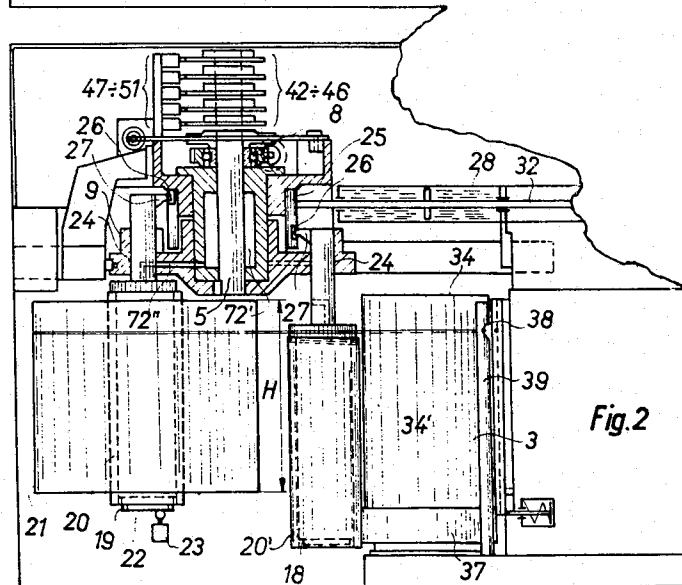
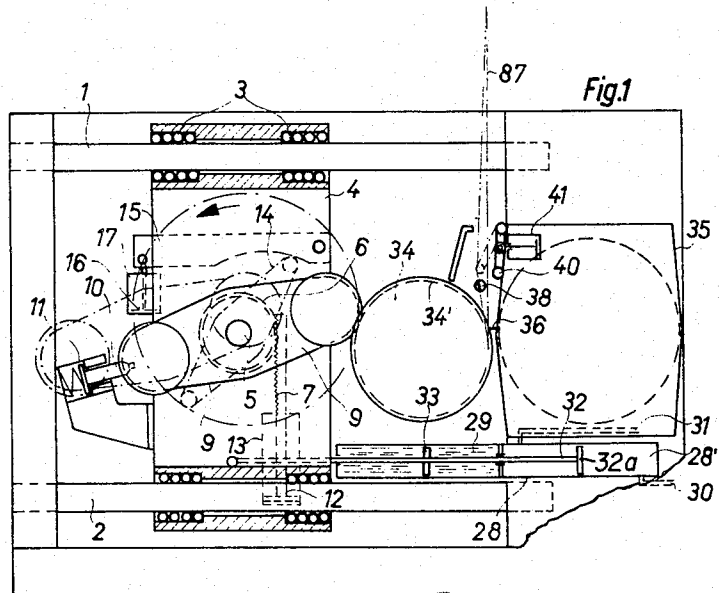
Primary Examiner—Stanley N. Gilreath
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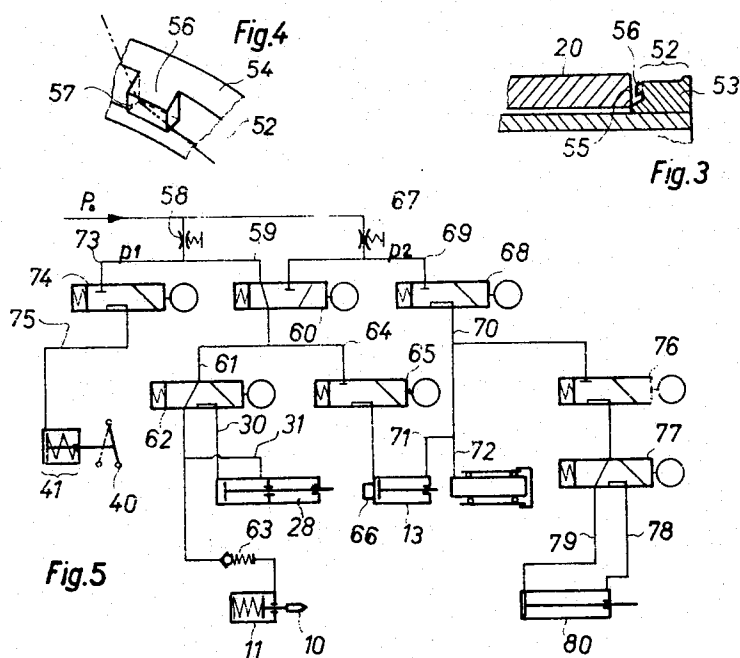
[57] **ABSTRACT**

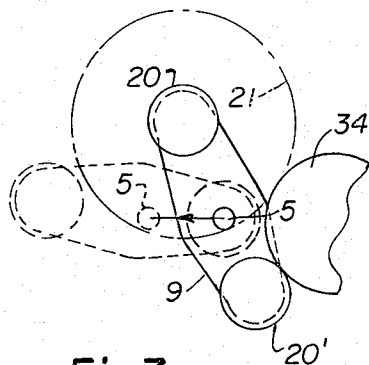
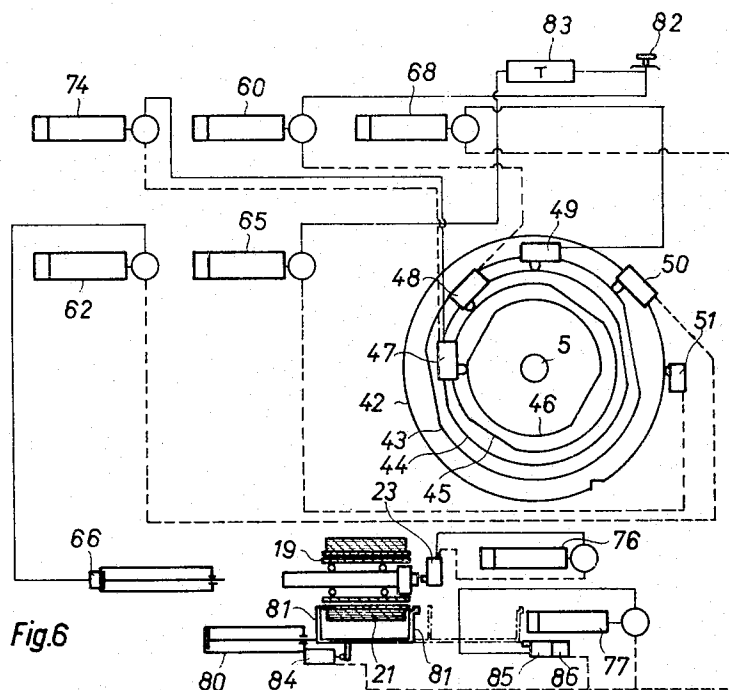
A method of and apparatus for automatically changing tubes seated upon tube clamping mandrels and wherein each tube, through rotation of a member carrying the tube clamping mandrels, is alternately brought out of a position in contact with a friction drive drum for the purpose of taking-up an endless thread delivered at a high speed and after reaching the desired package size thereon the tube with its package is brought into a package doffing position. A gripper is rocked out of a rest position essentially perpendicular to the axial direction of the tube clamping mandrel carrying the tube with the package wound thereon, and the package and its tube are engaged by means of the gripper. Then the engaged package and its tube are withdrawn from the tube clamping mandrel by moving the gripper in a direction away from the tube clamping mandrel and essentially parallelly with respect to the axial direction of the tube clamping mandrel into a predetermined position, and thereafter the package and its tube are released by carrying out an opposite rocking movement of the gripper.

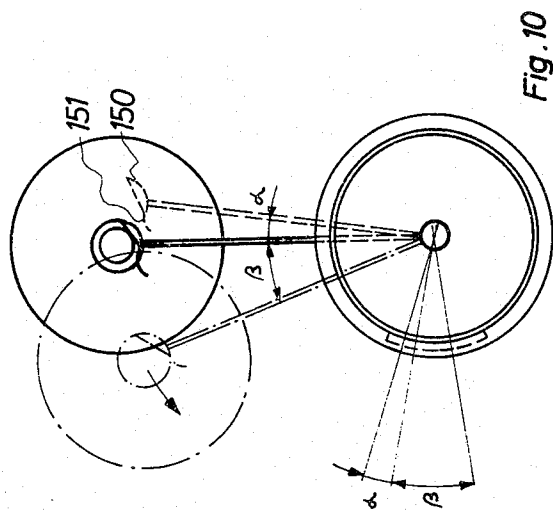
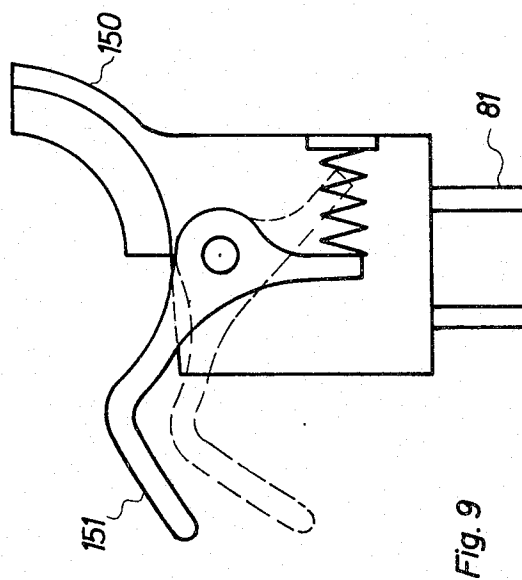
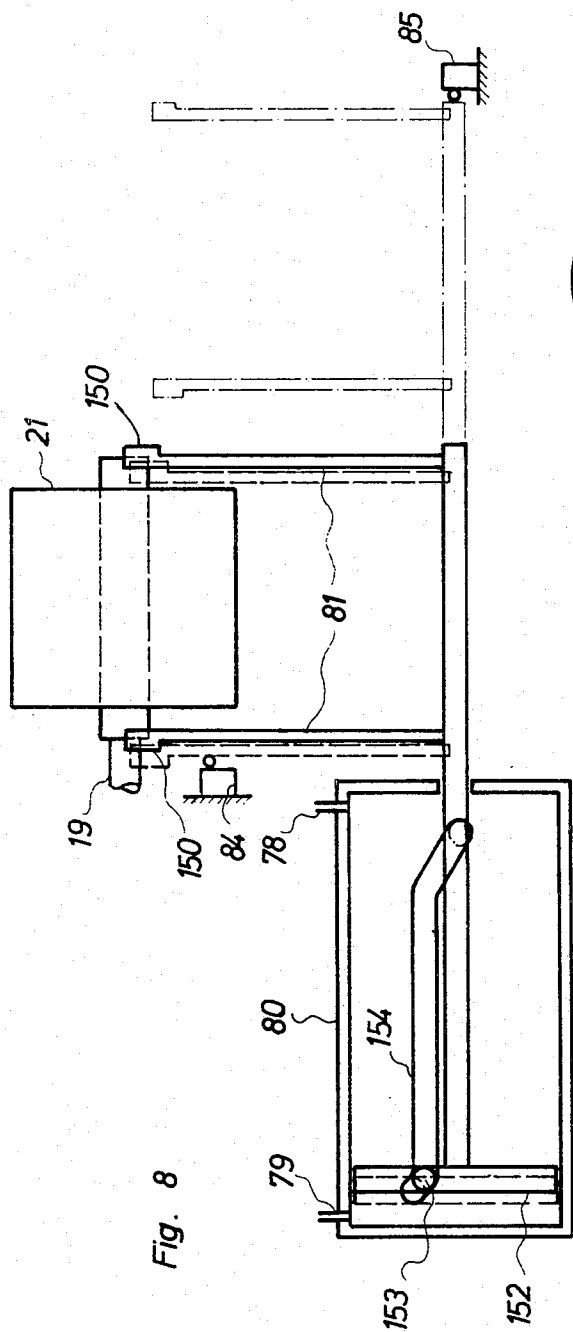
10 Claims, 28 Drawing Figures

