

[54] **YARN PACKAGE DOFFING APPARATUS
AND METHOD**

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[52] U.S. Cl. **242/18 A, 242/19, 242/35.5 A**

[51] Int. Cl. **B65h 54.02**

[58] Field of Search **242/18 A, 18 PW,
242/18 R, 19, 25 A, 35.5 A, 35.5 R**

[56] **References Cited**

UNITED STATES PATENTS

3,429,514 2/1969 Pospisil et al. **242/18 A**

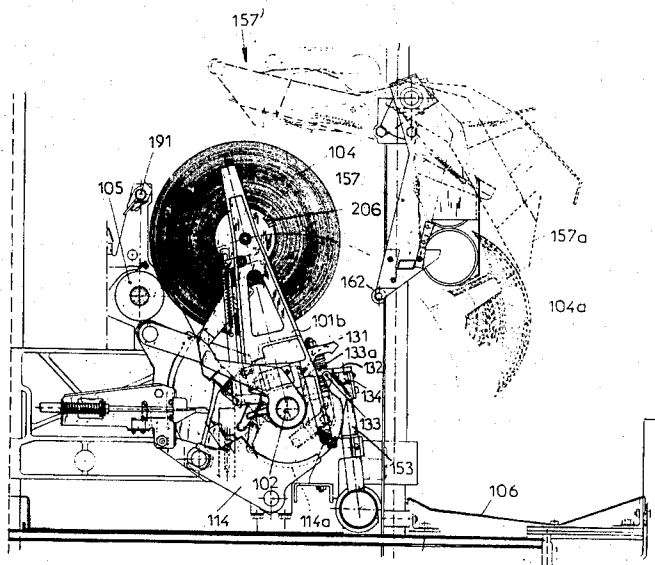
3,507,453 4/1970 Scragg et al. **242/18 R**
3,572,597 3/1971 Parker et al. **242/18 A**
3,682,403 8/1972 Willis **242/18 A**

Primary Examiner—Stanley N. Gilreath
Attorney—Daniel E. McConnell

[57] **ABSTRACT**

An improved method and apparatus for doffing wound packages of strand materials and donning empty cores for resumption of winding, in which the mounting of an empty core onto a core supporting arm is particularly facilitated by slowing movement of the arm as the arm returns to a winding position and an empty core is donned.

23 Claims, 26 Drawing Figures



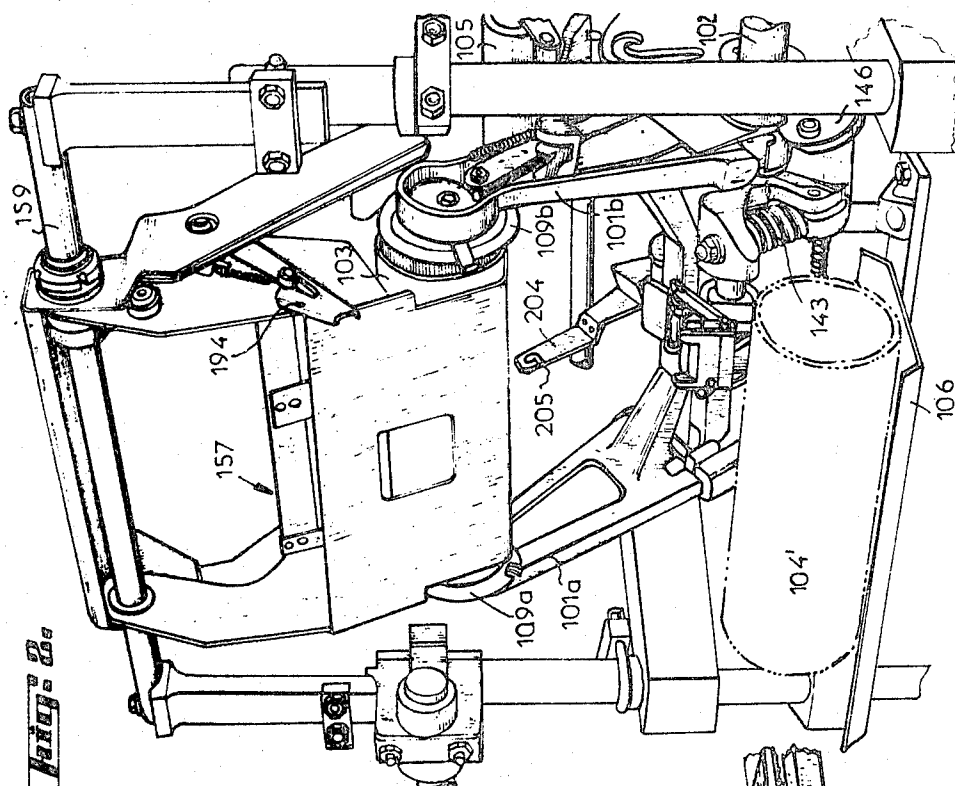


Fig. 2

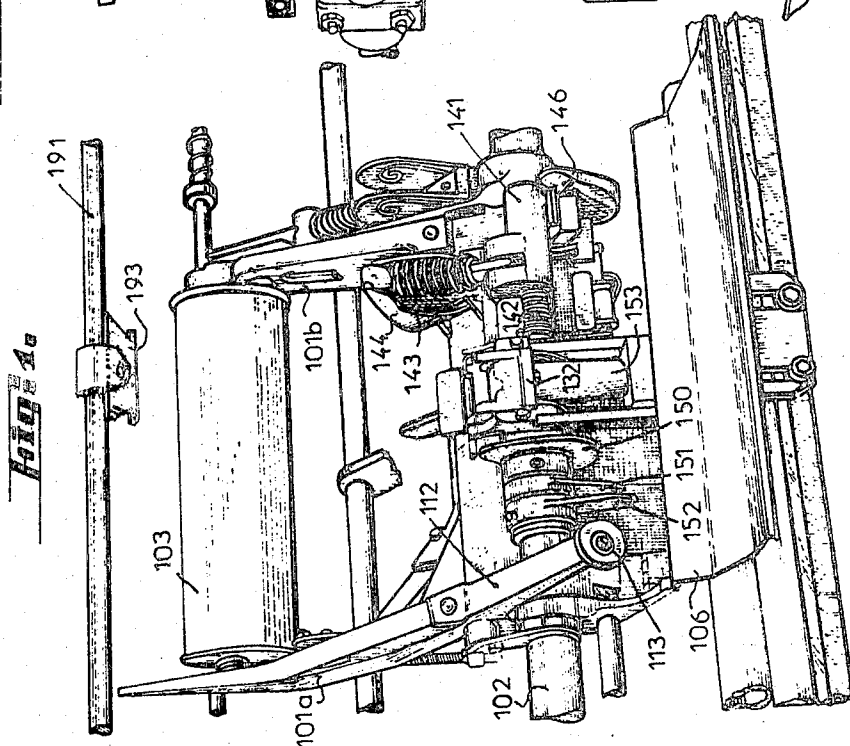


Fig. 4

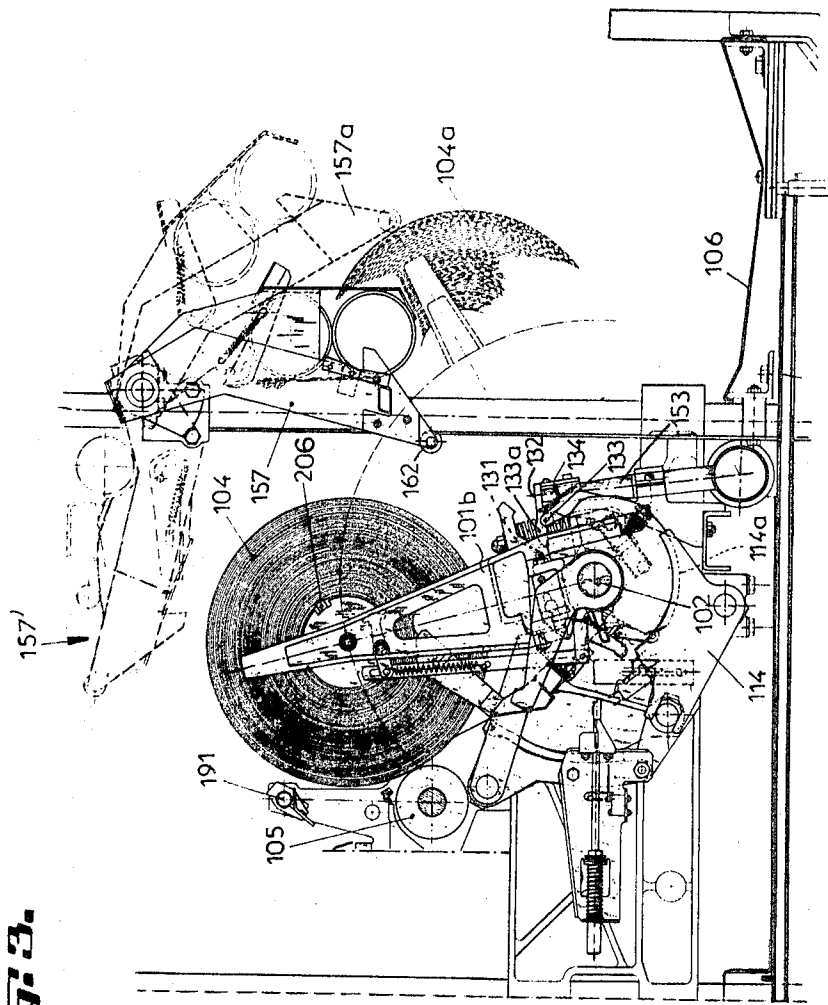


Fig. 3.

Fig. 4.

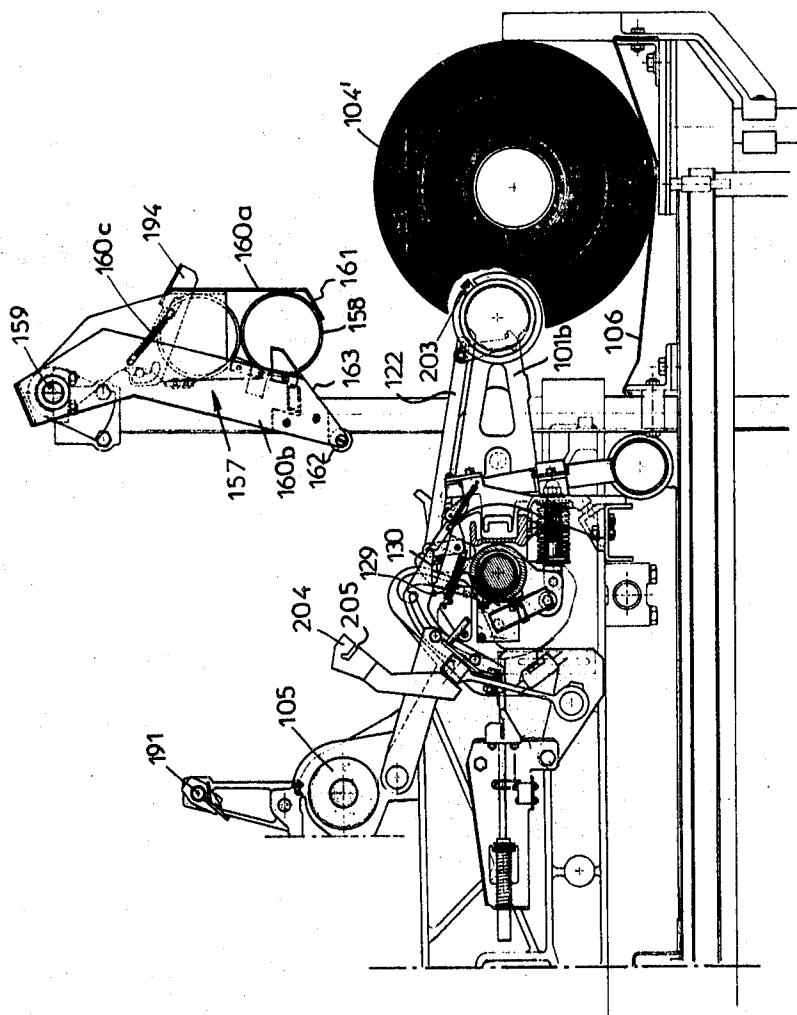


Fig. 5.

