

[54] YARN HANDLING APPARATUS

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Related U.S. Application Data

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[52] U.S. Cl. 242/47.01, 57/58.3, 57/58.49, 57/67, 66/132, 242/47.12, 242/47.13

[51] Int. Cl. B65h 51/20

[58] Field of Search 242/47.01, 47.04, 242/47.05, 47.08, 47.09, 47.12, 47.13; 66/132; 57/58.49, 58.3, 67

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Primary Examiner—Stanley N. Gilreath

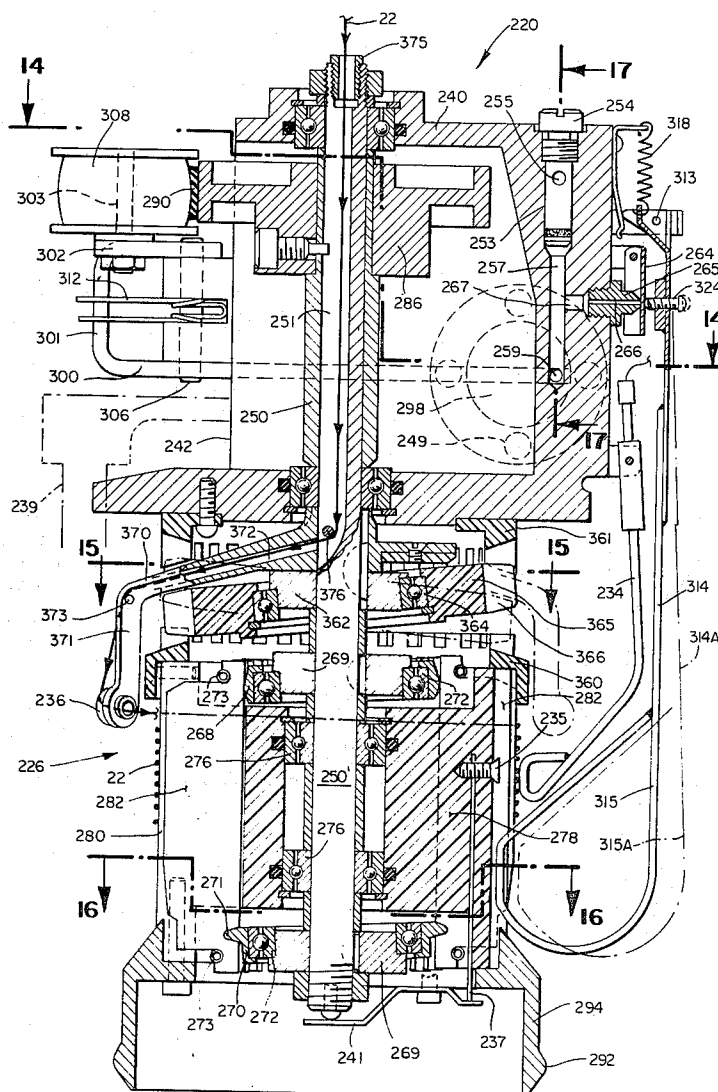
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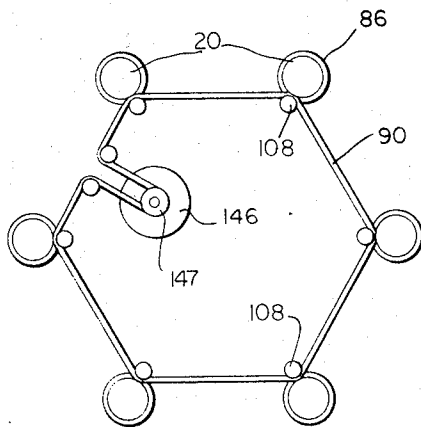
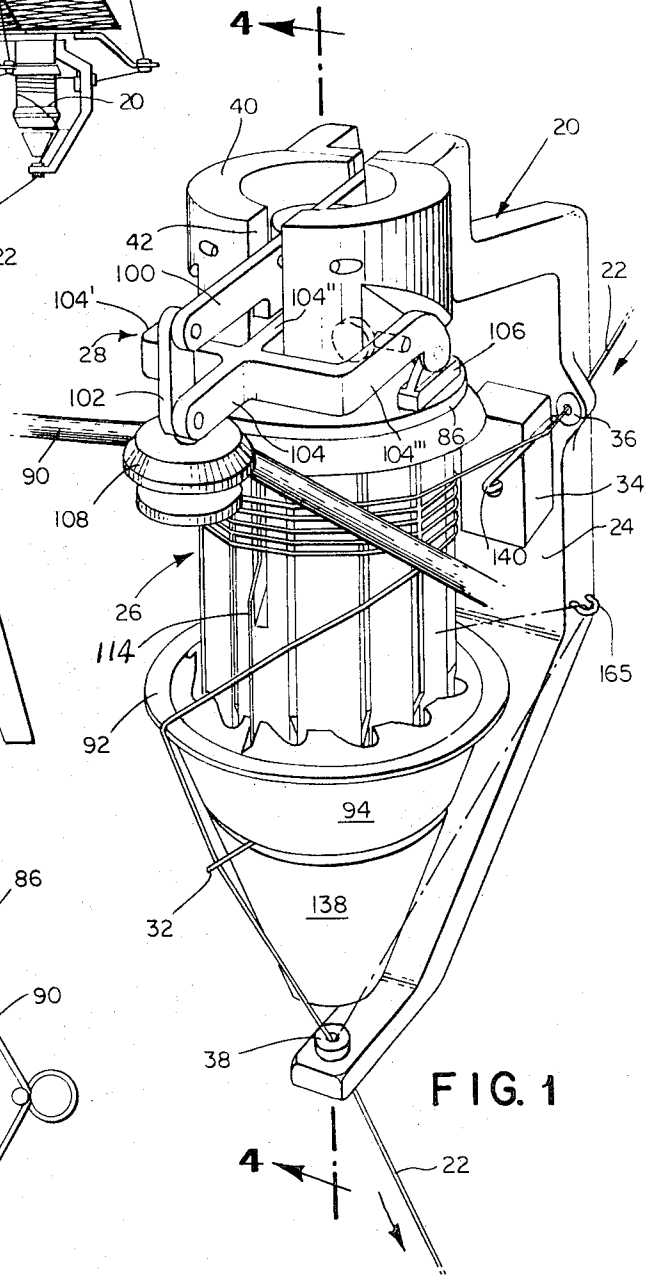