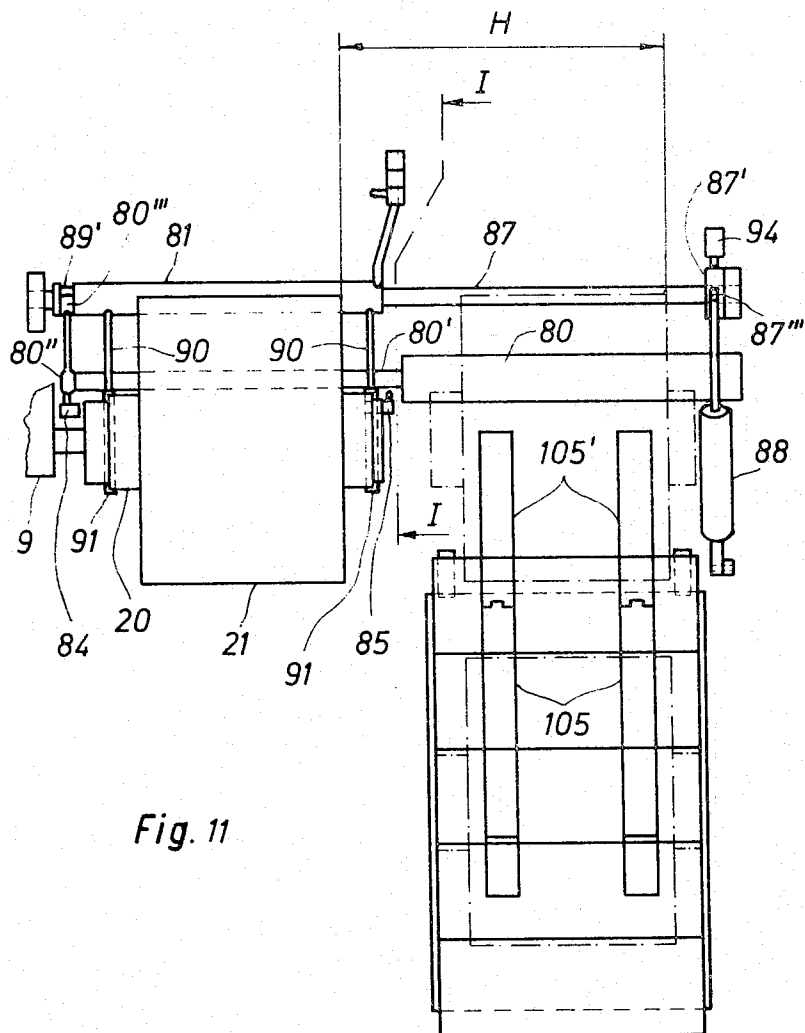












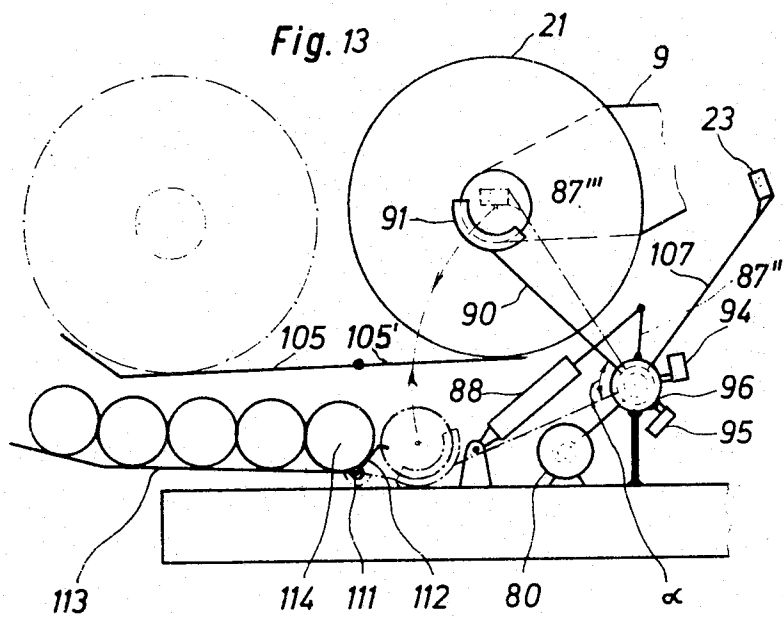
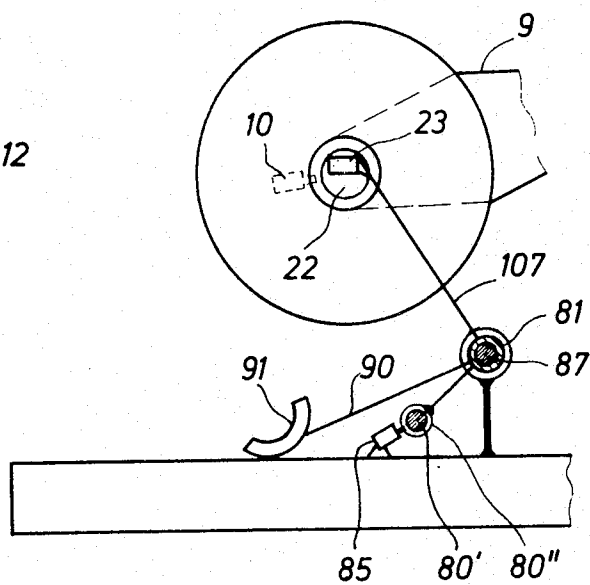


Fig. 12



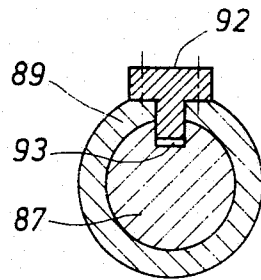


Fig. 14

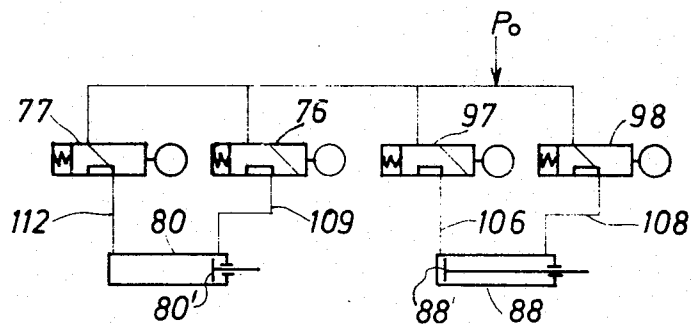


Fig. 15

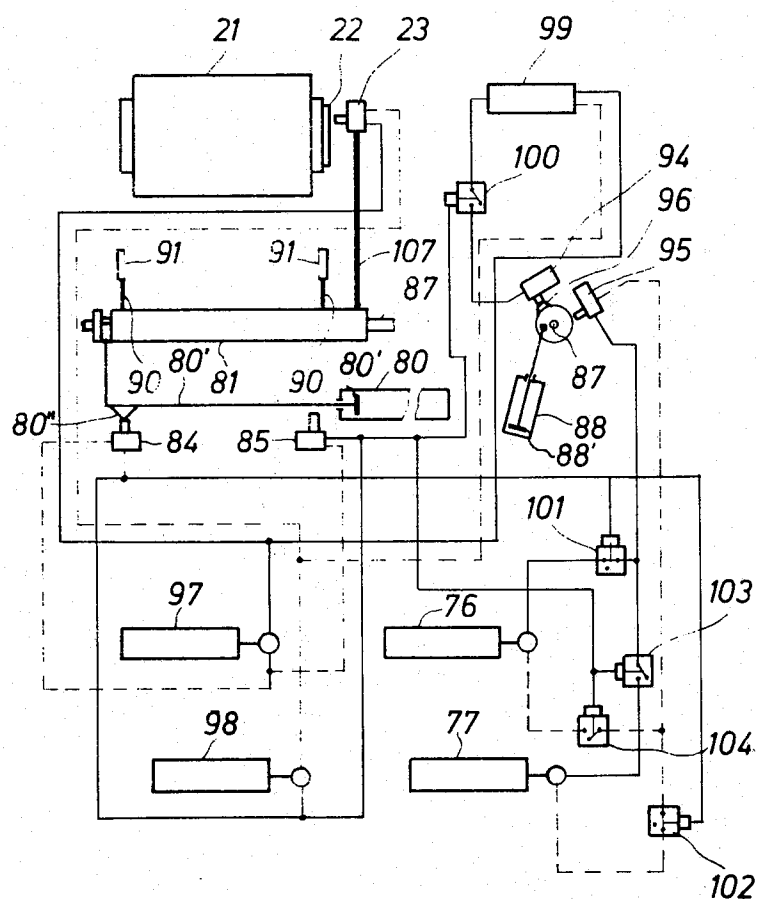
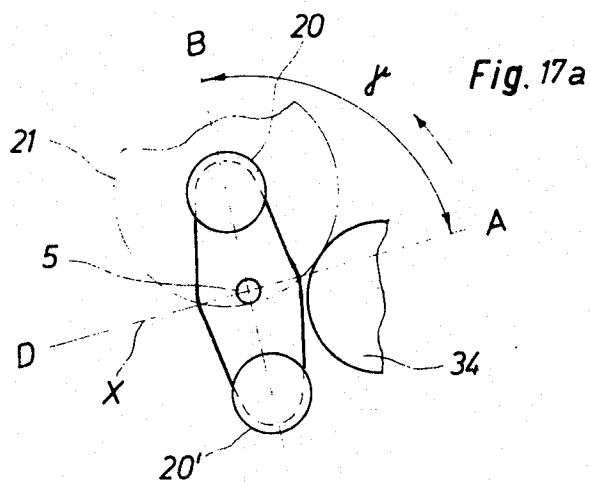
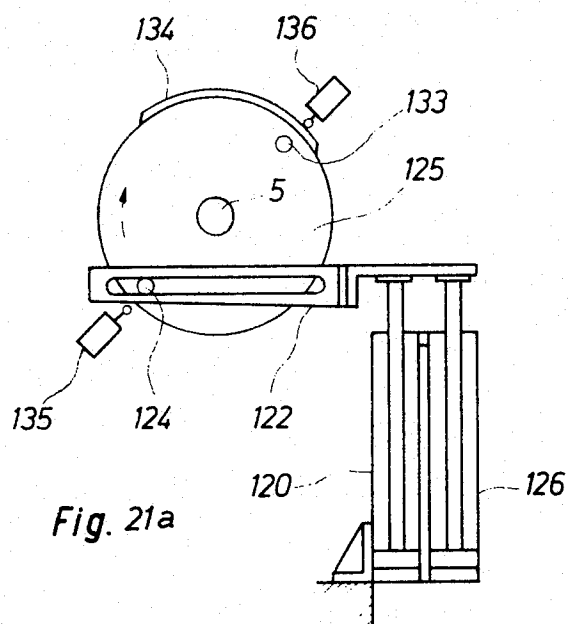
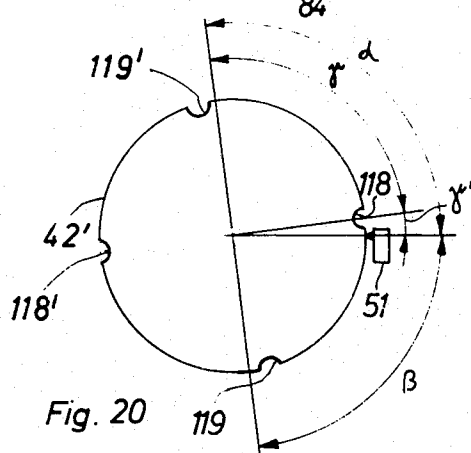
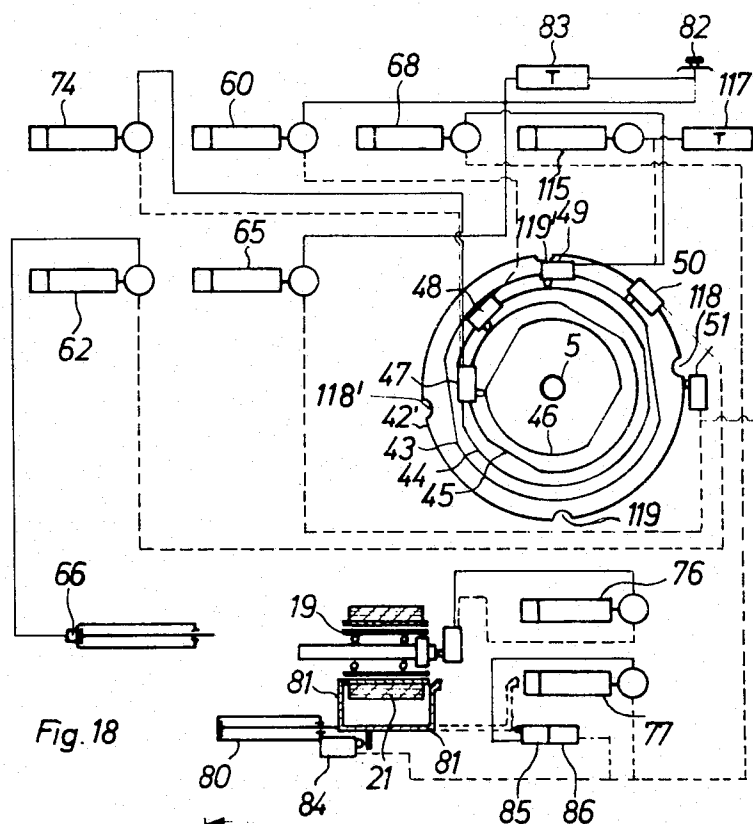