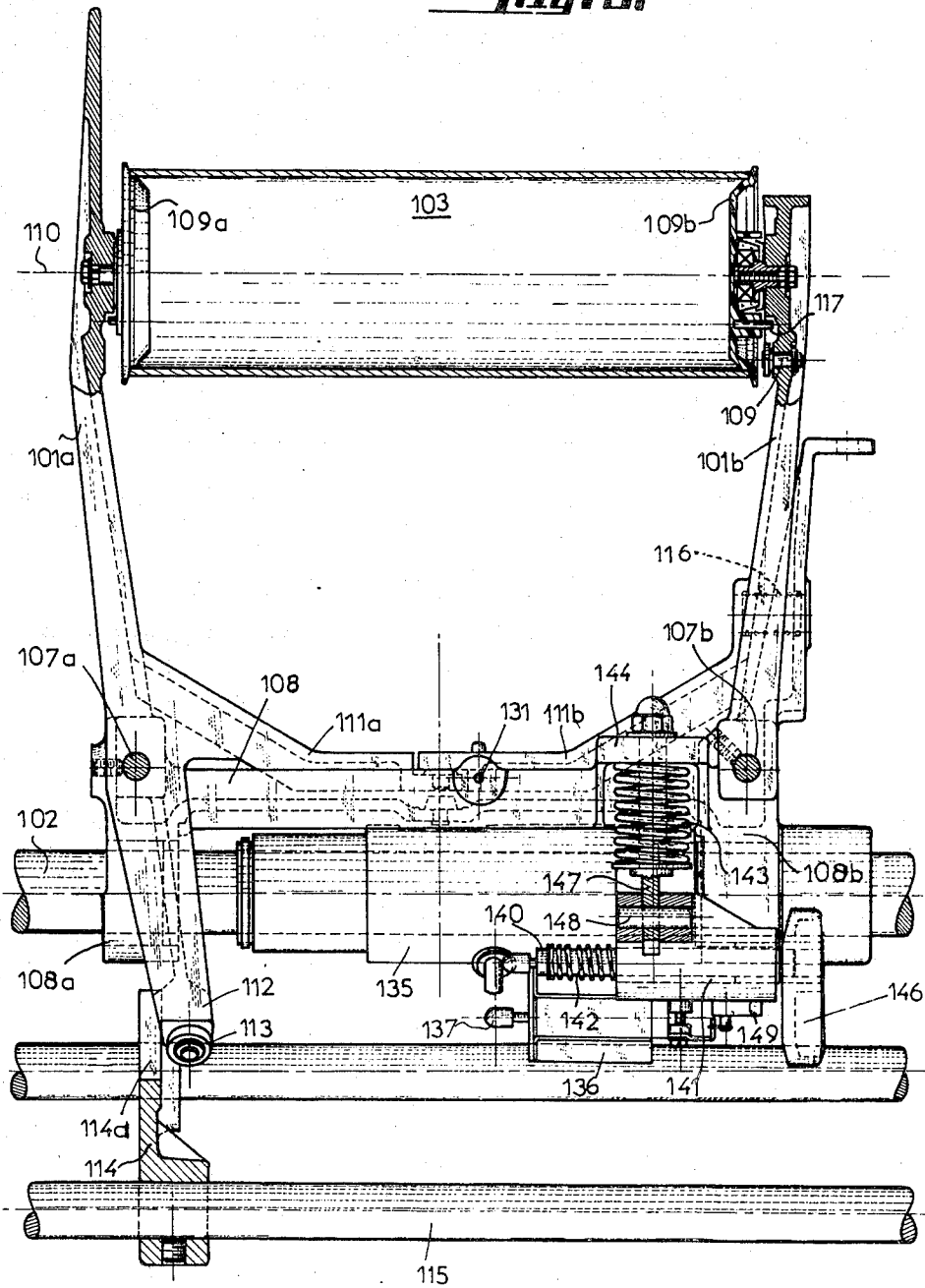


Fig. 6.

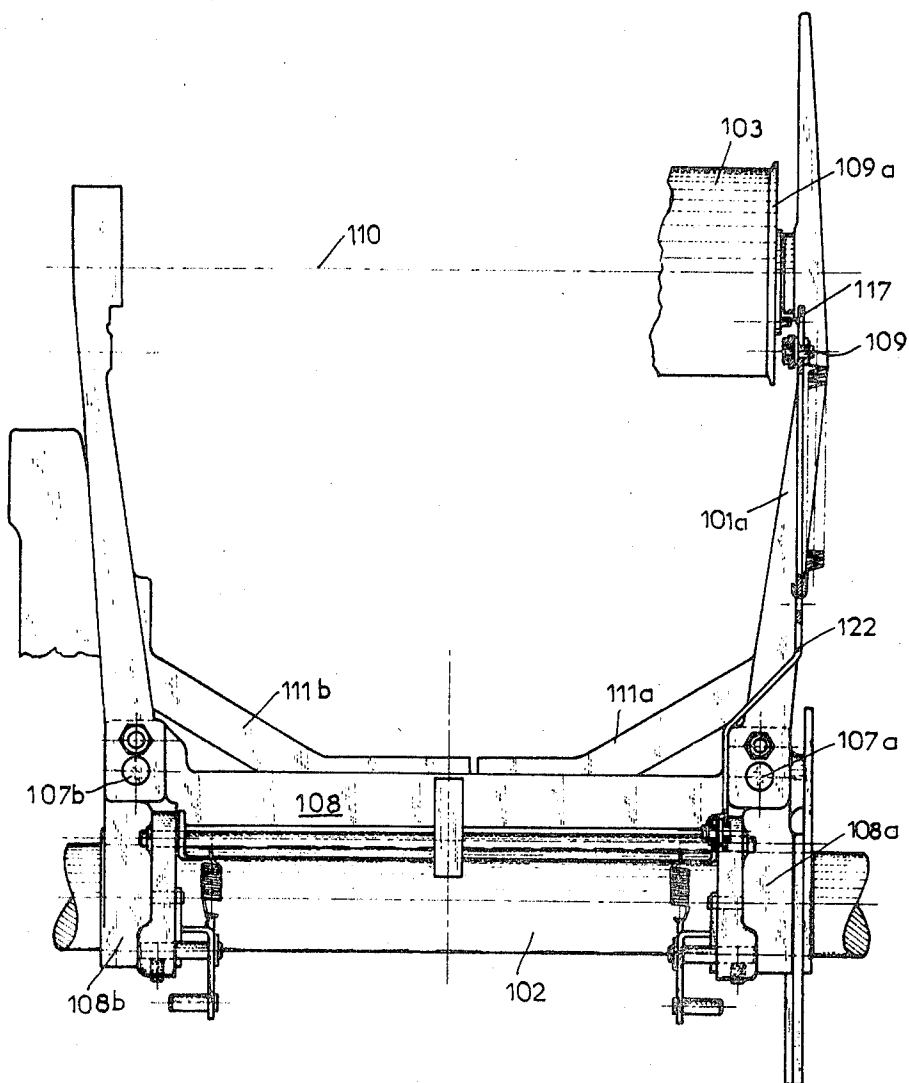
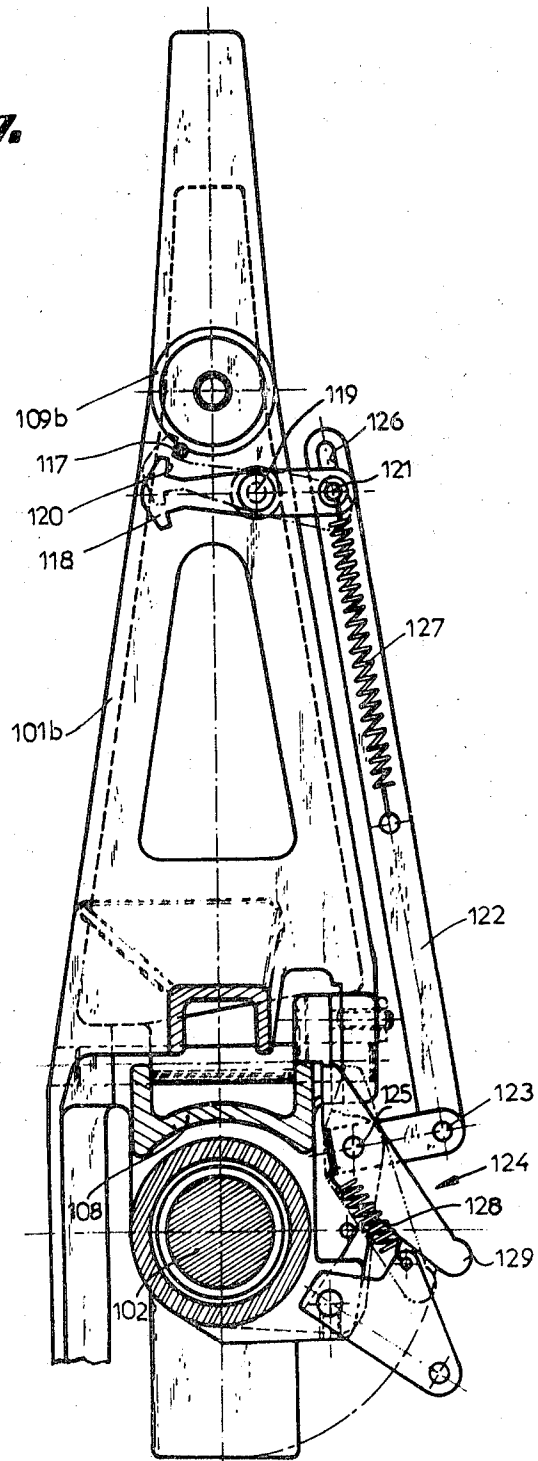


Fig. 7.



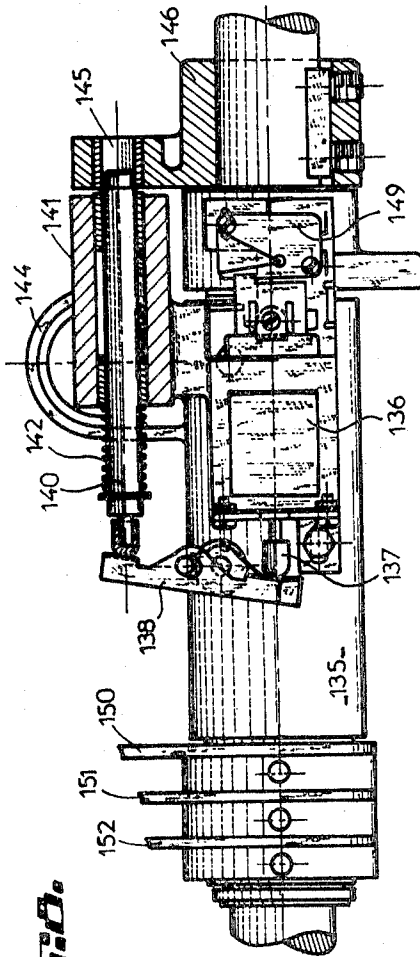


Fig. 8.