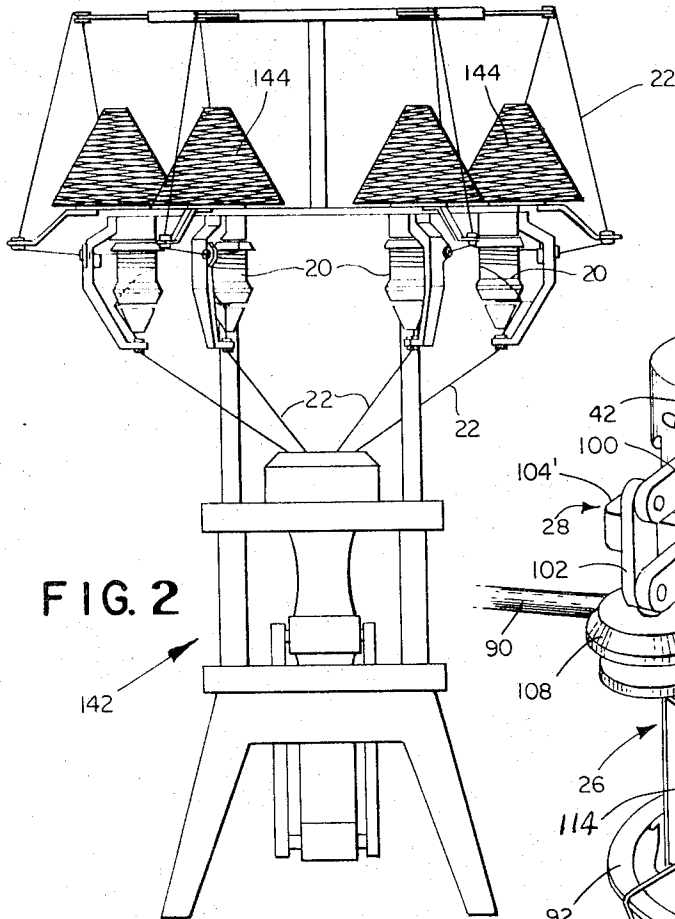
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ABSTRACT

A device for temporarily storing yarn for immediate use by a yarn consuming textile apparatus, such as a winder, a knitting machine, or for the filling thread of a shuttleless loom. The device includes a yarn collecting drum on which yarn from a supply source is wound temporarily and then removed under a controlled, uniform tension. The device eliminates the wide variations in yarn tension which occur when a yarn is delivered from a source, such as a cone or a package, and permits the yarn to feed to a textile machine at a substantially constant tension.