Fig. 16





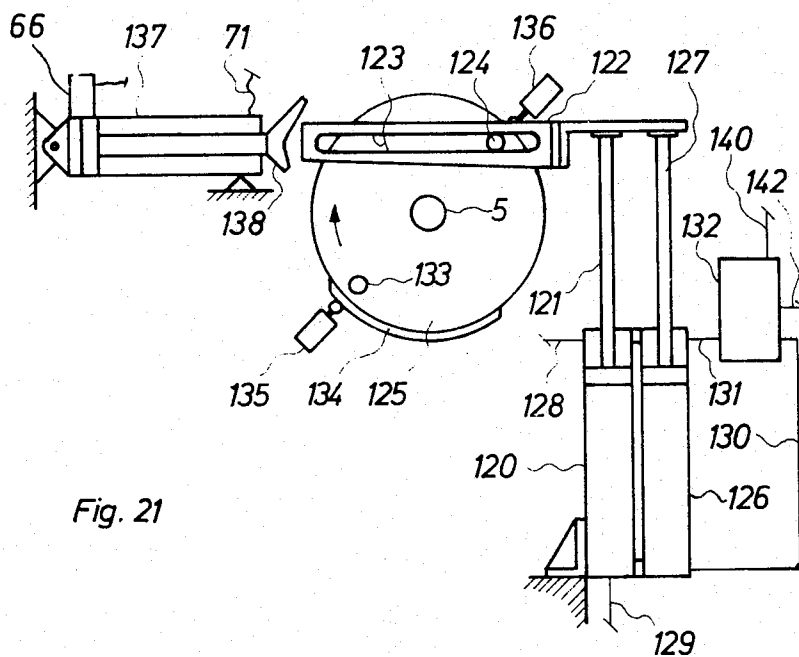


Fig. 21

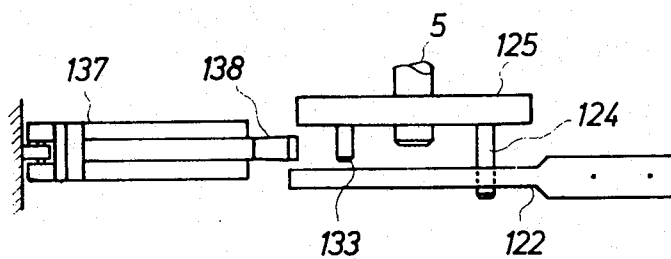
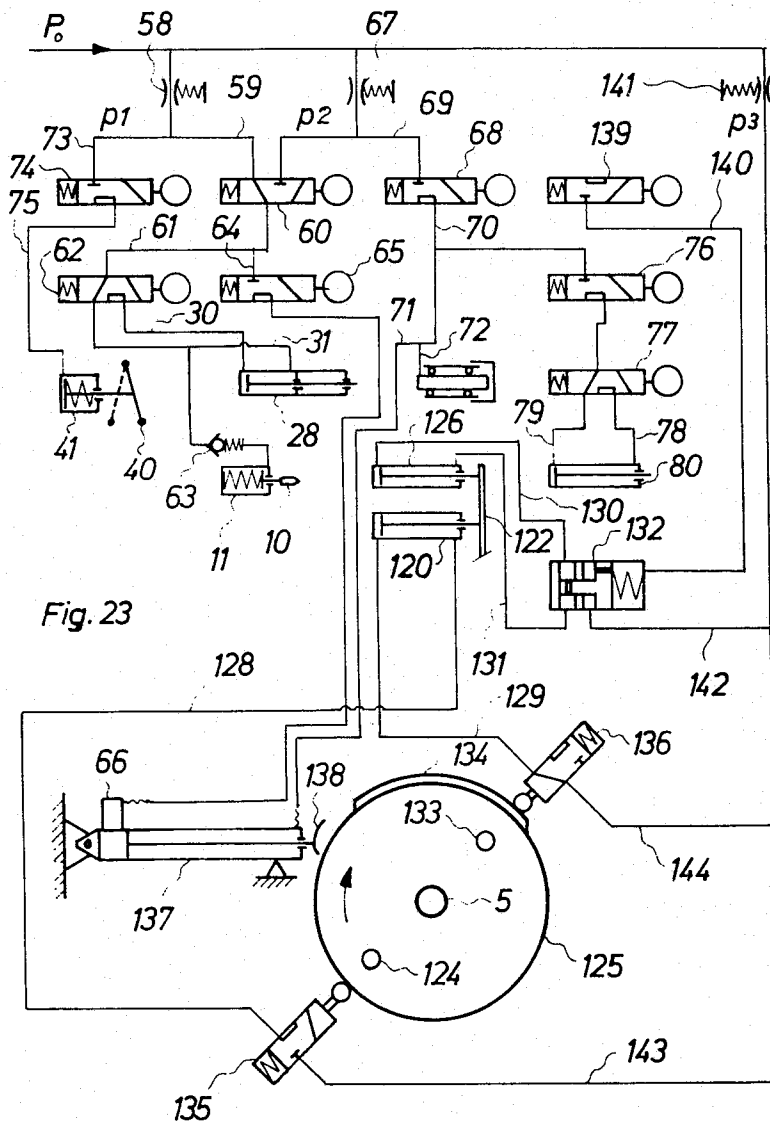
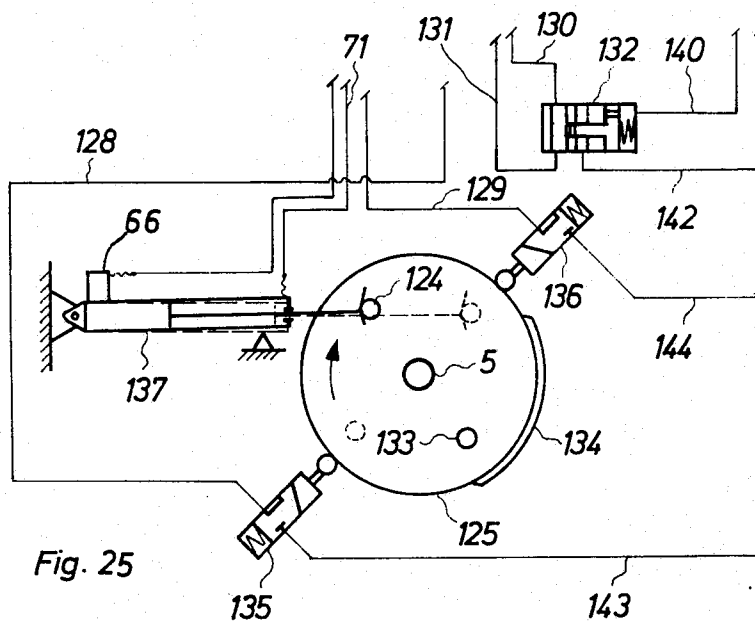
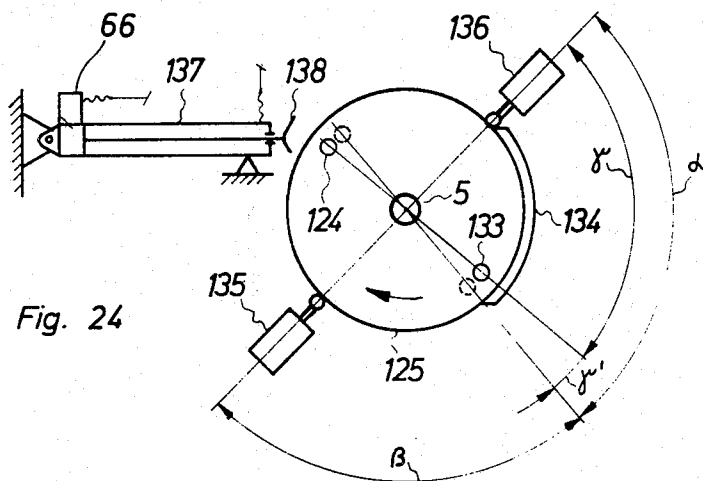