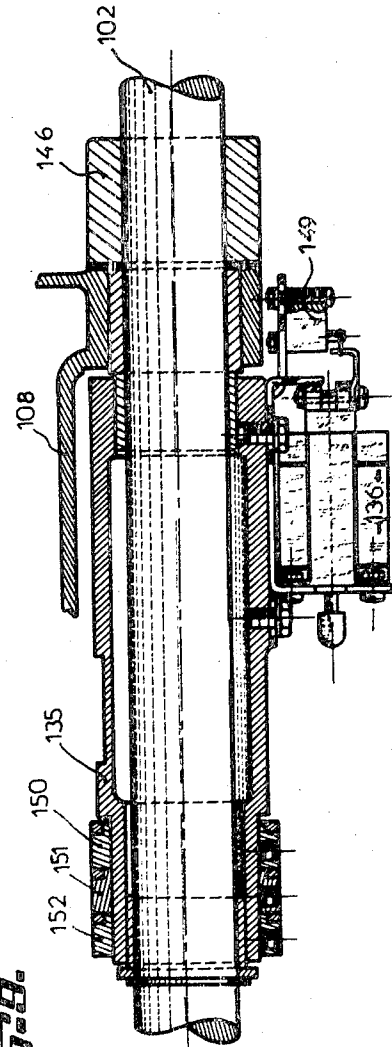
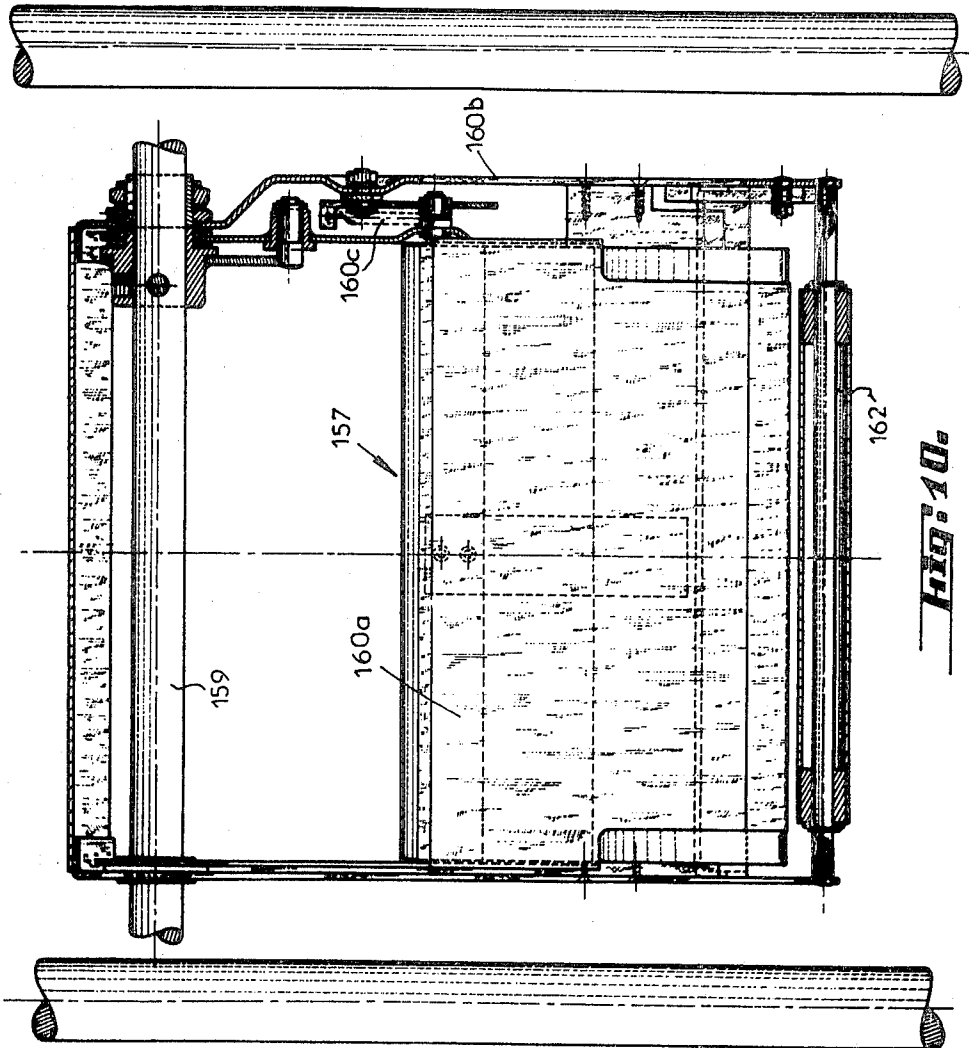


Fig. 9.



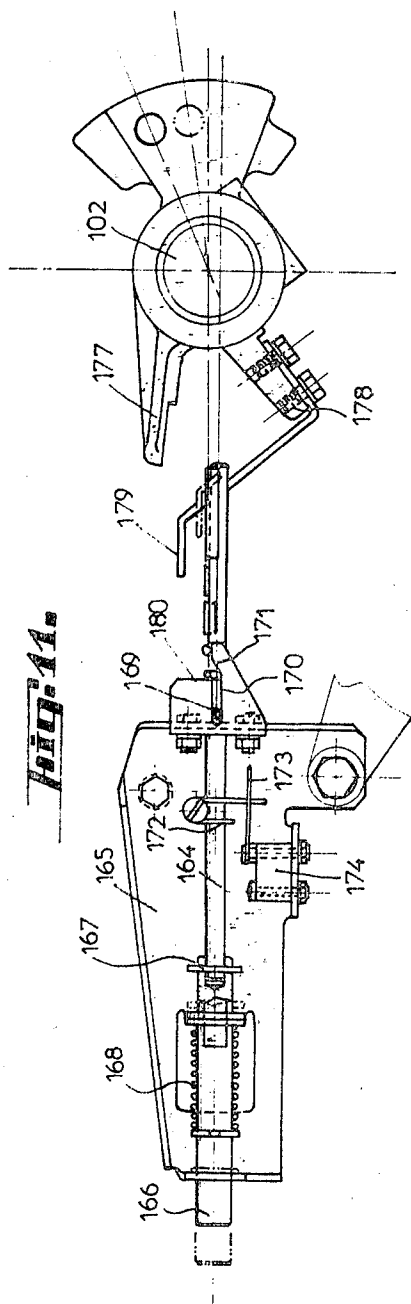
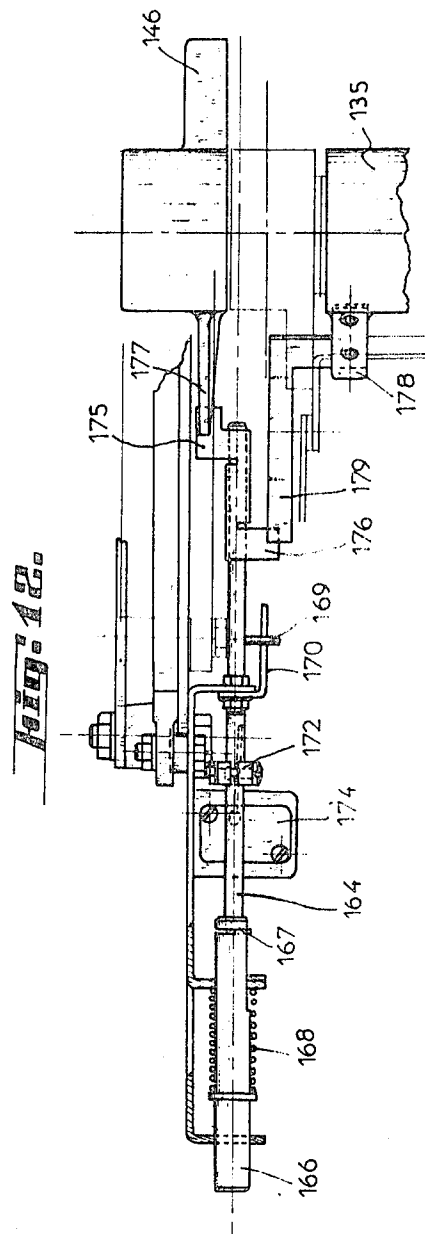


Fig. 13.

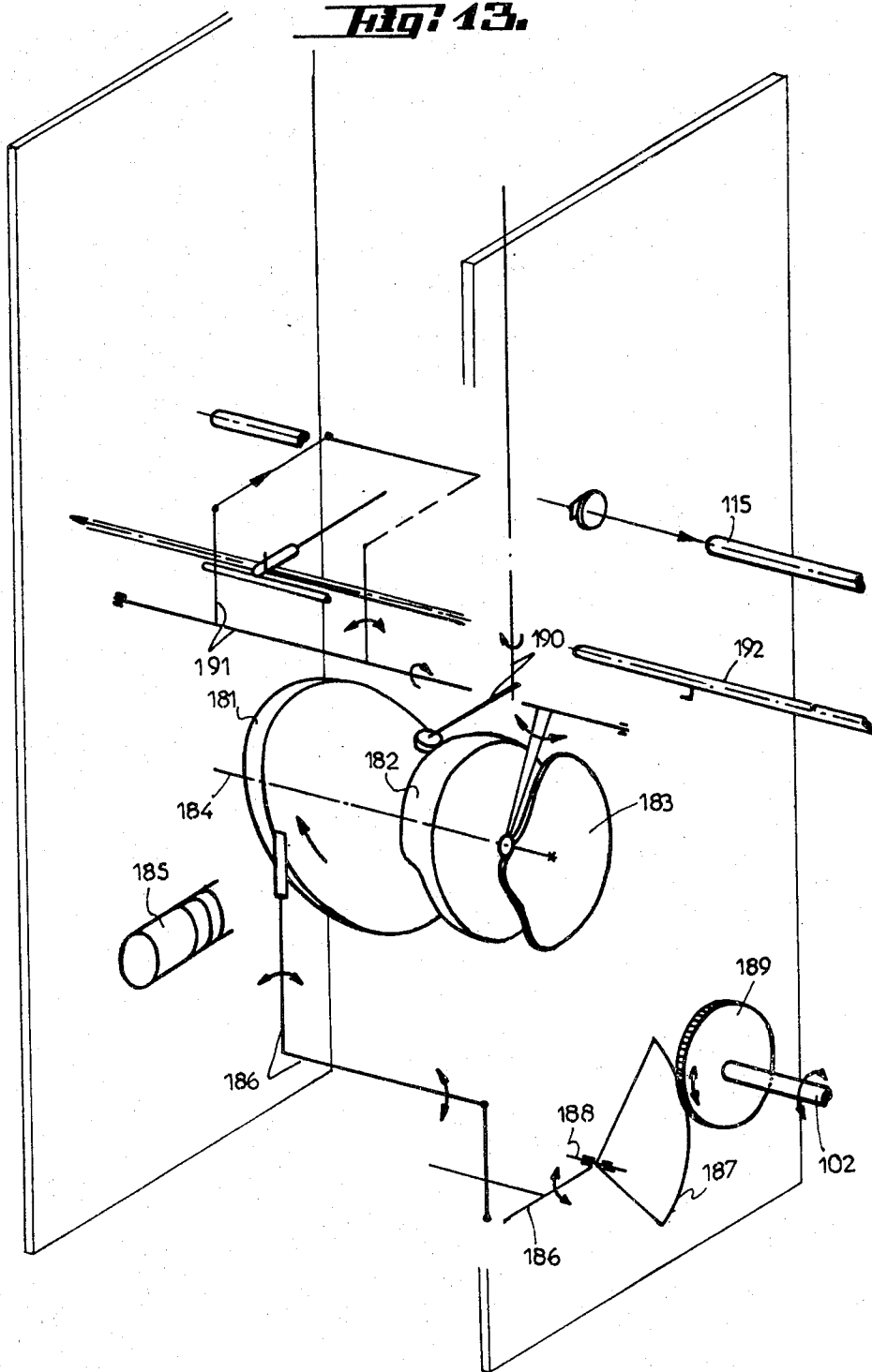


Fig. 14.

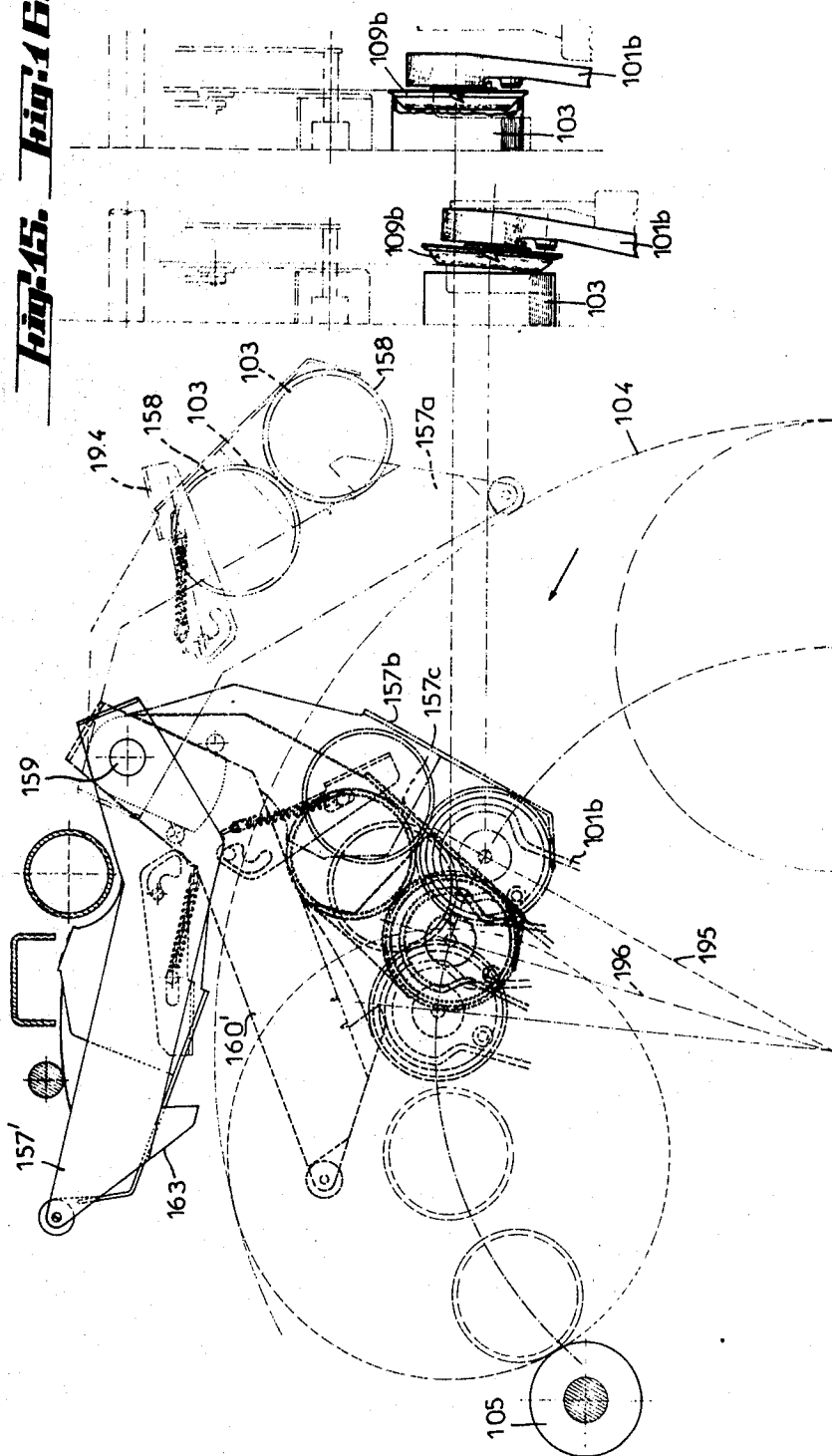


Fig. 15.