26 Claims, 24 Drawing Figures





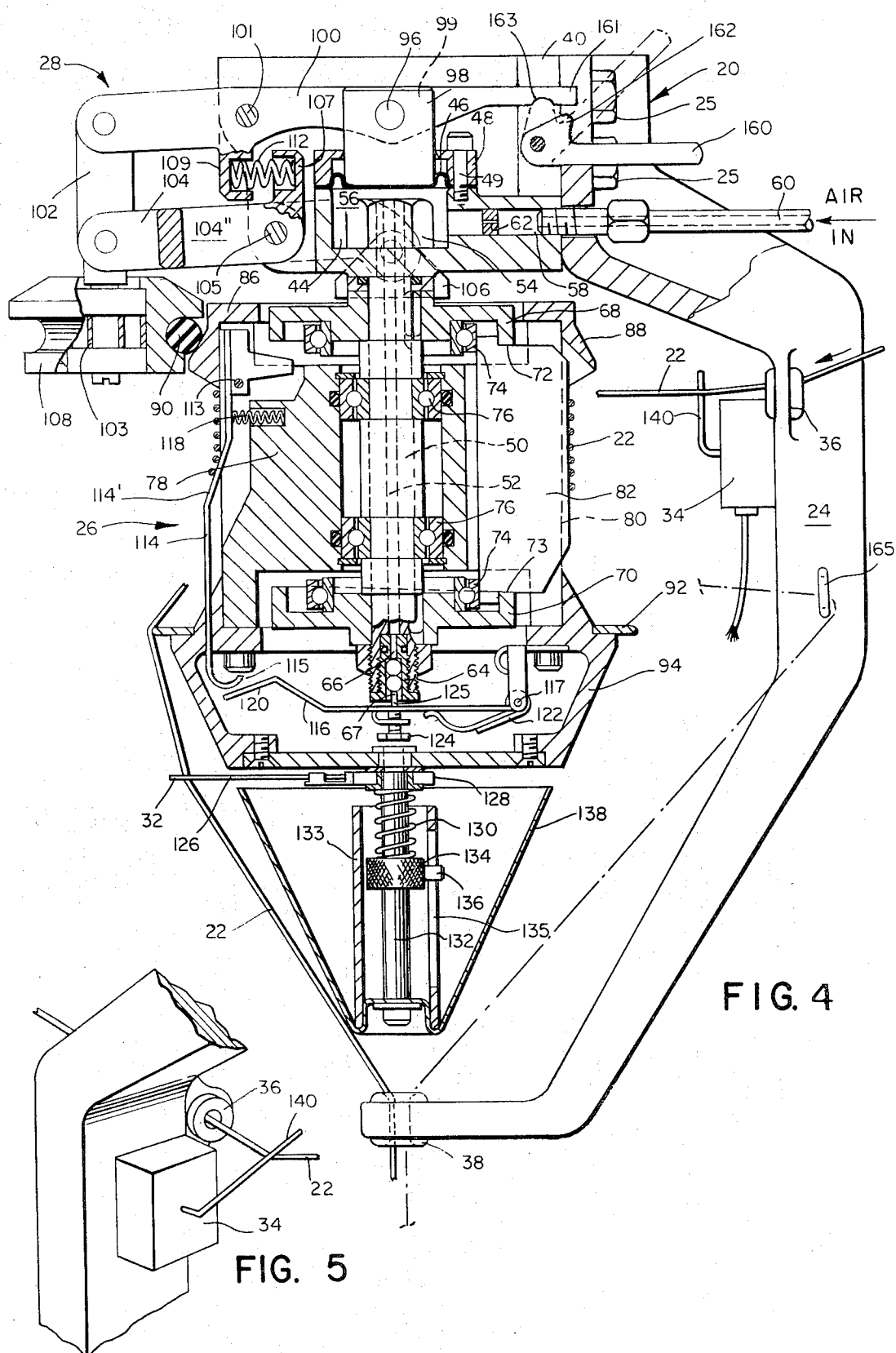


FIG. 6