Fig. 22





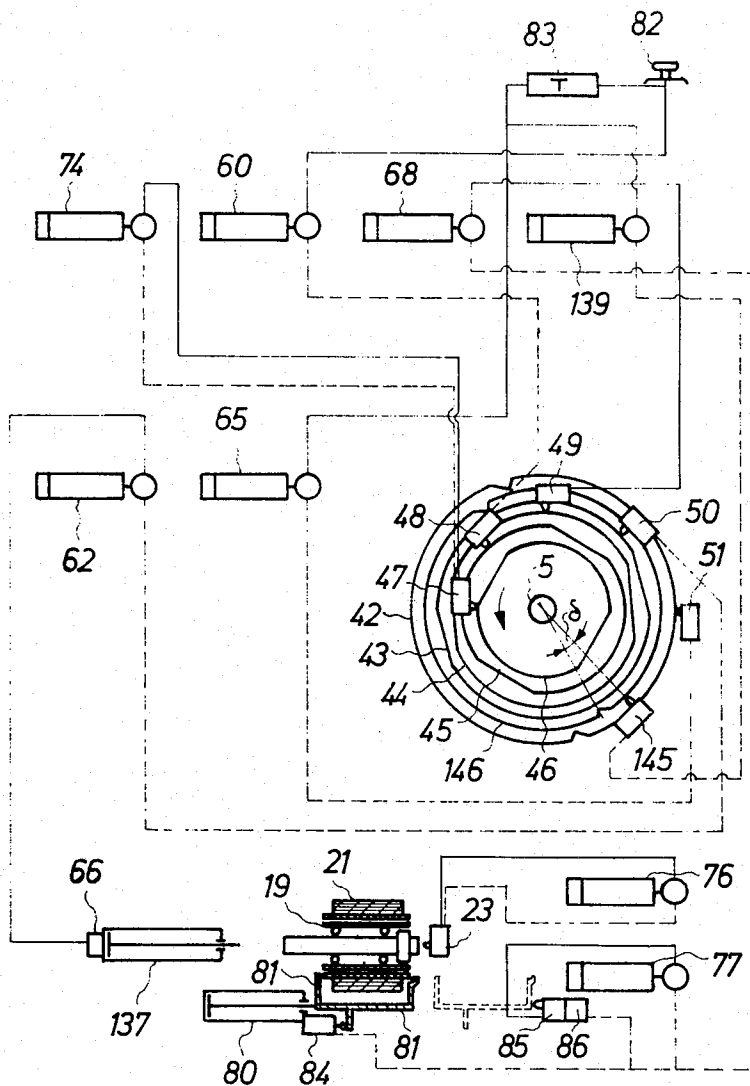


Fig. 26

METHOD OF AUTOMATICALLY CHANGING WINDING TUBES AND WINDING APPARATUS FOR IMPLEMENTING THE AFORESAID METHOD AND IMPROVED SPOOL DOFFING MECHANISM

CROSS-REFERENCE TO RELATED CASE

This is a divisional application of my commonly assigned copending U.S. application Ser. No. 350,793, filed Apr. 13, 1973, now U.S. Pat. No. 3,856,222, granted Dec. 24, 1974, and entitled "Method Of Automatically Changing Winding Tubes And Winding Apparatus For Implementing The Aforesaid Method And Improved Spool Doffing Mechanism" which, in turn, is a continuation-in-part application of my commonly assigned U.S. application Ser. No. 76,181, filed Sept. 28, 1970, now abandoned, and entitled "Method Of Automatically Changing Winding Tubes And Winding Apparatus For Implementing The Aforesaid Method."

BACKGROUND OF THE INVENTION

The present invention relates to an improved method of automatically changing tubes taking up endless filaments and further pertains to an improved winding apparatus for implementing the aforesaid method. The method techniques and apparatus structure of the invention are especially suitable for use in spindraw-winding in the man-made or synthetic fiber manufacturing industry. The invention also is concerned with an improved construction of spool doffing mechanism.

The prior art is already acquainted with the technique of lifting the full wound package off the drive drum for the purpose of changing the spool and to automatically pivot an arm supporting two spools. With this procedure the empty tube or sleeve is placed in rotation by manually pressing it against the friction drive drum for a short period of time, then lifting it off again for a short period of time, so that the thread or yarn can be manually wrapped several times around the empty tube. The winding process is thereupon started by again placing the empty tube onto the friction drive drum and by simultaneously threading the traversing thread guide, whereupon the connecting thread to the full package is torn off.

This technique possesses the notable drawback that automatic operation is not possible, resulting in operational difficulties at high processing speeds, inasmuch a manual operations can be no longer attained with sufficient precision and speed. A further disadvantage is that during the acceleration or speed-up time of the empty tube the full package must be already lifted off the friction drive drum, so that during a relatively long time interval thread is taken up by the undriven package, the speed of rotation of which decreases. As a result, the tension in the thread or yarn up to the location of the above-situated delivery element sharply decreases, greatly increasing the danger of lap formation at the delivery element. This phenomenon is particularly pronounced in the event a spool change operation must be effected for any reason during the initial stage of the package formation, during which time the inertia of the package is still extremely small. A still further disadvantage is that as the thread is unthreaded from the traversing guide, which occurs immediately after lifting the package, the thread tension considerably drops and cannot be compensated. Furthermore, this device does not permit formation of a thread reserve.

SUMMARY OF THE INVENTION

Hence, there is a real need in the art for an improved technique of automatically changing the winding tubes as well as for improved winding apparatus for implementing such technique or method without encountering the aforementioned drawbacks of the prior art. With this in mind a primary objective of the present invention is to provide an improved method of changing winding tubes and an improved winding apparatus for this purpose which effectively fulfills the existing need and is not associated with the aforementioned drawbacks prevailing in the state-of-the-art.

Another essential objective of the present invention not only constitutes the effective elimination of the aforementioned drawbacks of the prior art techniques and apparatus structure, but additionally aims at fully automating the process of spool change while at the same time achieving thread transfer from a full package to an empty tube held in readiness without generating any thread waste and while maintaining the normal winding speeds.

Still a further objective of the present invention is to realize a spool change operation in such manner that the still traversing thread or yarn contacting the friction drive drum does not cause the formation of irregular or otherwise disturbing layers at the full package, nor cause damage to the thread, nor cause the formation of bulges at the full package due to prolonged winding without traversing the thread.

Another object of this invention is to control the contact pressure of the full wound package against the friction drive drum during the spool change operation up to the moment of lifting off such package from the friction drive drum, in other words, to maintain the contact pressure as constant as possible.

In connection with the last-stated object of the invention a further objective of the present invention is to compensate changes in thread tension during the spool change operation by appropriately selecting the magnitude of the circumferential speeds of the thread guiding elements.

A further object of the invention is the provision of a spool doffing mechanism which is of relatively simple construction and design yet extremely efficient and reliable in operation.

Now, in order to implement these and still further objects of the invention, which will become more readily apparent as the description proceeds, the method for automatically changing two tubes each placed on a mandrel arranged on an arm movable parallel to its axis and rotatable such that such tubes alternately contact a friction drive drum for taking up in a winding device an endless thread delivered at high speed, is achieved by undertaking the steps of rolling the full package wound onto the tube, as the desired package size is reached, along the friction drum in the sense of an extension of the thread path on this drive drum until the empty tube is accelerated by the friction drive drum due to contact of such empty tube with the friction drive drum. Then the full package is lifted off the drive drum, thread still being wound onto this full package owing to the inertia of the full package. The thread passing from the friction drive drum to the full package which has been lifted off the drive drum and which thread in the meantime has been unthreaded from the traversing guide, is deflected through a rotating catching zone of the mandrel supporting the empty tube. The

connecting thread between the full package and the empty tube is subsequently severed by the rotating catching zone, and a number of reserve wraps are placed upon the empty tube by axially moving the tube into its normal winding position while rolling the tube along the friction drive drum.

The just-explained method aspects of the invention are successfully achieved through the use of a winding apparatus of the invention incorporating a friction drive drum for driving two tubes which are alternately brought into contact with such friction drive drum. These tubes are each placed upon a respective mandrel which can be braked and detached and which by means of a rotatable- and arrestable arm can be rotated through 180° in each instance into the spool- and the tube change position, respectively. Furthermore, means are provided for generating and transmitting a contact pressure to the supporting arm in such a manner that the mandrels are supported so as to be axially movable at the supporting arm and this axial movement is determined by the momentary position of the supporting arm.

The invention also deals with a method of, and apparatus for, the automatic doffing or changing of a tube seated upon one of the mandrels which contemplates engaging a full tube defining a package by means of a gripper rocked towards the full tube out of a rest position and in a direction essentially perpendicular to the axial direction of the mandrel into a package change position, withdrawing the package from the mandrel by carrying out a movement of the gripper away from the mandrel and essentially parallel with respect to the axial direction of the mandrel until reaching a predetermined position, and thereafter releasing the package by carrying out an opposite pivotal movement of the gripper.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood and objects other than those set forth above will become apparent when consideration is given to the following detailed description thereof. Such description makes reference to the annexed drawings wherein:

FIG. 1 is a side or elevational view of the tube change apparatus of the invention in normal winding position;

FIG. 2 is a top plan view, partly in section, of the apparatus of FIG. 1, showing the position of the structural components thereof immediately before thread transfer occurs;

FIG. 3 is a cross-sectional view showing a detail of the thread catching zone of the mandrel;

FIG. 4 is a perspective view illustrating details of the thread catching zone of the mandrel;

FIG. 5 is a schematic circuit diagram of an electro-pneumatic control of the inventive winding apparatus;

FIG. 6 is an electrical circuit diagram of the inventive winding apparatus;

FIG. 7 is a schematic view illustrating the position of the tubes in the thread severing position;

FIG. 8 is a schematic elevational view, partly in cross-section, showing details of a possible construction of spool doffing mechanism for use with the apparatus of FIG. 1;

FIG. 9 is an enlarged view showing details of a portion of the spool doffing mechanism of FIG. 8;

FIG. 10 is a cross-sectional view of the spool doffing mechanism depicted in FIG. 8;

FIG. 11 is a plan view of a further embodiment of spool doffing mechanism with the full spool or tube still located upon the mandrel;

FIG. 12 is a cross-sectional view of the mechanism of FIG. 11 taken substantially along the line I—I thereof;

FIG. 13 is a schematic elevational view of the spool doffing mechanism of FIG. 11;

FIG. 14 is a cross-sectional view showing a detail of the spool doffing mechanism of FIG. 11;

FIG. 15 is a pneumatic circuit diagram of the control for the spool doffing mechanism of FIG. 11;

FIG. 16 is an electrical circuit diagram of the control for the spool doffing mechanism of FIG. 11;

FIG. 17 is a schematic view of a variant operation of the arrangement of FIG. 7 depicting application of the full bobbin and the empty tube at the friction drum;

FIG. 17a is a schematic illustration of the construction of FIG. 17 showing contact of the full spool at the friction drum and approaching contact of the empty tube at such friction drum;

FIG. 18 is a modified electrical circuit diagram for the winding apparatus;

FIG. 19 is a circuit diagram of a modified electro-pneumatic control for the winding apparatus;