Fig. 16.

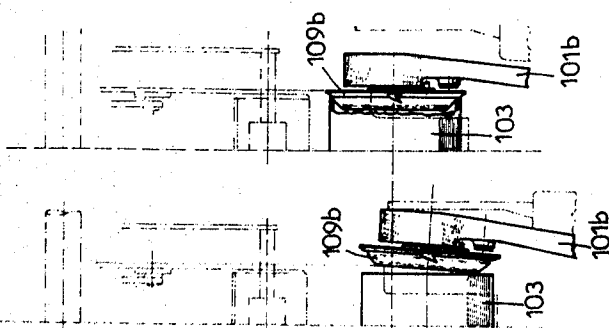


Fig. 17.

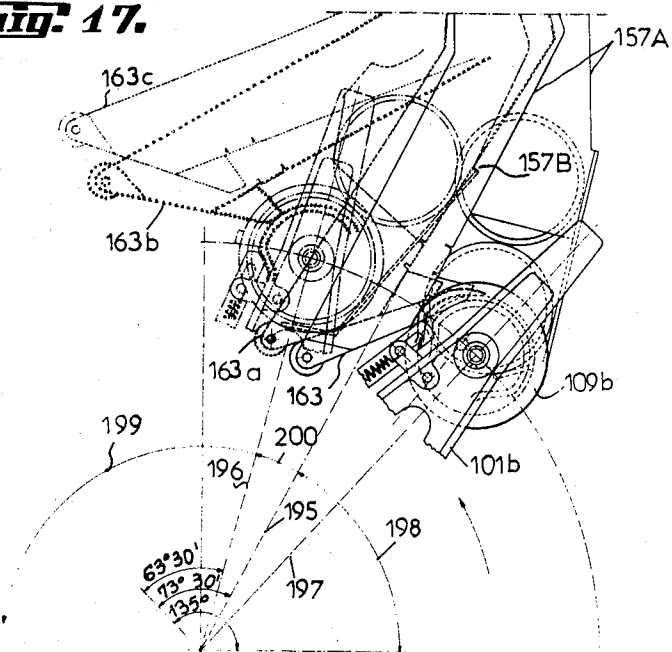


Fig. 18.

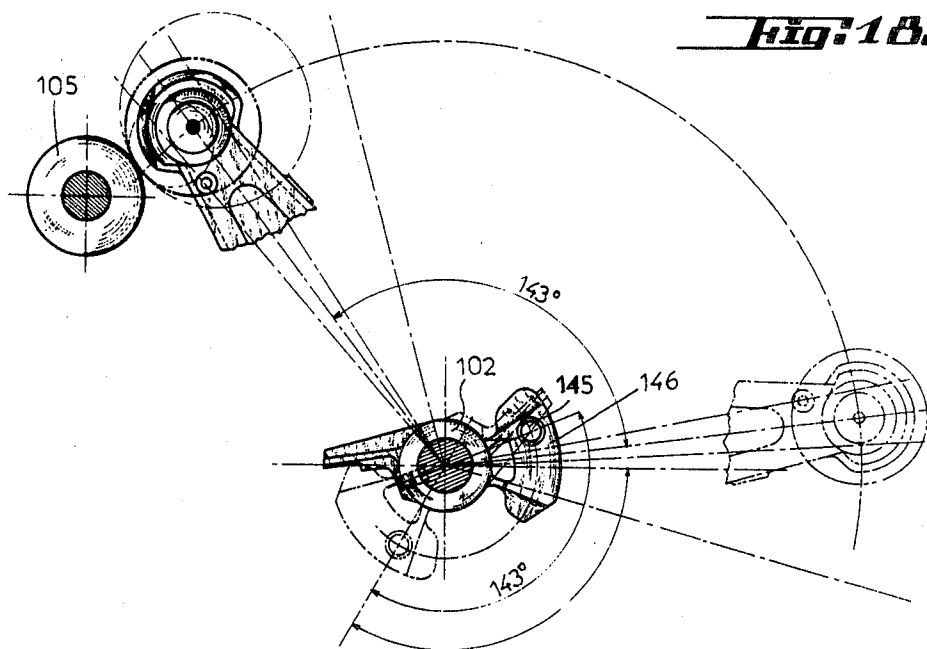


Fig. 19.

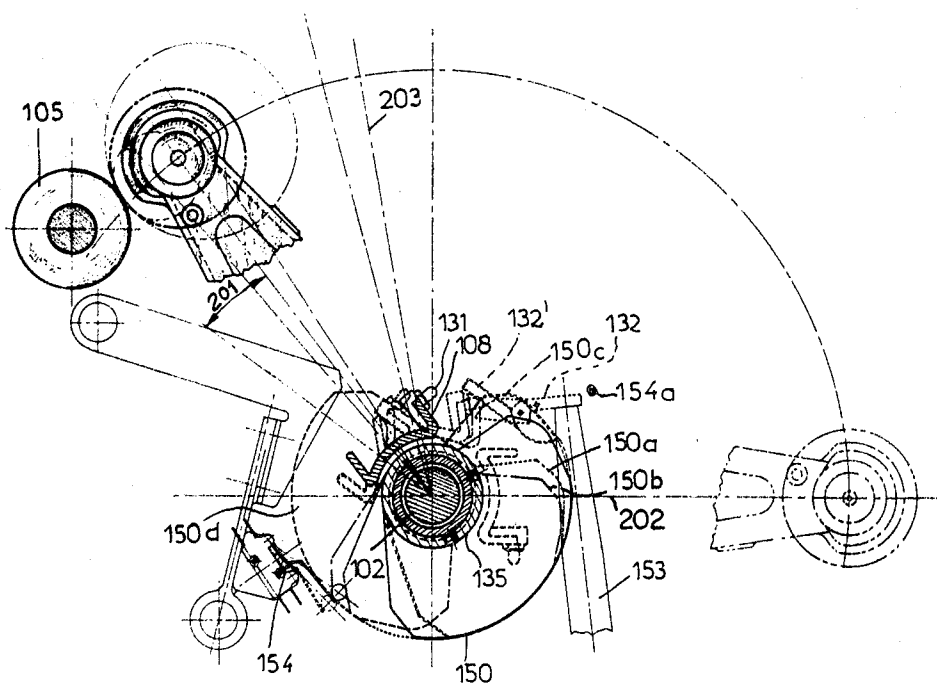
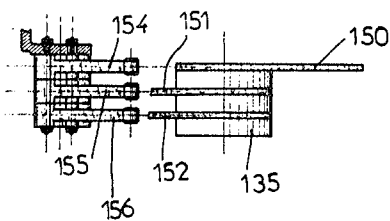


Fig. 20.

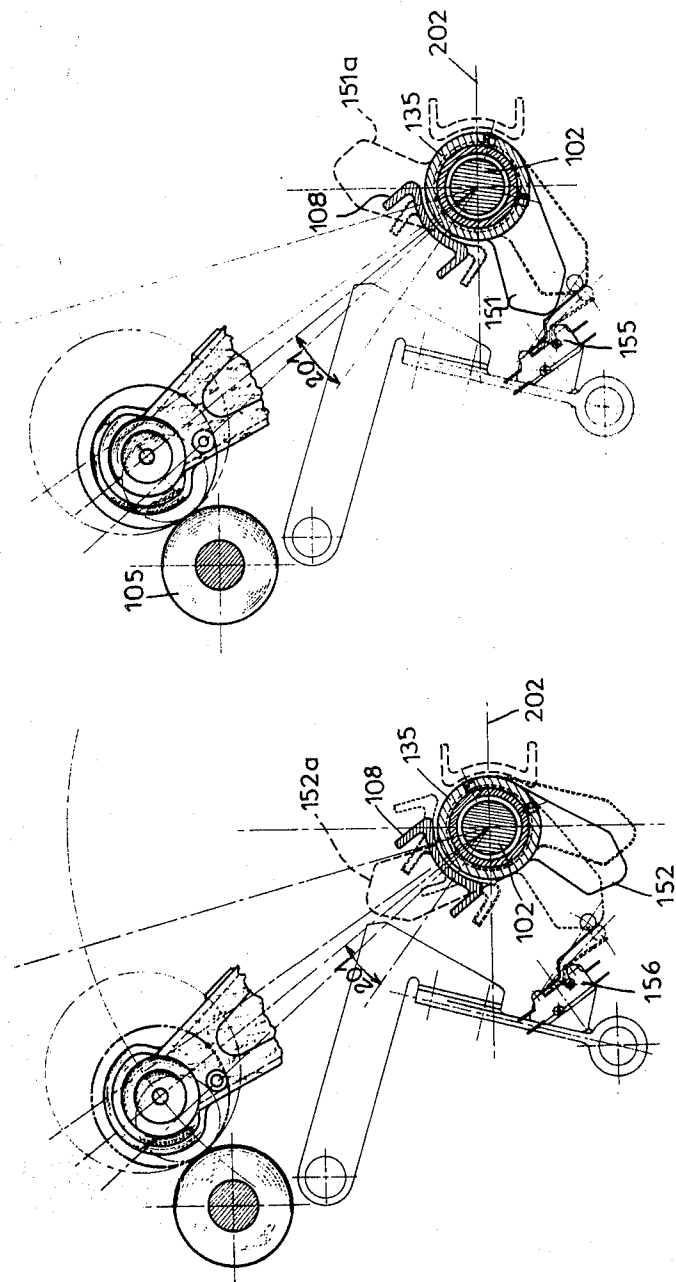


Fig. 24.

Fig. 22.

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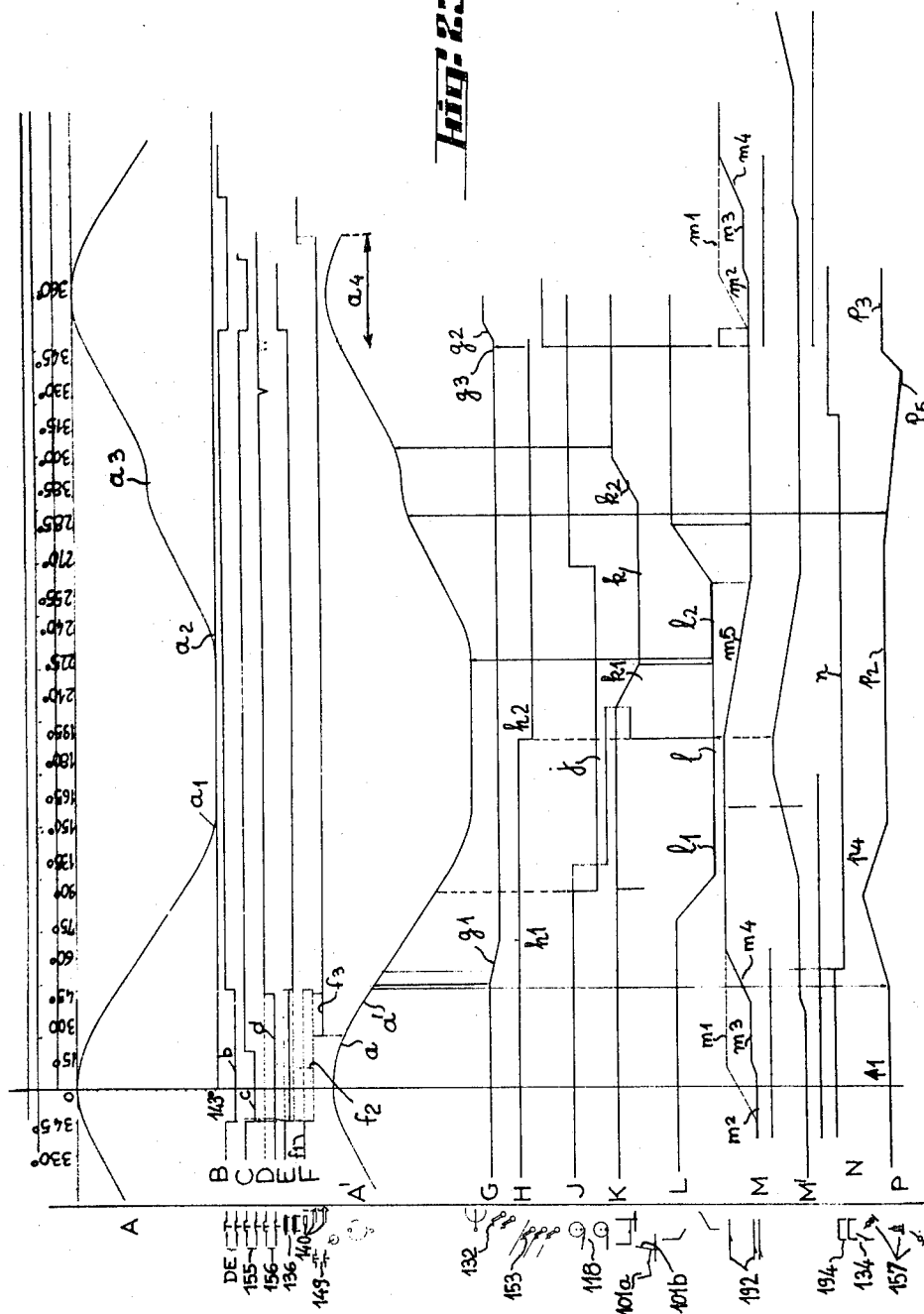