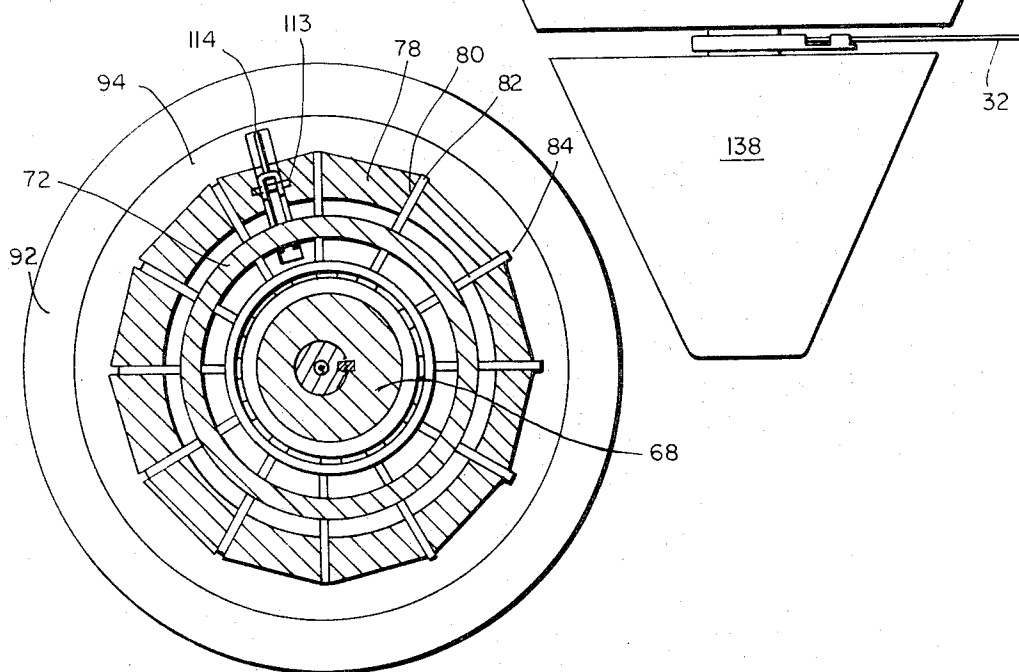
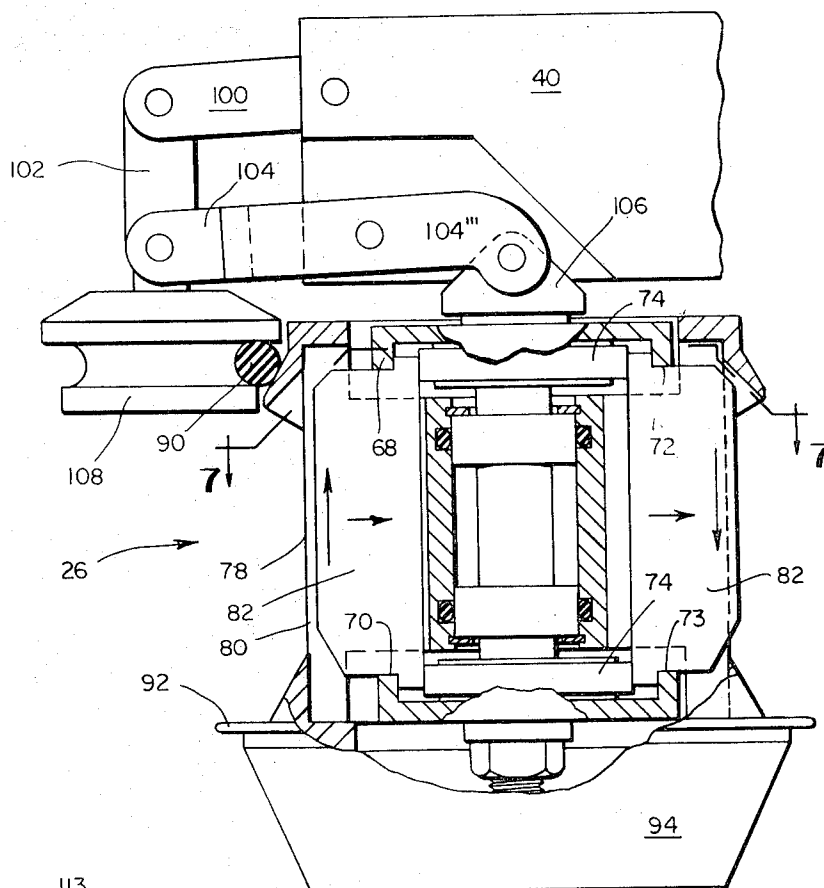