FIG. 20 is a schematic representation of the course of movement of the cam disk through 180°;

FIG. 21 is an elevational view of the rotating mechanism for the arm in a semi-schematic illustration in a position in which the full spool or bobbin is located at position D of FIGS. 17 and 17a;

FIG. 21a is a fragmentary view of the rotating mechanism depicted in FIG. 21 in a position where the full spool is located at position A of FIGS. 17 and 17a;

FIG. 22 is a plan view of the rotating mechanism depicted in FIG. 21;

FIG. 23 is a pneumatic circuit diagram wherein the position of the rotating mechanism corresponds to that shown in FIG. 21a;

FIG. 24 is a schematic illustration of the disk which is part of the rotating mechanism and in a position where the full spool is located at position B of FIG. 17a;

FIG. 25 illustrates a portion of the pneumatic circuit diagram depicted in FIG. 23 with the disk which is part of the rotating mechanism in a position in which the full spool is located at position C of FIG. 17; and

FIG. 26 is an electrical circuit diagram.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Describing now the drawings and, in particular, referring to FIGS. 1 and 2 illustrating a preferred embodiment of inventive winding apparatus, it will be seen that such comprises a platform 4 which is slidably arranged upon roller bearings 3 at the parallelly extending horizontal rail members 1 and 2 fixed to the machine frame F. Platform member 4 supports a rotatable shaft 5 capable of being rotated in counterclockwise direction through the action of a gear 6 and a meshing gear rack 7. When the gear 6 is driven in clockwise direction it rotates without transmitting its rotational movement owing to the action of a free-wheeling clutch 8, best recognized by referring to FIG. 2. An arm member 9 is rigidly connected with the rotatable shaft 5. Further, an arresting pin member 10 protrudes into the area of the arm member 9, this pin 10 being retractable through the action of a cylinder 11 so as to permit rotation of such arm 9. Rack member 7 actually constitutes an extension of a piston rod 12 which can be reciprocated up

and down by cylinder 13 arranged upon platform 4. The entire arrangement just-described constitutes the revolving or rotating mechanism for rotating the arm 9.

A further arm member 14 is likewise rigidly connected to the shaft 5. During such time as the shaft 5 is rotated this arm 14 progressively displaces or pushes a suitably shaped dampening or damping lever 15, pivotably mounted at the platform 4, towards the outside and against the resistance of a piston member 16 slidably arranged within an oil-filled cylinder 17. As a result, the arm member 9 is braked during such time as the cylinder 13 is activated, that is, this arm is indirectly connected with a dampening device 15, 16, 17, which, depending upon the position of such arm, prevents it from rotating too fast.

As best observed by referring to FIG. 2, mandrels 18 and 19 are seated upon the ends of the arm 9, these mandrels 18 and 19 serving to receive tubes or sleeves 20' and 20, respectively, onto which there is wound the thread package or spool 21. These mandrels 18 and 19 can be pneumatically loosened and braked and in their loosened or released position are provided with a piston member 22 protruding at the free end of the loosened mandrel, as indicated in FIG. 2 for the mandrel 19. Mechanism suitable for this purpose is well known to those versed in the art, as evidenced for instance from the apparatus structure of Swiss Pat. No. 443,993, corresponding to U.S. Pat. No. 3,495,781 of the assignee of this application, and also assignee's further U.S. Pat. No. 3,554,455, incorporated herein by reference, so that further description thereof can be dispensed with. The piston member 22 activates a terminal or contacting switch 23 which, in turn, activates the package and tube change mechanism to be described in greater detail hereinafter in conjunction with FIGS. 6 and 8-10.

Furthermore, these mandrels 18 and 19 are each supported so as to be axially slidable in a respective bore 24 of the arm member 9, these bores 24 being configured and dimensioned to provide a sliding fit. The mentioned axial movement or displacement is undertaken through the action of a ring-shaped cam 25 provided with grooves 26 into which extend appropriate extensions 27 provided at the mandrels 18, 19. During rotation of the shaft member 5 there is thus performed a predetermined axial movement of the mandrels 18 and 19. The platform member 4 is similarly displaced along the rails 1 and 2 through the action of a suitable piston-cylinder drive arrangement. The cylinder 28 thereof is partitioned so as to provide both a pneumatic work cylinder 28' and an oilfilled dampening cylinder 29. Work cylinder 28' may be conveniently operated through the provision of ducts or conduits 30 and 31 communicating with opposite faces of the piston 32a slidably arranged with work cylinder 28'. Furthermore, within the oilfilled cylinder 29 there is mounted upon the piston rod 32 a further piston or disk 33, this piston or disk permitting, by means of non-illustrated suitable valves, oil to only pass to a limited extent, thereby dampening the movement of the piston rod 32. Moreover, these valves are selected such that they permit a greater passage or throughflow of oil during such time as the platform 4 moves towards the outside, resulting in outward platform movement being faster than inward platform movement. The dampening cylinder 29 is additionally advantageously employed for slowing down the almost impact-like movement of the piston rod 32 brought about by the pneumatic system and further serves to suppress vibrations which may be brought about

through untrue or eccentric movement of the package 21 contacting the friction drive drum 34. The package 21 which is to be wound contacts the friction drive drum 34 with a predetermined contact pressure when the platform 4 is displaced towards the right of FIG. 1 through the action of the piston rod 32. Additionally, the winding apparatus of the invention possesses a thread traversing guide arrangement 35 which horizontally traverses back and forth a thread guide 36 through a traverse distance or stroke H along the friction drive drum 34.

Inasmuch as the drive mechanism for the thread traversing guide arrangement 35 and the friction drive drum 34 is conventional, and many different systems suitable for the purposes of the invention are already part of the prior art, any further description thereof can be dispensed with, particularly since such details are not important for understanding the underlying concepts of the invention. What is however worthy of mention in this context is that the friction drive drum 34 is provided with an acceleration or entrainment rim 37, the diameter of which exceeds the diameter of the drive drum 34 by about 1 to 3 percent. This acceleration rim 37 serves to contact and accelerate the tube 20' to a speed above the circumferential speed of the thread contacting surface 34' during such time as the tube is moved out or displaced into its thread transfer position. Additionally, an abrasion-resistant rod 39 provided with a lateral notch 38 as best observed by referring to FIG. 2, is arranged in the converging space or area formed by the friction drive drum 34 and the thread transversing guide arrangement 35, the mentioned notch 38 being located within the region of the traverse distance H, as shown.

In the same area there is pivotably arranged above the rod 39 a further rod member 40. Rod member 40 possesses good thread sliding properties and can be tilted from a rest position into a pivoted or thread transfer position shown in phantom lines in FIG. 1. Cams 42 to 46 are furthermore provided upon the shaft member 5, each such cam operating a terminal or contact switch 47 through 51, respectively, utilized for the control of the operation of the individual elements during spool change.

Continuing, it will be understood that the thread catching zone 52, shown in particular detail in FIGS. 3 and 4, and provided on the mandrels 18 and 19 is equipped with a tightly fitting steel ring 53. The outside diameter of this steel ring 53 is slightly less than the diameter of the tube 20, so that there is avoided damage to the friction drive drum 34 and the somewhat higher rotational speed of the tube is compensated. Ring member 53 under consideration is provided with a surface 54 which is conically inclined towards the inside, leaving a clearance of about 0.05 to 0.1 mm. towards the face 55 of the tube 20 placed upon the associated mandrel. Uniformly distributed along the circumference of this conical surface 54 are the teeth 56 which are inclined towards the tube face 55 and provided with a sharp inside edge. The clearance between the teeth 56 and the confronting tube face or surface 55 is sufficiently large to enable the thread to enter.

The circuit diagram of FIG. 5 for the electropneumatic control arrangement depicts the valves in their positions during the normal winding operation when building up the thread package, and this control arrangement is constructed and designed to operate as follows:

A pressure limiting valve 58 is supplied with air at a pressure p_0 from a non-illustrated compressed air source, delivering such pressurized air at a pressure p_1 via a conduit or duct 59 to an electromagnetic valve 60. Electromagnetic valve 60 in turn is flow connected via a further duct or conduit 61, an electromagnetic valve 62, a blocking or stop-valve 63 closed at the pressure p_1 but opened at a higher pressure p_2 , with the cylinder 11 of the previously discussed arresting pin member 10. In the description to follow all of the electromagnetic valves will be conveniently briefly referred to as simply valves. A conduit or duct 64 communicates in flow relationship a valve 65 with the heretofore discussed cylinder 13 of the likewise heretofore discussed revolving or rotating mechanism serving to rotate the arm member 9. Furthermore, cylinder 13 is equipped with a pressure sensor 66 which responds upon attaining the pressure p_2 in the cylinder 13 and closes the electrical circuit of FIG. 6 which will be more fully discussed shortly hereinafter. Incidentally, the pressure sensor 66 has been illustrated in the electrical circuitry diagram of FIG. 6 for purposes of clarity. Continuing, valve 60 is operated through the agency of a further pressure limiting valve 67 serving to reduce the pressure p_0 to the pressure value p_2 which, however, is higher than the pressure p_1 . By the same token, valve 68 receives air at a pressure p_2 by means of the conduit or duct 69. A further conduit 70 communicating with the valve 68 delivers air to a conduit 71 and to a conduit 72 for the purpose of pneumatically loosening the tube and braking the mandrels 18 and 19, respectively. Although not specifically illustrated in the drawings, the chamber 72' appearing in FIG. 2 is furnished with pressurized air via the duct 72 which communicates by means of the channel or throughpassage opening 72'' with the interior of the mandrel 19, shown just located in its changing position for the full package 21. The supply of pressurized or compressed air to the other mandrel 18 on which there is placed the empty tube is stopped or blocked. A conduit 73 branches off of the conduit 59 and communicates with a valve 74. Valve 74 is connected via the conduit 75 with the cylinder-piston arrangement 41 serving to tilt or pivot the rod member 40. Furthermore, duct or conduit 70 additionally supplies valves 76 and 77, and through the agency of the further conduits 78 and 79, respectively, delivers fluid medium to the cylinder 80 of a spool doffing or changing mechanism shown schematically by way of example in FIG. 6 and in greater detail in FIGS. 8, 9 and 10. This spool doffing or change mechanism embodies a displaceable and pivotable spool and tube gripping element 81, which can be outwardly displaced through the action of the cylinder 80, this gripping element serving to withdraw the full package 21 off the mandrel 19 (FIGS. 6 and 8) and subsequently pushing an empty tube held in preparedness onto such mandrel 19. As best seen by referring to FIGS. 8 to 10 the tube gripping element 81 possesses for such purposes the shoes or segments 150 equipped with a lever 151 which can be deflected against spring pressure, and which allows for the introduction and application of the tube gripping element 81 against the ends of the tube. The cylinder 80 accommodates the piston 152 which is equipped with a cam follower 153 engaging with a guide groove or cam 154, cam follower 153 being guided by guide groove or cam 154. The guide groove 154 is curved at its ends as shown in order to bring about the previously explained pivoting or rocking movement of the tube gripping ele-

ment 81.