Fig. 2

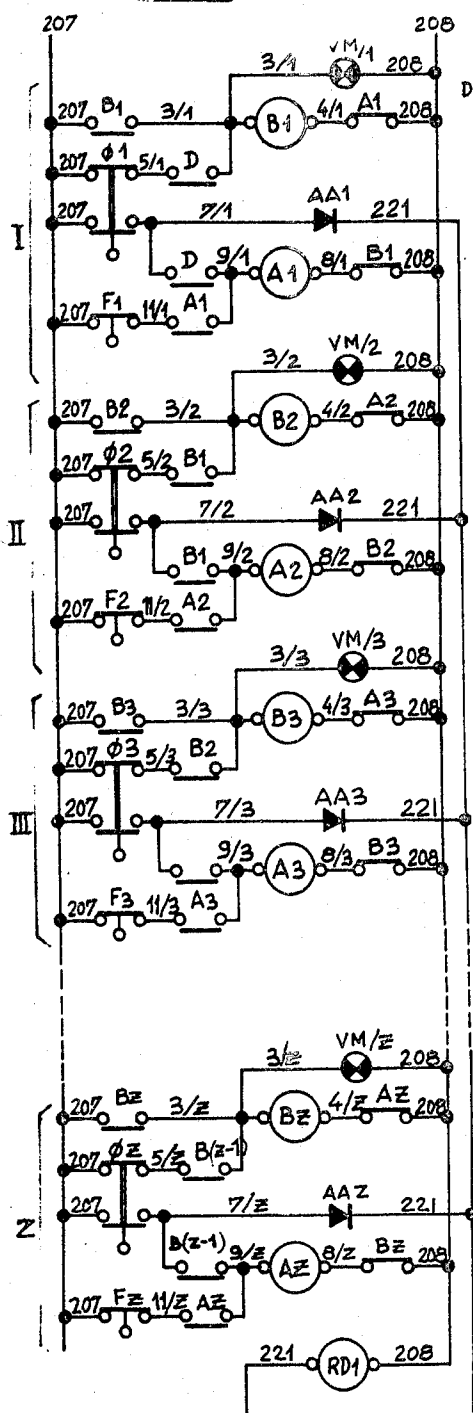
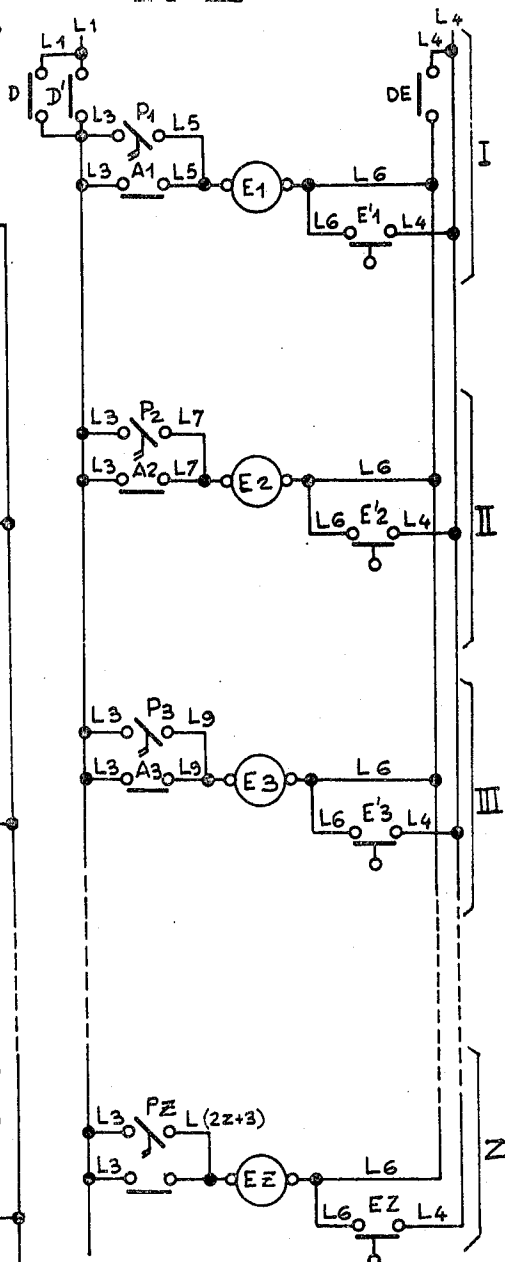
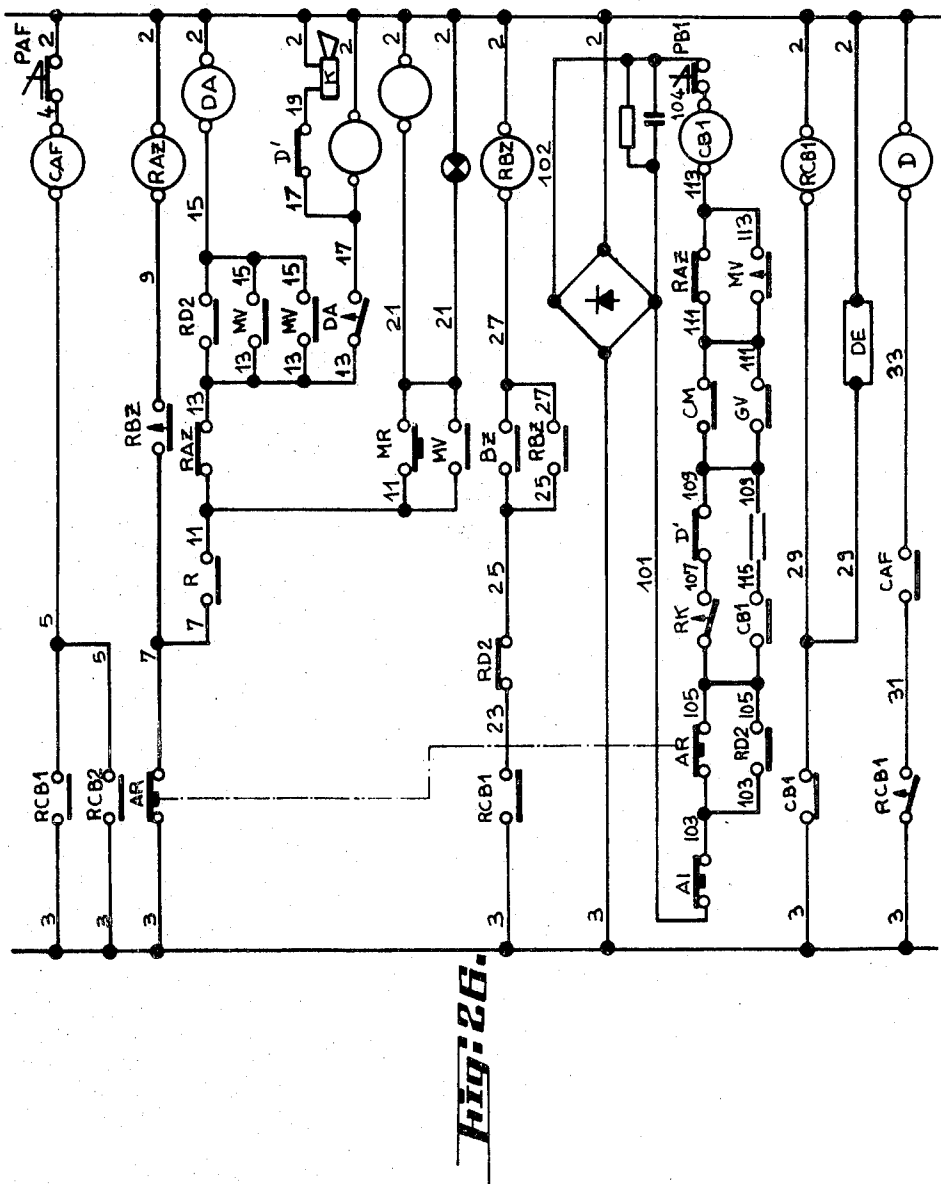


Fig: 29.





YARN PACKAGE DOFFING APPARATUS AND METHOD

It has heretofore been proposed that production of textile strand materials may be facilitated by an arrangement for doffing a wound package from a winding position of a textile strand handling apparatus and donning an empty package core onto the winding position in order to resume formation of a package. Particularly with reference to certain textile strand handling processes where the interruption of strand movement presents difficulty, such as the texturing of synthetic textile yarn, it has been proposed to take up a length of yarn processed by the strand handling apparatus during the interval of time required to doff a wound package and don an empty core.

While such proposals have successfully solved problems theretofore appearing in certain textile strand handling operations, most notably the texturing of synthetic textile yarn, it has been discovered during application of such proposals that enhanced reliability of operation can be obtained by certain improvements in such an apparatus and method. Accordingly, it is an object of the present invention to further facilitate the doffing and donning of wound packages and empty cores in an arrangement where delivery of a textile strand material continues throughout such doffing and donning. In realizing this object of the present invention, the capture of an empty core to be donned at a winding position is particularly facilitated by a slowing of the movement of a core supporting arm from a doffing position back to a winding position. Through such an intermediate slowing or pause in movement of the arm, enhanced reliability in the capturing of a core being donned is achieved.

Some of the objects and advantages of the invention having been stated, others will appear as the description proceeds, when taken in connection with the accompanying drawings, in which:

FIG. 1 is a fragmentary perspective view of a portion of an apparatus incorporating the present invention;

FIG. 2 is a view similar to FIG. 1, taken from a different point of view and showing a core supporting arm in position for donning of an empty core;

FIG. 3 is a side elevation, partially in section, of the apparatus of FIGS. 1 and 2, showing the winding position of a package being formed and an intermediate position during package doffing;

FIG. 4 is a view similar to FIG. 3, showing a wound package in the doffed position;

FIG. 5 is an enlarged front elevation, partially in section and broken away, of core supporting arms incorporated in the apparatus of FIGS. 1 and 2;

FIG. 6 is a view similar to FIG. 5, taken from the opposite side of the apparatus in FIGS. 1 and 2;

FIG. 7 is an elevation, broken away, of a portion of a package core holding arm of FIGS. 5 and 6;

FIG. 8 is a detail, partially in section, of an electromagnetically controlled selective coupling arrangement for a core supporting arm and of certain control cam elements;

FIG. 9 is a view from above, partially in section, of the arrangement shown in FIG. 8;

FIG. 10 is a rear elevation, partially broken away, of a portion of the apparatus of FIGS. 1 and 2, which stores empty cores to be donned;

FIG. 11 is a side elevation, partially in section, of a portion of the apparatus of FIGS. 1 and 2 which manually controls a priority call for doffing;

FIG. 12 is a view from above of the mechanism shown in FIG. 11;

FIG. 13 is a diagrammatic perspective view of a drive arrangement included in an apparatus in accordance with the present invention;

FIG. 14 is a schematic diagram showing on a side view the displacements of a core supporting arm and associated elements during movement between winding and doffing positions;

FIGS. 15 and 16 are front elevations corresponding to certain points of arm movement in the diagram of FIG. 14;

FIG. 17 is a schematic diagram showing the positions of a core supporting arm during movement from the doffing position to a position at which an empty core is captured;

FIG. 18 is a schematic diagram showing the relative angular positions of the coupling arrangement of FIG. 8 during package winding, during resumption of winding following donning of the core and during doffing;

FIG. 19 is a view similar to the view of FIG. 18 illustrating certain control operations;

FIG. 20 is a fragmentary view from above showing the three cams of FIGS. 8 and 19 together with associated electrical switches;

FIG. 21 is a schematic diagram showing the detection of the return of a core supporting arm to the winding position;

FIG. 22 is a view similar to FIG. 21 showing an arrangement for sensing when a wound package has become of such size as to require doffing;

FIG. 23 is a chart graphically illustrating the operations of various elements of the apparatus of FIGS. 1 and 2; and

FIGS. 24, 25 and 26 are electrical circuit diagrams illustrating portions of a control system for the apparatus of FIGS. 1 and 2 as incorporated into a multiple station synthetic yarn texturing machine.