The electrical circuitry employed in the winding apparatus of the present invention will now be described in conjunction with the illustration of FIG. 6. A switch 82, initiating the spool change operation and activated manually or automatically as a function of another parameter, such as for instance package size, thread length taken-up or winding time, is electrically connected via a pre-settable timing relay 83 with the heretofore discussed valve 65. As also shown in FIG. 6 this switch 82 is likewise directly connected with the valve 60. Furthermore, the terminal switches 47 to 51 are each connected with one of the valves 74, 60, 68, 62, 65. The position of the cams 42 to 46 depicted in FIG. 6 corresponds to the position assumed by the shaft member 5 at the start of its rotation through the action of the gear rack 7. The pressure sensing means or sensor 66 is operatively connected with the valve 62. The limit or terminal switch 84 controls operation of the valves 77 and 68, whereas the terminal or limit switch 23 acts upon valve 76. The terminal or limit switch 85 is activated when the gripping element 81 moves outwards and through the agency of the timing relay 86 switches the valve 77. In the circuit diagram of FIG. 6, all of the electrical connections used for the switching operations starting from the operating position are shown in full or solid lines, whereas the electrical connections employed for resetting are indicated with broken or phantom lines.

Having now had the benefit of the foregoing description of the inventive winding apparatus its operation now will be considered and is as follows:

A. Normal Operation

The endless thread 87 (FIG. 1) delivered by a conventional non-illustrated drawing arrangement, and which may be a single thread or a strand consisting of single threads, is delivered at high speed, approximately 3,000 meters per minute, and after having been traversed by the thread guide 36 of the thread traversing guide arrangement 35 arrives at the friction drive drum 34. From this location such thread is payed-up onto the package 21. During the winding operation the package diameter increases in the usual fashion to a maximum diameter, corresponding to the desired package weight. By virtue of the increasing package diameter the arrested arm member 9 together with the platform 4 moves out parallel into the position indicated in phantom lines in FIG. 1 and against the contact pressure transmitted by the piston rod 32.

B. Spool Change

The spool change operation is undertaken as follows: As the desired package weight is reached, the switch 82 is closed. Closing of this switch 82 causes switch-over of valve 60 to the higher pressure p_2 and via the conduit 61 and the further valve 63 the arresting pin 10 is retracted in the cylinder 11. Now the arm member 9 is free to pivot. At the same time the conduit 31 serves to increase the pressure in the cylinder 28 to the pressure value p_2 , causing displacement of the platform 4 towards the right while the full package 21 rolls upon the friction drive drum 34 and the shaft member 5 rotates. The increased force transmitted by the piston rod 32 is employed to compensate the weight of the heavy full package 21 and also to overcome the braking effect exerted by the arm 14 and the dampening lever 15. This braking effect is used for maintaining a controlled motion, and this can be realized by switching or setting the lever 15 and by suitably selecting the dampening

cylinder 17. Also in this manner there is maintained the contact pressure of the full package 21 against the friction drive drum 34, and simultaneously also avoiding too rapid pivotal movement of the arm member 9.

This pivotal motion of the arm member 9 then continues until the empty tube 20' contacts the acceleration or entrainment ring member 37 of this friction drive drum 34. It is here mentioned that in the meantime the mandrel 18 of the empty tube 20' has been moved axially outwards by the cam member 25. At this moment both the full package 21 as well as the tube 20' simultaneously contact the friction drive drum 34, the braking effect of the dampening arrangement ceasing inasmuch as the arm member 9 no longer pivots. The empty tube 20' is now accelerated to a circumferential speed which exceeds the speed of the surface of the friction drive drum by 1 to 3 percent, which it will be recalled is the amount of the larger selected diameter of the acceleration ring 37. The previously increased contact pressure acting upon the platform member 4 is now also useful inasmuch as both the full package 21 and the tube 20' are now in contact with the friction drive drum 34 and the contact pressure of both such full spool and empty tube must correspond to the normal operating-contact pressure, since the full spool or package 21 continues to wind-up thread and no change in the density of the last layers wound onto the package should occur. At the same time, as the switch 82 is actuated, the timing relay 83 begins to operate in such a manner that only after the empty tube 20' is placed against the friction drive drum 34 and is accelerated is the valve 65 actuated. The conduit 64 and the cylinder 13 are then furnished with pressurized medium at a pressure p_2 , and piston rod 12 and gear rack 7 begin to raise or lift and cause the shaft 5 and its arm member 9 to again rotate in the counterclockwise direction. This causes the empty tube or sleeve 20' to roll along the friction drive drum 34 in an upward direction and the full package or spool 21 is lifted-off.

The rotational movement from the position in which both spools i.e. package and empty tube contact the friction drive drum 34, as indicated in FIG. 7 in full or solid lines, into the position indicated with phantom lines, is assisted by switching the contact pressure transmitted by the piston rod 32 in that the pressure sensor 66, after the pressure p_2 is reached in the cylinder 13, switches the valve 60 and the conduit 30 serves to displace the disk or piston member 33 in the opposite direction. The outward movement of the piston rod 32 can be controlled through suitable selection of the dimensions of the cylinders 13 and 28, such that at all times the tube 20' is never lifted-off. When the tube 20' reaches its labile or unstable dead-center position, that is, a position where the center of the tube 20' is located at a plane containing the center of both the shaft 5 and the friction drive drum 34 (phantom-line position depicted in FIG. 7), then, the cam member 43 activates the limit or terminal switch 50 and thus resets the valve 62 into the position indicated in FIG. 5, namely the idle or rest position, which causes direction of the contact pressure of the piston rod 32 acting upon the platform 4 again towards the right-hand side. The position of the cam disks 42 to 46 shown in FIG. 6 corresponds to the position of the arm member 9 during such time as the tube 20' contacts the friction drive drum 34 (cf. FIG. 7). Somewhat after the switch 50 has been activated the switch 47 is closed, causing switching of the valve 74 and the piston-cylinder arrangement 41. Conse-

quently, the thread traversing motion is suppressed, that is, due to deflection of the rod member 40 the thread 87 is placed into the notch 38 provided at the rod member 39. In this regard comparison should be made of the thread path indicated with phantom lines in FIG. 1. During further rotation of the arm member 9 the wrapping angle of the thread passing onto the full package 21 has also increased at the cylindrical catch zone 52 of the mandrel 18. The wrapping angle must be large enough so that the thread quickly and reliably is brought beneath at least one of the teeth 56. Hence, this wrapping angle is dependent upon the diameter of the mandrel as well as upon the distribution or gauging of such teeth. The rotational movement of arm member 9 now continues and the cam 25 now displaces the mandrel 18 back in the direction of the normal operating position. As a result, the thread arrives at the region of the conical teeth 56 and moves along the end face or surface 55 towards the inside below such teeth, resulting in a sharp deflection of the thread portion extended towards the full package 21 and causing cutting or severing of the thread at the sharp edge 57 (FIG. 4).

Through continued axial movement of the mandrel 18 a few reserve wraps are now also placed onto the tube 20' until the normal operating position is attained. After the flattened portion of the cam disk 46 has moved past the switch 47 this switch 47 switches the valve 74 back into the position shown in FIG. 5, whereupon the piston and cylinder arrangement 41 retracts the rod member 40. The thread thus leaves the notch 38 and is automatically threaded into the thread guide 36 of the thread traversing guide arrangement 35. As a result, the winding operation performed with the normal stroke or traverse width H of thread onto the empty tube 20' which has now completely reached its retracted position, can be started. To this end, the contact pressure of this tube 20' against the friction drive drum 34 must correspond to the normal contact pressure, that is to say, cylinder 28 must again be supplied with compressed or pressurized air at the pressure p_1 . In order to bring this about, shortly prior to or upon termination of the rotation of the arm member 9, the switch 48 is activated by the cam disk 45 and the valve 60 is again switched to the position depicted in FIG. 5. Consequently, the throttle or pressure limiting valve 63 is also again subjected to the reduced pressure p_1 , that is, it shuts off the supply to the cylinder 11 and causes the arresting pin 10 to move outwards which, in turn, brings about blocking or arresting of the arm member 9 which has just passed. The normal winding position is therefore again reached. Shortly prior to the time that the normal winding position has been established the switch 51 of the cam disk 42 switches the valve 65 back into the position shown in FIG. 5. Thus the supply of compressed air via the conduit 64 to the cylinder 13 is interrupted and movement of the rack 7 is terminated. The switch 49 is activated by the cam disk 44 at such time as the valve 65 is switched and valve 68 is switched, that is, the conduit 70 as well as the conduits 71 and 72 are supplied with compressed air at the pressure p_2 . On the one hand, this causes return of the gear rack 7 into its starting position and, on the other hand, by means of the conduit 72 the compartment 72' of FIG. 2 is supplied with pressure so that in the operating position of the arm member 9 that mandrel which supports the full package 21 actuates by means of the throughflow passage 72' the pneumatic brake- and sleeve release mechanism (not shown) located within

the mandrel. Due to the loosening or release of the tube holding mechanism the piston 22 is moved outwards and the terminal or limit switch 23 is actuated which, in turn, switches the valve 76 and moves the piston 152 from the dotted-line position of FIG. 8 into the phantom-line position. Consequently the tube gripping element 81 initially pivots through a predetermined angle α out of its pivoted position into a vertical position in which the shoes or segments 150 bear against the ends of the full tube. The subsequent linear trajectory of the tube gripping element 81 is initiated until the tube is stripped from the associated mandrel. Then there is carried out pivoting of the tube gripping element 81 through the angle β into the phantom-line ejection position. In this position the full tube presses the lever 151 downwardly owing to its inherent weight and the ejection or removal of the full tube occurs. After there has been applied the empty tube, either manually or by any suitable non-illustrated charging mechanism, the tube gripping element 81 returns back into the starting position by virtue of the action of the terminal switch 85, timing relay 86 and valve 77. As a result the empty tube is now placed upon the mandrel 19. Upon reaching the starting position the terminal switch 84 simultaneously actuates the valves 77 and 68, so that such again return into the position depicted in FIG. 5. Now the spool doffing or change operation has been completed: as soon as the switch 82 is again actuated the entire cycle begins anew.

The entire system generating the movement of the arm supporting the mandrels is advantageously operated by pneumatic means inasmuch as such type means insure for a minimum of inertia, and accordingly, mechanical movements follow the pulses of the program control device very quickly. This is of advantage since thread transfer at high winding speeds and without interruption of the thread delivery can be brought about within a very short period of time, that is, within fractions of a second.

Continuing further, it is here mentioned that a preferred construction of spool doffing mechanism, in other words a full tube unloading and empty tube charging mechanism and its control has been depicted in FIGS. 11 to 16 inclusive and again embodies a tube gripping element 81 which can be actuated by the cylinder 80, the tube gripping element 81 being displaceably seated upon a shaft 87. The gripper or gripper element 81 comprises a tubular portion 89 and two arms 90 secured thereat, each of which is provided with a shoe or bucket segment 91. Furthermore as best seen by referring to FIG. 14 a groove block 92, which is connected with the tubular portion 89, is guided in a longitudinal groove 93 provided at the shaft 87. Near one end of the shaft 87 there is provided a ring 87' which is fixedly connected with the shaft 87. At the ring 87' there is provided an arm 87'' to which there is connected a hinge or pivot joint 87''', as best seen by referring to FIG. 13. The piston (not visible) of a pivotably mounted cylinder 88 is coupled with the hinge joint 87''', and by means of the aforementioned cylinder 88 the shaft 87 can be rocked through the angle α (FIG. 13), whereby the gripper element 81 is pivotably entrained by means of the groove block 92 engaging in the groove 93 (FIG. 14). In both end or terminal positions of this pivotal range α a respective terminal switch 94 and 95 is actuated by means of a cam 96 (FIGS. 13 and 16) which rotates together with the shaft 87. In the showing of FIG. 11 only the terminal switch 94 has

been depicted. An arm 80'', coupled with the piston arrangement 80' of the cylinder 80, engages by means of a bifurcated or forked portion 80''' belonging to the arm 80'' in an annular groove 89' (FIG. 11) provided at the tubular portion 89 (FIG. 14). Additionally, in the one terminal position of the piston arrangement 80' the arm 80'' actuates the terminal switch 84 and in the other terminal position the terminal switch 85.

FIG. 15 schematically illustrates a modification of the pneumatic control depicted in FIG. 5, wherein only the differences have been shown and will be considered. Apart from the valves 76 and 77 respectively for actuating the cylinder 80 there is additionally provided a respective valve 97 and 98 for actuating the cylinder 88. The valves have been illustrated in a position corresponding to the rest- or starting position of the gripper element 81 depicted in FIG. 12. Furthermore, the valves 76, 77, 97 and 98 are directly supplied by a suitable pressure source at the pressure p_0 . The electrical components and connections are described in conjunction with FIG. 16.

Generally, those electrical connections employed for shifting the valves 76, 77 and 97, 98 respectively out of the starting position depicted in FIG. 15 have been shown in full lines and those electrical connections for resetting the valves have been shown in broken lines. The terminal switch 23 which is actuated by the piston member 22 (FIG. 16) actuates the valves 97 and 98 which also can be actuated by the terminal switches 84 and 85 as well as by timing relay 99. The terminal switch 94 places the timing relay 99 into operation whereas the terminal switch 95 actuates the valves 76 and 77. In the connection line from the terminal switch 94 to the timing relay 99 there is mounted a self-opening electromagnetic switch 100 which is actuated by the terminal switch 85. In the lines connected with the valves 76 and 77 there are mounted the respective self-opening electromagnetic switches 101 and 102 and 103 and 104 respectively. The actuated terminal switch 84 closes the switches 101 and 102, whereas the actuated terminal switch 85 closes the switches 100, 103 and 104.

After the arm member 9 (FIG. 11) has again been brought into its operating- or tube change position and fixed by the arresting bolt 10, then in the manner already previously described, the terminal switch 23 is actuated by the piston member 22. Such actuates the valve 97 in such a manner that a conduit or line 106 which connects the valve 97 and the cylinder 88 (FIG. 15) is placed under pressure. At the same time the valve 98 is reset by the terminal switch 23, so that a conduit 108 which connects the valve 98 and the cylinder 88 is without pressure. As a result, the piston of the cylinder 88 is displaced and thus turns or rotates the shaft 87 and therefore the gripper element 81 through the angle α . Simultaneous with the movement of the gripper element 81 the terminal switch 23, which is secured to arm 107, is brought out of the position depicted in FIG. 12 into the position depicted in FIG. 13. On the other hand, due to the rotation of the gripper element 81 the arms 90 secured thereto and therefore the bucket segment or shoes 91 are brought into such position at the tube 20 of the full bobbin 21 that such gripper shoes 91 engage the tube 20. Together with the rotation of the shaft 87 the cam 96 is rotated from the location of the terminal switch 94 to the location of the terminal switch 95. The thus activated terminal switch 95 actuates, on the one hand, the valve 76 in such a

manner that a conduit 109 which connects the valve 76 and the cylinder 80 is pressurized. At the same time the terminal switch 95 actuates the valve 77 so that a conduit 110 which connects the valve 77 and the cylinder 80 is relieved of pressure. As a result, the piston arrangement 80' of the cylinder 80 is displaced through the stroke of length H (FIG. 11). Due to this displacement the spool or package 21 is brought into position over a pair of roll-off rails 105. At the same time, in this terminal position of the piston arrangement 80', the terminal switch 85 is actuated which, in turn, closes the switches 100, 103 and 104 as well as bringing the valves 97 and 98 respectively into the position depicted in FIG. 15. The piston or piston arrangement 88' of the cylinder 88 is thus again brought back into the position depicted in FIG. 15, whereby the shaft 87 and therefore the gripper element 81 as well as the cam 96 are again rocked back through the angle α . The cam 96 again thereby actuates the terminal switch 94 which, in turn, places into operation the timing relay 99. Due to this downward rocking the spool or package 21 is deposited upon the roll-off rails 105, upon which it rolls into the final position depicted in phantom lines in FIG. 13.

Likewise owing to the downward rocking of the gripper element 81 and therefore the shoes or buckets 91 into the phantom-line position depicted in FIG. 13 a flap member 112, which is upwardly urged by a spring 111, is downwardly pressed by the shoes or buckets 91 in such a way that a tube 114 retained in ready supply upon the rails 113 rolls into the shoes 91. Thereafter, the timing relay 99 which has been set for the duration of such tube charging operation actuates the valves 97 and 98 in such a manner that the connection line or conduit 106 is subjected to an overpressure and the connection line or conduit 108 is vented. Consequently, due to the action of the piston 88' of the cylinder 88 the shaft 87 and therefore the gripper element 81 and the shoes 91 respectively are again upwardly rotated through the angle α together with one of the empty tubes 114. The tube 114 which is raised during this rotational movement in turn upwardly raises two tiltable members or components 105' of the roll-off rails 105 to such an extent that it can rock or pivot therepast. After completion of this rotation through an angle α the terminal switch 95 is again activated and in turn actuates the valves 76 and 77 such that the conduit 110 is now subjected to the pressure p_0 and the conduit 109 is vented, so that the piston 80' of the cylinder 80 is again retracted by the stroke length H. Due to this movement the empty tube 114 is pushed onto one of the clamping mandrels 18 or 19 (FIG. 2). Due to the retraction of the piston 80' of the cylinder 80 into the position depicted in FIG. 15 the terminal switch 84 is again actuated and the terminal switch 85 released. Due to the release of the terminal switch 85 the switches 100, 103 and 104, previously closed by such terminal switch, are again opened and owing to actuation of the terminal switch 84 the switches 101 and 102 are again closed. The terminal switch 84 likewise actuates the valves 97 and 98 in such a manner that the conduit 108 is subjected to an excess pressure and the conduit 106 is without pressure, so that the piston 88' in the cylinder 88 is again shifted back into the position depicted in FIGS. 15 and 16. Consequently the shaft 87 and therefore the gripper element 81 is again brought back into the starting or basic position depicted in FIG. 11. At the same time the terminal switch 23 is again rocked into the position in front of the piston 22 as de-

picted in FIG. 11 so that the apparatus is ready for the next spool doffing and tube charging operation. Instead of the cylinders 80 and 88 it would be possible to employ other means which would carry out the same functions, such as for instance a spindle driven by a motor instead of the cylinder 80 and a transmission coupled with the shaft 87 and driven by a motor instead of the cylinder 88.

At this point there will be considered in conjunction with FIGS. 17 and 20 an additional possibility for carrying out rotation of the arm member 9 out of the position depicted in FIG. 1 and the basic- or wind-up position depicted by the line X of FIG. 17, that is to say, to rock the full spool or package 21 out of the position depicted by reference character A in FIGS. 17 and 17a through an angle α (FIGS. 17 and 20) into the position depicted by reference character C (FIG. 17) in which the full spool or package 21 and the empty tube 20' simultaneously bear against the friction drive drum 34. In this case the full spool 21 seated upon the arm 9 initially carries out a pivotal or rocking movement through an angle γ (FIGS. 17a and 20) into the position depicted by reference character B (FIG. 17a), i.e. shifts until shortly prior to achieving contact of the empty tube 20' with the friction drive drum 34 owing to the action of the cylinder 13 and rack 7, whereas there occurs during the second phase of operation the remaining rocking or pivotal movement through the angle γ' (FIG. 20), that is, from the position B (FIG. 17a) into the position C (FIG. 17) by means of the already previously explained contact force which prevails between the full package and the friction drive drum.

The elements required for achieving such and the modifications of the system to realize the same reside in the features that the valve 65 (FIG. 18) parallel to the connection with the timing relay 83 is also directly connected with switch 82, that for the return of the rack 7 (FIG. 1) there is provided an additional valve 115 (FIGS. 18 and 19) actuated by the switch 49 and which, on the one hand, is connected by a conduit 116 (FIG. 19) with the conduit 69 and, on the other hand, via a conduit 71' with the cylinder 13, and further, switch 51 additionally places into operation a timing relay 117 which likewise actuates the valve 115. Furthermore, a cam disk 42' possesses the respective switching grooves 118 and 119 which serve to actuate the switch 51.

During change of the spool, and after the switch 82 is closed, the arresting bolt 10 is retracted and the arm member 9 is therefore released for rotation, the valve 65 (FIGS. 18 and 19) and therefore the cylinder 13 actuated, so that the rack 7 (FIG. 1) rotates the arm member 9 through the angle γ (FIGS. 17a and 20). Simultaneous with the actuation of the cylinder 13 the pressure in the cylinder 28 is increased to the value p_2 via the conduit 31, so that the carriage, as already previously discussed, with rolling-off of the full bobbin 21 and rotation of the shaft 5, moves towards the right. After pivoting of the arm member 9 through the angle α the switching groove 118 provided at the cam disk 42' actuates the switch 51 (FIGS. 18 and 20) so that, on the one hand, the valve 65 is reset into the position depicted in FIG. 19 and, on the other hand, the valve 115, after expiration of the time set at the timing relay 117, is actuated in such a manner that the conduit 71' is subjected to pressure, so that the rack 7 is again retracted back into the starting position depicted in FIG. 1. The course of movement with respect to the rotation of the shaft 5 and the rolling-off of the full spool or

package 21 over the friction drive drum 34 is carried out in a controlled manner by means of the braking action exerted by the arm 14 (FIG. 1) and the damping lever 15.

The remaining operations until reaching the starting- or wind-up position respectively of the arm member 9, that is to say, until reaching the position D (FIGS. 17 and 17a) of the full package 21 while rotating the arm member through the angle β (FIGS. 17 and 20), that is to say, until the bolt 10 again fixes the arm member in position, correspond to the already described operations discussed in conjunction with FIGS. 1 to 7.