The detailed disclosure which follows hereinafter shall proceed with particular reference to the embodiment illustrated in the drawings. At the outset, however, it is to be understood that this detailed disclosure and the illustration set forth in the drawings are of a preferred embodiment only and are not to be construed as limiting upon the broad utility contemplated for this invention.

In the embodiment of the drawings, an apparatus for processing a plurality of textile yarns, such as a synthetic yarn texturing machine, is provided with means at each working station of the apparatus for automatically changing or removing fully wound packages. This means comprises a core holding fork formed by a pair of substantially parallel arms 101a, 101b which extend radially from an oscillating rotary shaft 102. The pair of arms or fork are adapted to swing about a longitudinal axis of the shaft 102 while carrying between the free outer ends thereof a package core 103, thereby moving the package core from a winding position (FIG. 3), wherein a package 104 being wound is held in rolling engagement with a package drive roll 105, to a doffing position (FIG. 4). In the doffing position, the arms 101a, 101b are withdrawn from the package drive roll 105 and are spread apart to release the wound package 104' to a receiving chute 106.

Each of the parallel arms 101a, 101b is a portion of a corresponding one of a pair of levers pivotally mounted on two pins 107a, 107b which extend at right angles to the shaft 102. The pins 107a, 107b are carried by a yoke 108 which is mounted for free rotation on the shaft 102 through a pair of spaced bearings 108a, 108b. The outboard free ends of the arms 101a, 101b each carry corresponding ones of two centering elements 109a, 109b respectively mounted for free rotation about a substantially horizontal axis 110 parallel to the shaft 102. Each of the centering elements 109a, 109b is a generally circular or disc-like member comprising a substantially tapered or conical portion projecting towards the opposite centering element and adapted to fit into the corresponding end of a core 103 for rotatably supporting the core. The empty core desirably is a tube made of paperboard or the like which is held tightly by being clamped between the arms 101a, 101b of the core holding fork in such a manner that the centering elements 109a, 109b enter the respective opposite ends of the core 103. Through frictional contact of the centering elements 109a, 109b with the core 103, the rotary motion of the core is transmitted to the centering elements.

The levers which include the arms 101a, 101b also have corresponding second legs or limbs 111a, 111b extending generally parallel with the shaft 102 and toward one another. One of the legs 111a is overlapped at its free end by the corresponding end of the other leg 111b and is in engagement therewith, so that movement of the one leg 111a will be transmitted to the other leg 111b. One lever also has an actuating projection 112 which has a cam following roller 113 at a free end thereof. By engagement of the cam following roller 113 with a cam member 114, the levers are moved in rotation about their respective pivot axes 107a, 107b to spread apart or open the arms 101a, 101b and thereby free or release a package clamped therebetween. The cam member 114 is carried by a shaft 115 extending in parallel relation to the oscillating shaft 102 and moving in axially reciprocating translation. The cam member 114 comprises an arcuate guide track 114a extending in substantially concentric relation to the oscillating shaft 102 (FIG. 3), the function of which will be explained hereinafter.

A return spring 116 acting on the leg 101b of one of said levers brings the core holding arms 101a, 101b back into their closed position of clamping a core 103 when the lever 112 is released.

Preferably, one of the core holding arms 101b has an arrangement for braking the package core 103, in the form of locking device for a corresponding centering element 109b (FIG. 7). This braking system comprises a pin 117 carried by the centering element 109b and extending horizontally or in parallel relation to the axis of rotation 110 to project towards the arm 101b and a cooperating hook- or latch-like lever 118 mounted at a pivot 119 on the arm 101b. A nose 120 of the lever 118 catches the pin 117 during rotation of the centering element 109b to lock it against motion. For this purpose, the end of the lever 118 opposite the nose 120 is connected by a pivot pin 121 to an upper end of an actuating link 122 and thereby connected at 123 to a bell crank or bent lever 124 mounted at a pivot 125 on the fork holding yoke 108. To avoid abnormal stresses, the pivotal connection 121 is preferably slidably mounted within an elongated longitudinal slot or groove 126 of

the top end of the link 122 and is subjected to the action of a return spring 127 one end of which is fastened to the link 122 and the other to the movable pivotal connection 121, so as to urge the lever 118 to turn in the direction of rotation for braking. A return spring 128 acts upon the bent lever 124 in the brake releasing direction to urge the nose 120 to move away from the pin 117 and free or disengage the centering element 109b. The bent lever 124 comprises a free arm 129 adapted to engage a stationary guide ramp or operating cam 130 (FIG. 4) upon pivoting of the package core holding arms 101a, 101b and to actuate said locking system to cause the associated centering element 109b to stop and accordingly brake rotation of the package core supported between said core holding arms.

The fork holding yoke 108 comprises a radially projecting lug 131, located substantially in a central plane of the fork at right angles to the oscillating shaft 102, which is adapted upon swinging motion of the fork to open a closure cap or cover 132 closing the top end of a tube 153 (FIG. 3) which forms a pneumatic yarn sucking nozzle. The flap cover 132 is mounted on a pivot 133 with one arm 133a located in the downward directed path of travel of the lug 131 and is biased by a return spring 134 so arranged with respect to the pivot 133 that opening and closing of the cover are effected in a snap-like fashion.

A selective clutch coupling (FIG. 5) connects the core-holding fork 101a, 101b temporarily with the oscillating shaft 102 for unitary rotation therewith. This clutch essentially comprises a tubular sleeve 135 mounted for free rotation on the oscillating shaft 102 and supporting an electro-magnet 136 having a rod armature 136 reciprocating in translatable motion parallel to the oscillating shaft 102 (FIGS. 8 and 9). The outer free end of this rod 136 co-operates with one end of a rocking or tilting lever 138 (FIG. 8), pivotally mounted at 139 on the sleeve 135 and also co-operating with an adjacent end of a locking pin 140 which is slidably mounted in a guide bushing 141 and extends parallel to the oscillating shaft 102. A return spring 142 biases the pin 140 toward the unlocking direction (from right to left on FIGS. 5 and 8). The sleeve 135 or bushing 141 is resiliently connected to the fork-holding yoke 108 by a coil spring 143 extending between a spring seating cup 144 and the sleeve 135. The locking pin 140 may enter a corresponding hole 145 of a coupling element 146 integral with the oscillating shaft 102 when the bore of the bushing 141 and the hole 145 register in aligned relationship with each other.

The spring 143 is slidably mounted coaxially on a guide rod 147 which terminates at a bottom portion in a lug pivotally mounted at 148 on the sleeve 135.

An electrical switch 149 for self-energizing or holding the electro-magnet or solenoid 136 is associated with and actuated by the solenoid.

Three cams 150, 151 and 152 are mounted on the sleeve 135 for operating three corresponding electrical switch contacts (FIGS. 1, 8, 9 and 20). A first cam 150 mechanically operates the closing of the cover 132 of the suction nozzle 153 and actuates an electric switch 154 for energizing a heated electrical yarn cutter adjacent the suction nozzle 153. A second cam 151 actuates an electric switch 155 signaling the end of a doffing and donning operation and a third cam 152 actuates an electric switch 156 for detecting the maximum wound package size or diameter (FIG. 20).

Empty package cores 158 are supplied from a means 157 mounted for free swinging motion at its top portion on an upper horizontal shaft 159 (FIG. 10). This supply means, also shown in FIGS. 3 and 4, comprises a storage space for empty package cores 158 defined by a rear panel 160a and a front panel 160b pivotally connected to each other about the shaft 159 and biased toward each other by a return spring 160c. The rear panel 160a is provided at its lower portion with a flange 161 forming a stop or abutment for empty package cores which move downwards within the storage space under the action of their own weight. The front panel 160b has a rotary guide roll 162 for engagement with a fully wound package of yarn and a guide ramp 163 for frictionally engaging one of the core-holding arms 101b upon its pivoting motion for receiving and taking over an empty package core. The supply means 157 may be raised to and locked in an inoperative position shown in dash-dotted lines at 157' on FIG. 3 to clear the angular sweep or path of travel of the core-holding arms when desired for servicing purposes.

Priority doffing operation of a core-holding fork, independently of the sequential doffing system, is accomplished by a device shown in FIGS. 11 and 12. This device comprises a rod 164 slidingly mounted for axial or longitudinal movement within a support 165 and connected at one end 167 with a manual set push-button 166. A return spring 168 acts upon the push-button 166 to urge it towards its outward extended or inoperative position. The rod 164 is formed with a radial spline 169 slidingly engaging a stationary guide groove or slot 170 extending in substantially parallel relation to the rod 164 and extended by an oblique ramp 171 which, when the spline 169 engages this ramp, causes the rod 164 to rotate about its longitudinal axis. A staple 172 or the like on the rod 164 straddles a pivoting operating lever 173 of an electric switch 174 directly controlling the energizing of the clutch electro-magnet 136. The rod 164 also carries a pair of wings 175, 176 which project radially from either side of the rod 164 to lie in the path of travel of a pair of fingers 177 and 178 when the set push-button 166 has been depressed, that is when the rod 164 has been moved towards the right on the drawing. One finger 177 moves with the oscillating shaft 102, as by being integral with the clutch segment 146, whereas the other finger 178 moves with the sleeve 135, which is mounted for free rotation on the oscillating shaft 102. The other finger 178 carries a tongue 179 adapted to bear upon the corresponding wing 176.

In the inoperative condition of the device, the rod 164 with its push-button 166 are moved back by the return spring 168 to the left-hand position shown in dotted lines on FIG. 11, wherein the wings 175, 176 are outside the rotary paths of travel of the finger 177 and tongue 179. When it is desired to cause priority energizing of the electro-magnet 136 operating the coupling between the particular core-holding fork 101a, 101b and the oscillating shaft 102, the operator depresses the push-button 166 corresponding to that fork thereby moving the rod 164 towards the right on FIG. 11 until the spline 169 integral with the rod moves out of the straight guide slot 170 and is rotated by the stationary ramp 171 to come in front of a stationary edge 180 forming a stop abutment for the rod 164 which prevents the rod from slidingly returning to its initial position. In this set position, the wings 175 and 176 inter-

sect the paths of travel of the finger 177 and tongue 179. Upon oscillating motion of the shaft 102, the one finger 177 moves to bear onto the cooperating wing 175 thereby rotating the rod 164 about its longitudinal axis, so that the staple 172 displaces the operating lever 173 of the electric switch 174 energizing the electro-magnet and initiating the doffing motion at the desired working location. Upon return movement of the core-holding fork, the tongue 179 engages the cooperating wing 176 thereby rotating the rod 164 in the direction of rotation which is reverse of the preceding one, bringing the spline 169 back in alignment with its guide slot 170 so that the return spring 168 returns the rod 164 and push-button 166 assembly to the initial inoperative position wherein the electric switch 174 is open. This operation of the priority control for doffing takes place, for example, when the normal operation at a working station of the apparatus has been stopped accidentally such as when a yarn has broken; the operator then pieces up or mends the yarn and depresses the reset push-button 166 to cause a doffing operation at the working station involved.

A general drive system or doffing box for the apparatus of this invention essentially comprises three cams 181, 182 and 183 mounted on a common rotary shaft 184 and driven by an electric motor 185. A first cam 181 drives the oscillating shaft 102 in predetermined rotary reciprocating motion through a transmission linkage system 186 oscillating a toothed sector or segment 187 which is pivotally mounted on a horizontal shaft 188 and meshes with a gear 189 fixed on the shaft 102. A second cam 182 actuates the shaft 115 for spreading apart the core-holding forks or arms by reciprocating axial translatory motion transmitted through a suitable transmission linkage 190. Finally, a third cam 183 controls through a suitable transmission linkage 191 the reciprocating translatory motion of a shaft 192 controlling the formation of yarn tail portions on the packages, which will be referred to hereinafter. Each of the cams may of course control the motion of several superposed parallel shafts through the medium of a suitable mechanical transmission arrangement instead of actuating a single one as shown on FIG. 13.