Continuing, it is here further indicated that according to the embodiment of FIGS. 21 to 26 there additionally exists the possibility of carrying out the rotation of the arm member 9 from the one basic- or wind-up position into the other position rotated through 180° at least partially by means of a lifting cylinder 120, at the piston or piston arrangement 121 of which there is connected a transversely extending member or traverse 122 having a guide track 123 for guiding a bolt 124 connected with a disk 125 seated upon the shaft 5. A braking or brake cylinder 126 is arranged parallel to the cylinder 120 and secured thereto. This braking cylinder 126 has a piston or piston arrangement 127 which is likewise connected with the traverse 122. The cylinder 120 is coupled by the conduit 128 with a valve 135 and by a conduit 129 with a valve 136. The braking cylinder 126 is connected on the one hand via a conduit 130 and on the other hand via a conduit 131 with a throttle- and shunt valve 132. The shunt valve 132, in the position depicted in FIG. 23, operates as a throttle for a fluid medium flowing through the conduits 130 and 131. A further bolt 133 is connected with the disk 125 and relative to the axis of rotation of the shaft 5 is located in a position which is symmetrically opposite the bolt 124. A raised portion 134 provided partially at the periphery of the disk 125 actuates the valves 135 and 136 respectively (in FIG. 21 there is only partially visible the valve 136). Perpendicular to the arrangement of the cylinders 120 and 126 there is provided at the opposite side of the disk 125 a pivotably mounted cylinder 137, the piston 138 of which can be advanced at the region between the traverse 122 and the disk 125. A valve 139 is coupled by means of a conduit 140 with the shunt valve 132 (FIGS. 21, 23 and 25). Furthermore, a conduit 142 communicates the shunt valve 132 with a pressure reduction valve 141. The valve 135 is likewise connected with the pressure reduction valve 141 by a conduit 143 and the valve 136 by a conduit 144. Furthermore, the valve 139 is connected with the timing relay 83 and with a terminal switch 145 (FIG. 26). The terminal switch 145 is actuated by a cam disk 146.

Now for the purpose of changing the spools the following operations are performed:

As best seen by referring to FIG. 23, in the illustrated position the valve 136 is actuated by the raised portion 134, and specifically in such a way that there exists a flow connected between the conduits 144 and 129 and therefore the pressure p_3 prevails at the cylinder 120. Now if after attaining the desired package weight the switch 82 is closed and if the manner previously described the valve 60 is switched-over or reversed to the higher pressure p_2 and via the conduit 61 and the valve 63 the arresting bolt 10 is retracted in the cylinder 11, then, as a result, the arm member 9 is freed for rotation. Owing to the aforementioned pressure p_3 the piston 121 and therefore the traverse 122 are displaced so

that the disk 125 is rotated out of the position depicted in FIG. 21a by means of the bolt 124 which is guided at the guide track 123. This occurs for such length of time until the valve 136 is no longer actuated by the raised portion 134. As a result, the disk 125 carries out a rotation through the angle γ (FIGS. 17a and 24), that is to say, the arm member, during this rotation, is rotated out of the wind-up position into a position in which the empty tube 20' (FIG. 1) is brought to the region of the friction drum 34 whereas the full package 21 still bears against the friction drive drum 34. The remaining rotation of the arm member through the angle γ' (FIG. 24) until contact of the empty tube 20' and the full spool or package 21 against the friction drive drum 34 (FIG. 1) is generated by the already previously described contact force which prevails between the spool 21 and the friction drive drum 34. The sum of the angles γ and γ' correspond to the angle α (FIGS. 17 and 24). The empty tube 20', upon bearing against the friction drive drum 34 in the manner already explained, is accelerated thereby.

Upon expiration of the time which has been set at the timing relay 83 and the valve 65 and at the same time the valve 139 are actuated. The valve 139 in turn actuates the shunt valve 132 in such a way that the aforementioned throttling between the conduits 130 and 131 is eliminated (FIG. 25). The valve 65 actuates the cylinder 137 so that the piston 138 upon reaching the bolt 124 (FIG. 25) rotates the drive disk 125 and therefore the shaft 5 and the arm member 9 respectively again into the position depicted in FIG. 21. The disk 125 then carries out a rotation through the angle β (FIGS. 17 and 24). Corresponding to the position depicted in FIG. 25 of the disk 125 the valve 136 at the beginning of such rotation is no longer actuated by the raised portion or cam 134 and the valve 135 is still not actuated, that is to say, the conduits 128 and 129 are relieved of pressure. The position of the cam disk 146 depicted in FIG. 26 corresponds to the position of the disk 125 depicted in FIG. 25, that is to say, at the beginning of the lifting of the full spool or package 21 from the friction drive drum 34. As best seen by referring to FIG. 26 the terminal switch 145, after the cam disk 146 has been rotated through the angle γ (FIG. 26) is actuated thereby, so that the valve 139 is again reset back into the starting position depicted in FIG. 23. As a result the shunt valve 132 is again brought back into the position depicted in FIG. 23, that is to say, it again works as a throttle. The angle δ (FIG. 26) is smaller than the angle β . The bridging or by-passing of the aforementioned throttling has the purpose of rapidly carrying out the rotation of the arm member 9 at the beginning of the lifting of the full spool or package 21 until the already described take-over of the thread by the empty tube 20'.

For the exchange of the full tube 20' (not shown) for a new empty tube the operations are essentially the same, with the exception that now the valve 135 actuated by the raised portion or cam track 134 establishes a connection between the conduits 128 and 143 and therefore the pistons 121 and 127 and the traverse 122 are moved out of the position depicted in FIG. 21 to the position depicted in FIG. 23 and the disk 125 is rotated by means of the bolt 133 via the piston 138 through the angle β . The remaining components depicted in FIGS. 23 and 26 and which have been provided with the same reference characters as the corresponding components or elements of FIGS. 5 and 6 carry out the same func-

tions as already previously described.

While there is shown and described present preferred embodiments of the invention, it is to be distinctly understood that the invention is not limited thereto, but may be otherwise variously embodied and practiced within the scope of the following claims.

Accordingly, what is claimed is:

1. A method of automatically changing tubes seated upon tube clamping mandrels and wherein each tube, through rotation of a member carrying the tube clamping mandrels, is alternately brought out of a position in contact with a friction drive drum for the purpose of taking-up an endless thread delivered at a high speed and after reaching the desired package size thereon the tube with its package is brought into a package doffing position, the improvement comprising the steps of rocking a gripper in a first direction of movement out of a rest position essentially perpendicular to the axial direction of the tube clamping mandrel carrying the tube with the package wound thereon, engaging the package and its tube by means of the gripper, withdrawing the engaged package and its tube from the tube clamping mandrel by moving the gripper in a direction away from the tube clamping mandrel and essentially in a direction which is parallel with respect to the axial direction of the tube clamping mandrel into a predetermined position, and thereafter releasing the package and its tube by carrying out a rocking movement of the gripper in a second direction of movement opposite to said first direction of movement.

2. The method as defined in claim 1, further including the step of charging the gripper with an empty tube following depositing of the package with its tube during said rocking movement of said gripper in said second direction of movement, moving the gripper with the empty tube into a substantially coaxial position with respect to the tube clamping mandrel, displacing the gripper together with the empty tube substantially axially towards the tube clamping mandrel, pushing the tube onto the tube clamping mandrel, and thereafter again rocking the gripper back into its rest position.

3. A winding apparatus comprising a friction drive drum for driving tubes onto which are wound thread packages and which tubes can be alternately placed into contact with the friction drive drum, a respective brakable and releasable tube supporting mandrel upon which there can be mounted each of said tubes, a rotatable and arrestable member for alternately bringing the tubes into a thread wind-up position and into a thread package doffing position and an empty tube loading position, respectively, an unloading and loading mechanism for unloading the thread packages and loading an empty tube cooperating with said tube supporting mandrels, said unloading and loading mechanism comprising a gripper, means including a rotatably mounted shaft for supporting said gripper, said shaft extending substantially parallel to the axis of the thread package wound on a tube supported by one of said mandrels, means for receiving the wound thread packages, means for delivering empty tubes, said gripper being carried by said supporting means for movement in the axial direction of said shaft and pivotable together with said shaft, drive means for rotating said shaft and drive means for displacing said gripper in the axial direction of the shaft for engaging and withdrawing a wound thread package and its tube from its associated tube supporting mandrel and depositing such wound package and tube at said means for receiving the wound

thread packages and for also engaging an empty tube from said means for delivering empty tubes and for displacing such empty tube onto the tube supporting mandrel from which the package was previously removed.

4. The winding apparatus as defined in claim 3, wherein said gripper includes a pair of shoe means for engaging the tubes.

5. The winding apparatus as defined in claim 4, wherein said means for receiving the wound thread packages deposited by said gripper comprises rail means, said rail means incorporating tiltable rail section means, said rail means being arranged above said means for delivering the empty tubes in such a manner that the shoe means of said gripper during pivoting of said gripper can move past said tiltable rail section means, to permit the gripper to be brought into a position at the empty tube delivering means for receiving an empty tube, whereupon said gripper can again be rotated past said tiltable rail section means and into a position where such empty tube is located substantially coaxially with respect to the tube supporting mandrel at which such empty tube is to be mounted.

6. The winding apparatus as defined in claim 3, wherein said drive means for rotating said guide means comprises a pivotably mounted cylinder means, said guide means having an arm, said cylinder means incorporating a piston hingedly connected by hinge means with said arm of said guide means.

7. The winding apparatus as defined in claim 3, wherein said drive means for displacing the gripper serves to axially displace said gripper and comprises a fixedly arranged cylinder, said fixedly arranged cylinder being provided with a piston, an arm member carried by said piston and extending in a direction essentially perpendicular to the direction of movement of said piston, said gripper means being provided with an annular groove, said arm member engaging with said annular groove.

8. a thread package doffing and empty tube loading apparatus for use with a tube supporting mandrel, comprising a gripper, means including a rotatably mounted shaft for carrying said gripper, said shaft extending substantially parallel to the axis of the thread package wound on a tube supported by said mandrel, means for receiving the wound thread packages, means for delivering empty tubes, said gripper being supported by said carrying means for movement in the axial direction of said shaft and pivotable together with said shaft, drive means for rotating said shaft and drive means for displacing said gripper in the axial direction of said shaft for engaging and withdrawing a wound thread package and its tube from the tube supporting mandrel and depositing such wound package and tube at said means for receiving the wound thread package and for also engaging an empty tube from said means for delivering empty tubes and for displacing such empty tube onto the tube supporting mandrel.

9. A method of automatically doffing a tube with a package wound thereon seated upon a tube supporting mandrel and loading said mandrel with an empty tube, comprising the steps of: displacing a gripper in a first direction of movement out of a rest position in a direction towards the tube supporting mandrel carrying the tube with the package, engaging the tube by means of the gripper, moving the gripper in a direction away from the tube supporting mandrel and essentially parallel with respect to the axial direction of the tube supporting mandrel to thereby remove the engaged tube

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from the tube supporting mandrel, thereafter releasing and depositing the tube with the package by carrying out a further movement of the gripper in a second direction of movement opposite to said first direction of movement, then charging the gripper with an empty tube following the releasing and depositing of the package with its tube during said movement of said gripper in said second direction of movement, moving the gripper with the empty tube into a substantially coaxial position with respect to the tube supporting mandrel, dis-

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placing the gripper together with the empty tube substantially axially towards the tube supporting mandrel, pushing the tube onto the tube supporting mandrel, and thereafter again moving the gripper back into its rest position.

10. The method as defined in claim 9, including the step of engaging the tube at opposite ends thereof by means of the gripper.

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