Starting from the initial winding position, an empty package core supported for rotation between the arms of a core-holding fork 101a, 101b frictionally contacts a package drive roll 105 and processed yarn delivered from the processing machine winds onto the package core 103 while being guided by the transversing or reciprocating motion in parallel relation to the axis of rotation of a traversing thread guide or the like. Under such circumstances, the core-holding fork is disconnected from the oscillating shaft 102, so that it may freely swing about the latter and more gradually away from the package drive roll 105 as the winding diameter of the package 104 increases during winding (FIG. 3). When the package 104 reaches a predetermined diameter, an electric feeler or detecting switch triggers or initiates the operation of the doffing motion by energizing the electro-magnet 136 to couple the core-holding fork and the oscillating shaft 102 by moving the pin 140 first into abutment against the sector 146, which slides past the tip thereof until the hole 145 aligns with the pin 140, and then into this hole to achieve the coupling. The core-holding fork is then rotatably driven (clockwise in FIG. 3), the fully wound yarn package 104 engages the rotary roller 162 of the empty package core

supply means 157 which rolls on the surface of the package 104, and the supply means is pushed backwards (or to the right in FIG. 3) as shown in dotted lines in the position 104a of the package.

During this backward pivotal motion, the lug 131 has engaged the arm 133a of the closure cover 132 of the suction nozzle 153 to open this cover, so that when the core-holding fork has been rocked backwards, the processed yarn delivered from the processing instrumentalities is continuously drawn into the nozzle as a folded loop constantly increasing in length so as not to stop the motion of the incoming yarn. This yarn at the time of being drawn in is above the suction nozzle and substantially in the vertical central plane of the fork, since the yarn has left the traversing thread guide and assumed this position. It should be noted that the suction nozzle is located beyond the oscillating shaft with respect to the package drive roll. The thread portion coming out of the suction nozzle 153 and connected to the yarn package 104 then engages a yarn cutter 154a (FIG. 19) consisting of a heated electric conductor. At the end of the backwards rocking motion of the core-holding fork, the lever 129 of the package braking system engages its stationary control cam 130 thereby causing the free inertial rotation of the package 104 about its axis to be stopped before it reaches the chute 106. Owing to this, the yarn portion passing over the electric thread cutter is held immovable in contact therewith and the electric thread cutter is then energized electrically to melt and sever the yarn.

At that time, the shaft 115 is moved in translation and operates the opening or spreading apart of the fork 101a, 101b to release the fully wound package 104' in the position shown on FIG. 4 whereby it is smoothly laid down onto the receiving chute 106. The chute slopes downward and outward so as to cause the fully wound package to roll immediately outwards, be entirely freed from between the arms, and clear the arms of the core-holding fork. At that time, the oscillating shaft 102 initiates its rotary return motion toward the initial winding position.

During the first part of this return motion, the roller 113 for operating the spreading apart of the fork remains in engagement with the guide track 114a of the abutment 114 so as to keep the fork in the spread apart or open position. The relative successive angular positions of the core-holding fork and of the empty package core supply means during the return motion of the fork are shown in FIGS. 14 through 17. The position of the supply means during the passage of the fully wound package 104 is shown at 157a in FIG. 14. As illustrated, the supply means contains two empty package cores 103 clamped between a rear resilient blade 160a and a front element 160b which terminates in a fork sensing or feeling portion 163. When the fork moves backwards, one of the arms 101b of the fork engages the sensing member 163 of the core supply means and rotates the latter about its shaft 159. In the package core gripping inception position 157b (FIG. 15), the package core 103, still supported by the core supply means, is seen to be disposed substantially in coaxial relation to the centering elements 109a, 109b of the fork which is still in the spread apart position. In the package core gripping end position 157c (FIG. 16), the fork is seen to have been closed to clamp therein the empty package core 103 by its centering elements 109a, 109b entering the open ends of the core 103. The package

core 103, rigidly held by the fork, is withdrawn from the core supply means 157 as the arm 101b of the fork pushes the sensing member 163 further into a position 160' wherein the sensing member 163 is in the uppermost raised position to allow the free passage of the fork therebeneath. The relative angular positions of the core-holding fork (arm 101b) at the beginning 195 of the empty package core being gripped and at the end 196 of said gripping step are also illustrated.

In the stand-by position 157A the empty package cores 103 are positioned lengthwise within the core supply means by the sensing members 160b (FIG. 17). The position of the core supply means at the end of the core gripping step is shown at 157B. A radius vector 197 shows the position of the arm 101b when engaging the slant guide edge 163 of the sensing member 160b. In the angular position corresponding to the radius vector 197, the fork is open or spread apart whereas it is closed in the angular position of the radius vector 196 indicating the end of the core-gripping step. The sensing member in one angular position 163a causes disengagement of the hook of the centering element 109b and assumes another angular position 163b upon the empty package core being gripped by the fork. At 163c the sensing member is in the uppermost raised position for allowing the passage of the fork. Thus the fork is opened during its rotary motion over the distance shown by the arc 198 and is closed during its rotary motion shown by the arc 199. The fork is opened or closed during its pivotal displacement along the intermediate arc 200.

It should be pointed out that the pivotal mounting of the core supply means comprises friction linings for self-braking or self-damping of the swinging motion of the core supply means. A self-acting retaining catch means may keep the core supply means in the raised inoperative position.

A significant feature of this invention is that the reciprocating rotation of the oscillating shaft 102 is interrupted and the shaft stops during the period of time extending from the beginning of the braking of the package until the beginning of the return motion of the fork.

When the fork has been brought back to its initial position wherein the new empty package core it carries is in rolling engagement with the package drive roll 105, the coupling between the oscillating shaft and the fork is not released forthwith but is maintained for some period of time during which the empty package core 103 is resiliently pressed against the package drive roll through the medium of the spring 143 to thereby facilitate the beginning of the winding operation. In the illustrated embodiment, the oscillation amplitude of the oscillating shaft desirably is of approximately 143° and FIG. 18 shows the relative positions of the coupling sector 146 integral with the oscillating shaft 102 in the respective winding (solid line) and doffing (dashed-dotted line) positions of the core-holding fork.

The various successive angular operating positions of the abutment 131 actuating the opening of the closure cover 132 and of the cam 150 operating the closure of this cover and the energizing of the heated thread cutter, respectively, are shown in FIG. 19. The arc 201 is the angular excess displacement of the oscillating shaft corresponding to the compression stroke of the spring 143 upon resiliently pressing the package core 103 against the package drive roll 105. The angular position 150a of the cam 150 corresponds to the beginning of

the opening of the closure cover 132 by the lug 131 integral with the fork. The angular position 150b of the cam corresponds to the opening of the electric switch 154 energizing the heated electric resistor of the thread cutter 150a. The position 150c of the cam corresponds to the closing of the closure flap cover 132. The position 150d of the cam corresponds to the open or spread apart fork. The radius vector 202 corresponds to the angular position of the fork upon opening of the electric switch 154 whereas the radius vector 203 corresponds to the angular position of the fork at the beginning of the opening of the closure flap cover 132.

FIG. 21 illustrates various successive positions of the cam 151 actuating the electric switch 155 detecting the end of operation. The angular position 151a of the cam corresponds to the open condition of the fork in the doffing position 202.

FIG. 22 illustrates various successive angular positions of the cam 152 operating the electric switch 156 which signals when the predetermined winding diameter of the package has been reached. The solid line position of the cam 152 corresponds to the package having reached the predetermined maximum winding diameter whereas the position 152a corresponds to the spread apart fork placed in a substantially horizontal doffing position along the radius vector 202.

When the fork carrying the empty package core has reached the winding position against the package drive roll 105, the yarn is placed in a tail winding position by means of a catch element 193 carried by a reciprocating shaft 191 and then the yarn is brought in front of a hook 206 integral with one of the centering elements 109a, 109b by means of a rear lever 204 carrying a sharp blade such as a thread cutting razor blade 205. The yarn is at that time gripped by the hook 206 of the centering element and cut by the razor blade 205 and, through a return motion of the shaft 191, a double thread tail portion is formed on the empty package core carried by the fork. The yarn is then replaced in the traversing winding thread-guide by the rod 191 and the end of the operation is indicated by the corresponding electric switch 156.

FIG. 23 shows various operating flow charts of the automatic doffing apparatus. A curve A illustrates the theoretical variation in angular position (expressed in degrees and plotted in abscissae) of the cam 181 controlling the oscillating shaft 102 versus the angular position of the fork (plotted in ordinates and expressed in degrees). The curve A' is an actual corrected curve corresponding to the theoretical curve A. The total oscillation amplitude of the shaft is 143° to move the fork from the winding position to the position of discharging a fully wound package and return. It is seen that the region a on curve A' corresponds to the empty package core (that is to the non-wound core) and the area a' corresponds to the full package wound to the largest predetermined winding diameter. Between the initiation of package core braking at point a1, to enable the yarn to be taken up by the suction nozzle, and the beginning of the return motion of the fork at point a2 a stop or pause of the oscillating motion of the shaft 102 and of the pivotal movement of the fork takes place. In the region a3 a slowing down of the oscillating motion of the shaft takes place to facilitate the gripping of an empty package core by the fork upon delivery by the core supply means. In the region a4 of the curve A' the

resilient pressing of the empty package core against the package drive roll 105 takes place.

The curve B corresponds to the operation of the winding diameter detector or sensor DE mounted on the general oscillating shaft. The downward stepped portion b of this curve corresponds to the period during which the fork may be locked to the oscillating shaft (picking up the fork when starting from the dead center or neutral position).

The curve C corresponds to the operation of the electric switch detecting the end of operation and the stepped down portion c corresponds to authorizing the passage to the next operating step.

The curve D corresponds to the operation of the electric switch 156 detecting the largest winding diameter and the stepped down portion d corresponds to the triggering or tripping for initiating the rocking motion of the fork.

The curve E corresponds to the operation of the electro-magnet 136 and the portion e of this curve corresponds to the period of scanning the successive working stations for the stepwise control of their respective electro-magnets.

The curve F corresponds to the operation of the electric switch 149 for holding or self-energizing the electro-magnet 136 and of the locking pin 140. The portion f1 of this curve corresponds to the unlocked or retracted position of the locking pin 140 whereas the portion f2 corresponds to the outward extended or projecting position of the locking pin in abutment against the solid portion of the coupling sector 146. The portion f3 of this curve corresponds to the period of inserting the locking pin 140 into the hole 145 of the coupling sector.

The curve G corresponds to the operation of the flap cover 132 of the yarn taking up or suction nozzle 153. The sloping portion g1 of the curve corresponds to the opening of the flap cover whereas the sloping portion g2 corresponds to the closing of the flap cover. Such a closing may be effected from the point g3.

The curve H corresponds to the various phases of taking up the yarn by the suction nozzle 153. The yarn may be drawn in from the point of full opening of the nozzle at h1, the latest point to effect such a suction being located at h2.

The curve J illustrates the operation of the package core braking device 118 on the fork, such a braking taking place in the stepped down portion j.

The curve K corresponds to the operation of the drive means for spreading apart the fork arms, such a spreading apart taking place in the stepped down portion k of the curve. The fork arms are being spread apart or opened in the sloping portion k1 and are drawn towards each other or closed in the sloping portion k2.

The curve L corresponds to the centering of the yarn with respect to the hook of the centering element on the fork and to the variable position of the thread cutter provided with a sharp knife or blade. The portions 11 and 12 in the stepped down part l correspond to the spring action, respectively.

The curve M corresponds to a long cycle operation for the formation of yarn tail portions by the programmed reciprocating translatory motion of the shaft 192. The portions in dashed lines m1 correspond to operation without any yarn tail portions. The portions m2 correspond to the formation of the first thread tail portion and the parts m3 to the formation of the second

thread tail portion. The sloping parts m_4 correspond to the return motion of the yarn replaced in the traversing thread guide for resumption of winding. The central sloping part m_5 of the curve corresponds to a sidewise displacement of the yarn for advancing into the position of formation of the tail portions. The next curve M' corresponds to the operation of the cam designed for a short cycle for the formation of thread tail portions. The curve N corresponds to the operation of the electric switch 154 energizing the electric resistive yarn cutter 154a. The stepped-down portion n of this curve corresponds to the severing of the yarn through melting upon contact with the electric resistor of the thread cutter.

The curve P corresponds to the operation of the empty package core supply means 157. The plateau parts p_1 , p_2 and p_3 of the curve correspond to the actual vertical position of the supply means whereas the part p_4 corresponds to the position of the supply means pushed backwards upon passage of the fully wound package held by the fork and the part p_5 corresponds to the position of the supply means pushed forward upon the return passage of the fork when gripping an empty package core.

Partial electric diagrams for stepwise control of automatic doffing apparatus at various successive working stations are set forth in FIGS. 24 through 26. FIG. 24 shows at I, II, III, . . . Z, respectively, partial control circuits for successive working locations forming processed yarn receiving creels each one of which has an automatic doffing apparatus for removing the fully wound packages and substituting empty package cores therefor.

At ϕ_1 , ϕ_2 , ϕ_3 , are shown package size or winding diameter detectors 156 whereas the electric switch 155 sensing the end of operation is shown at F1, F2, F3. The electro-magnets or solenoids 136 operating the fork coupling with the oscillating shaft at the various working locations are shown at E1, E2, E3, etc. on FIG. 25 which also illustrates the fork angular position detector DE and the electric switch 174 for manual priority doffing control at P1, P2, P3. The electric switches 149 for holding or self-energizing the electro-magnets 136 are shown at E'1, E'2, E'3, etc., respectively, on FIG. 25.

The operation of the stepwise electric control system through scanning is as follows, assuming for example that working location II requires doffing. The package size or diameter detector ϕ_2 is then actuated so that the upper contact of this detector opens and the lower contact thereof closes. The closing of the lower contact energizes a diode AA2 (FIG. 24) which conducts and allows passage of electric current to a relay coil RD1 which closes two corresponding associated auxiliary contacts. The circuit-breakers or cut-out switches controlling a motor of a vacuum pump feeding the suction nozzles as well as the cut-out switch of a motor 185 controlling the doffing drive box are closed as are auxiliary contacts CAF and CDA (FIGS. 26) which are mechanically actuated by these cut-out or master switches. Since the fork angular position detector DE shunting the coil RCB1 (FIG. 26) is open, this coil RCB1 is energized and closes the contact RCB1 mounted in the line of the coil D' which is therefore also energized and closes the contact D'' thereby energizing the coil D which closes the self-energizing or holding contact D (connected in shunting relation-

ship). The energizing of the coil D also closes both contacts D present at the first working location I of FIG. 24 thereby initiating the stepwise scanning of the various working locations.

The closing of the upper contact D energizes the coil B1 at the first working location I which closes both upper and lower contacts B1, respectively, at a second working location II. The closing of the lower contact B1 energizes the coil A2 which closes the contact A2 on the line L3 thereby energizing the coil or solenoid E2 of the electro-magnet 136 locking the fork of the working location II to the oscillating shaft 102 (FIG. 26) and causing doffing movement to be initiated. The coil A2 also closes a self-energizing contact A2 and, when the fork has returned to the winding position, a cam 151 on the oscillating shaft 102 opens the contact F2 (155) on the line 207-112 thereby interrupting the energizing of the coil A2. The contact A2 on the line L3-L7 is then opened and disconnects the fork from the oscillating shaft through de-energizing the electro-magnet coil E2. Energizing of the coil A2 has also opened the contact A2 on the line of the coil B2, so that upon de-energizing of the coil A2, this contact A2 closes and, as the detector ϕ_2 has come back to its initial position, its upper contact closes thereby energizing the coil B2 which closes the contacts B2 at a following working location III. The stepwise scanning process thus proceeds gradually from one working station to the next one.

On FIG. 26, the relay coil RAz stops the doffing drive box after a time delay and, for manual priority doffing, prevents the automatic doffing from taking place upon maintained command. The push-button Mr corresponds to the push-button 166 for operating the manual priority doffing control. The relay coil DA provides confirmation of the condition of a fully wound package after the time delay. The warning device K reports or indicates to an operator the start of the doffing drive box or of a manual priority call for doffing. The coil RVz forms a last location control relay. The coil CB1 serves to control the doffing drive box whereas the parallel or shunt-connected capacitor and resistor assembly shown above the coil CB1 serves to keep the latter energized in case of a short accidental voltage drop of the mains.

In the drawings and specification, there has been set forth a preferred embodiment of the invention, and although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation.

What is claimed is:

1. In a yarn processing machine which continually advances at least one yarn at a corresponding one location and which has arm means for mounting package cores about which advancing yarn is wound into packages, core supply means for retaining a supply of empty cores, oscillating shaft means for driving said arm means from a winding position to a doffing position and to a donning position and back to the winding position, arm actuating means cooperating with said arm means for doffing a package moved by said arm means to the doffing position and for capturing an empty core from said core supply means at the donning position, severing means for separating a package being doffed from the advancing yarn and forming a running free end of advancing yarn, and control means for controlling the running free end of advancing yarn during doffing and

donning, an improvement facilitating doning of empty cores by said arm means and comprising drive means operatively connected with said shaft means for driving said shaft means in predetermined oscillation at a first velocity from a first rotational position through a second rotational position to a third rotational position and then in return to said second position and, after slowing to a lower velocity at said second position, back to said first position whereby donning of an empty core onto said arm means at said second position is facilitated.

2. Apparatus according to claim 1 wherein a plurality of yarns are simultaneously advanced at a corresponding plurality of locations and wherein said shaft means functions for driving said arm means of at least two of said locations and further comprising at least two selectively operable clutch means for operatively connecting corresponding ones of said at least two arm means with said common shaft means and doffing sequence control means operatively connected with said clutch means for normally selectively operating said clutch means one at a time in predetermined sequence as required.

3. Apparatus according to claim 2 wherein said doffing sequence control means comprises at least two package size detecting means for sensing when a corresponding package being wound at a corresponding one of said at least two locations reaches a predetermined diameter and stepping means operatively connected to said size detecting means and responsive thereto for sequentially testing the need for doffing at each of said at least two locations and for operating said clutch means only where doffing is needed.

4. Apparatus according to claim 2 further comprising manually operable doffing control means for overriding said doffing sequence control means and for selectively operating one of said clutch means out of sequence and on manual actuation.

5. Apparatus according to claim 2 wherein said drive means is operatively connected with said doffing sequence control means and is responsive thereto for interrupting the reciprocating rotation of said shaft means during such interval of time as operation of said clutch means is not required.

6. Apparatus according to claim 1 wherein said yarn handling means further includes a drive roll parallel to and spaced from said shaft means and for engaging and rotating a package being wound and further wherein said control means comprises suction tube means aligned with a line perpendicular to said shaft means and medial of said arm means for drawing in an advancing yarn passing thereadjacent, cover means for normally closing said suction tube means, and cam means for opening said cover means during movement of said arm means to the doffing position.

7. Apparatus according to claim 6 wherein said suction tube means is disposed to the side of said shaft means opposite said drive roll so as to underlie the advancing yarn upon movement of said arm means to the doffing position.

8. Apparatus according to claim 1 further comprising brake means operable in timed relation to movement of said arm means for braking rotation of a package upon movement of said arm means to the doffing position.

9. Apparatus according to claim 8 further comprising yarn severing means operable in timed relation to said

brake means for severing stationary yarn following braking of the package and thereby for separating the package from the advancing yarn.

10. Apparatus according to claim 1 wherein a drive roll means is mounted parallel to and spaced from said shaft means for engaging and rotating a package being wound and further wherein said arm means comprises a hub member mounted on said shaft means for selective oscillation therewith, first and second arm members mounted on said hub member, and elastically deformable means operatively coupling said hub member and said arm members for normal movement together, said deformable means accommodating relative movement between said hub member and said arm members during return movement of said shaft means to said first position and thereby permitting exertion of pressure between said drive roll and a donned empty core and facilitating formation of a new package.

11. Apparatus according to claim 1 further comprising tail forming yarn guide means operable in timed relation to movement of said arm means for engaging advancing yarn to be wound about a newly donned empty core and for guiding the yarn to wind an initial length about a portion of said empty core adjacent one end thereof.

12. In a textile yarn handling machine which continually advances yarn and which has arm means for mounting package cores about which advancing yarn is wound into packages, oscillating shaft means for driving said arm means from a winding position to a doffing position and back to the winding position, arm actuating means cooperating with said arm means for doffing a package moved by said arm means to the doffing position, and severing means for separating a package being doffed from the advancing yarn, an improvement facilitating separation of a doffed package from an advancing yarn and comprising aligned opposing disk means mounted on said arm means for engaging corresponding end portions of a core gripped therebetween and for rotating therewith during package winding, and brake means responsive to movement of said arm means to the doffing position for locking one of said disk means against rotation relative to said arm means and thereby for braking rotation of a package being doffed.

13. In a synthetic yarn texturing machine which continually advances textured yarn and which has yarn handling means for winding an advancing yarn about a core into a package which includes a drive roll for engaging and rotating a package being wound, oscillating shaft means spaced from and parallel to said drive roll for reciprocating rotation relative thereto, a hub member mounted on said shaft means for selective rotation therewith, and first and second arm members mounted on said hub member for moving wound packages from a winding position to a doffing position and moving empty cores from a donning position back to the winding position, an improvement which facilitates initiation of yarn winding about a newly donned core and comprising elastically deformable means operatively coupling said hub member and said arm members for normal movement together, said deformable means accommodating relative movement between said hub member and said arm members during movement of said arm members back to the winding position and thereby permitting exertion of pressure between said drive roll and a donned empty core.

14. In a yarn production process including continually advancing yarn, mounting a core on an arm and winding the advancing yarn about the core and into a package, moving a wound package from a winding position to a doffing position and doffing the package from the arm while severing the advancing yarn to separate the package and form a running free end of advancing yarn, and controlling the running free end of advancing yarn while moving the arm to a donning position and donning an empty core onto the arm and moving the empty core to the winding position, an improvement facilitating donning of empty cores onto the arm and comprising moving an oscillating drive shaft in predetermined oscillation from a first rotational position at a first velocity through a second rotational position to a third rotational position and then in return to the second position and, after slowing to a lower velocity at the second position, back to the first position, and driving the arm from the shaft whereby donning of an empty core is facilitated by the slower movement of the arm means at the donning position.

15. A process according to claim 14 wherein a plurality of yarns are simultaneously advanced and wound into a corresponding plurality of packages at a corresponding plurality of arm locations and the oscillating drive shaft is common to at least two arm locations and further comprising selectively operatively connecting corresponding ones of the at least two arms with the shaft one at a time and in predetermined sequence as required.

16. A process according to claim 15 further comprising sensing the winding of a package to a predetermined size and, upon a package reaching such a size, testing the need for doffing at each of the at least two arm locations and doffing only at those locations where needed.

17. A process according to claim 16 further comprising scanning stepwise the need for doffing at each arm location, detecting the end of a previous doffing operation, and initiating doffing at another arm location in response to such scanning and detecting.

18. A process according to claim 15 further comprising manually selecting an arm for connection out of sequence.

19. A process according to claim 14, wherein the controlling of the running free end comprises mechanically actuating a suction yarn entrapping mechanism in response to movement of the package to the doffing position.

20. A process according to claim 14, further comprising braking a wound package against rotation during severing of the yarn and discharging the package in an immovable condition into a receiving chute.

21. A process according to claim 14, wherein wind-

ing is effected by rotating a core through frictional contact with a winding drive roll and further comprising resiliently pressing a donned empty core against the winding drive roll to facilitate winding of the free end of yarn thereabout.

22. In a textile yarn handling process including continually advancing yarn, mounting a core on an arm and winding the advancing yarn about the core and into a package, moving a wound package from a winding position to a doffing position and doffing the package from the arm while severing the advancing yarn to separate the package and form a running free end of advancing yarn, and controlling the running free end of advancing yarn while moving the arm to a donning position and donning an empty core onto the arm and moving the empty core to the winding position, an improvement facilitating donning of empty cores onto the arm and comprising moving an oscillating drive shaft in predetermined oscillation and driving the arm from the shaft to displace the arm at a first velocity from the winding position to the doffing position and then to the donning position and, after slowing to a lower velocity at the donning position, back to the winding position whereby donning of an empty core is facilitated by the slower movement of the arm means at the donning position.

23. In a textile yarn handling machine which continually advances yarn and which has arm means for mounting package cores about which advancing yarn is wound into packages, core supply means for retaining a supply of empty cores, oscillating shaft means for driving said arm means from a winding position to a doffing position and to a donning position and back to the winding position, arm actuating means cooperating with said arm means for doffing a package moved by said arm means to the doffing position and for capturing an empty core from said core supply means at the donning position, severing means for separating a package being doffed from the advancing yarn and forming a running free end of advancing yarn, and control means for controlling the running free end of advancing yarn during doffing and donning, an improvement facilitating donning of empty cores and comprising drive means operatively connected with said shaft means for driving said shaft means in predetermined oscillation and for displacing said arm means at a first velocity from the winding position to the doffing position and then to the donning position and, after slowing movement of said arm means to a lower velocity at the donning position, back to said winding position whereby donning of an empty core is facilitated by the slower movement of said arm means at the donning position.

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