FIG. 7

FIG. 10

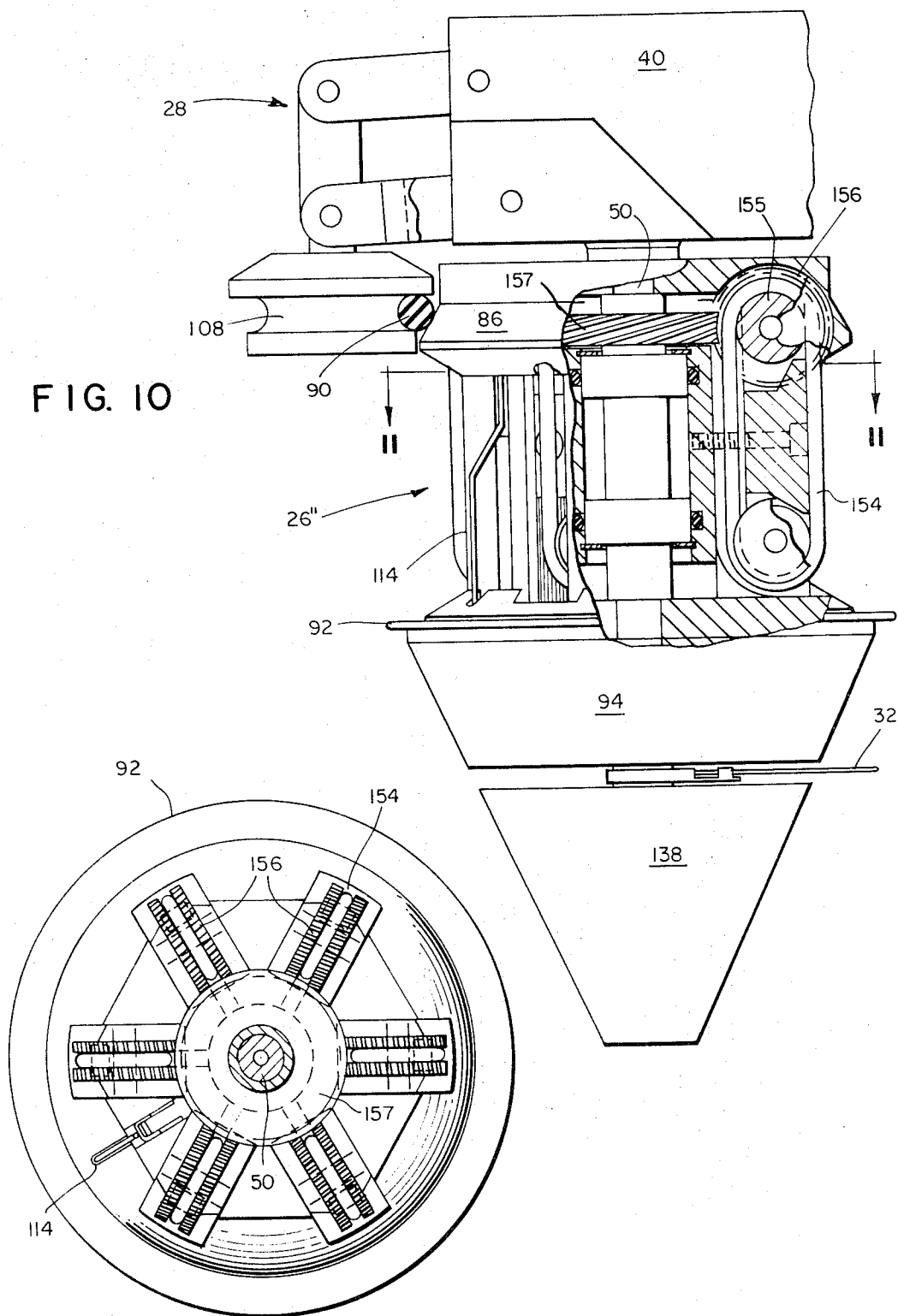


FIG. II

Fig. 12

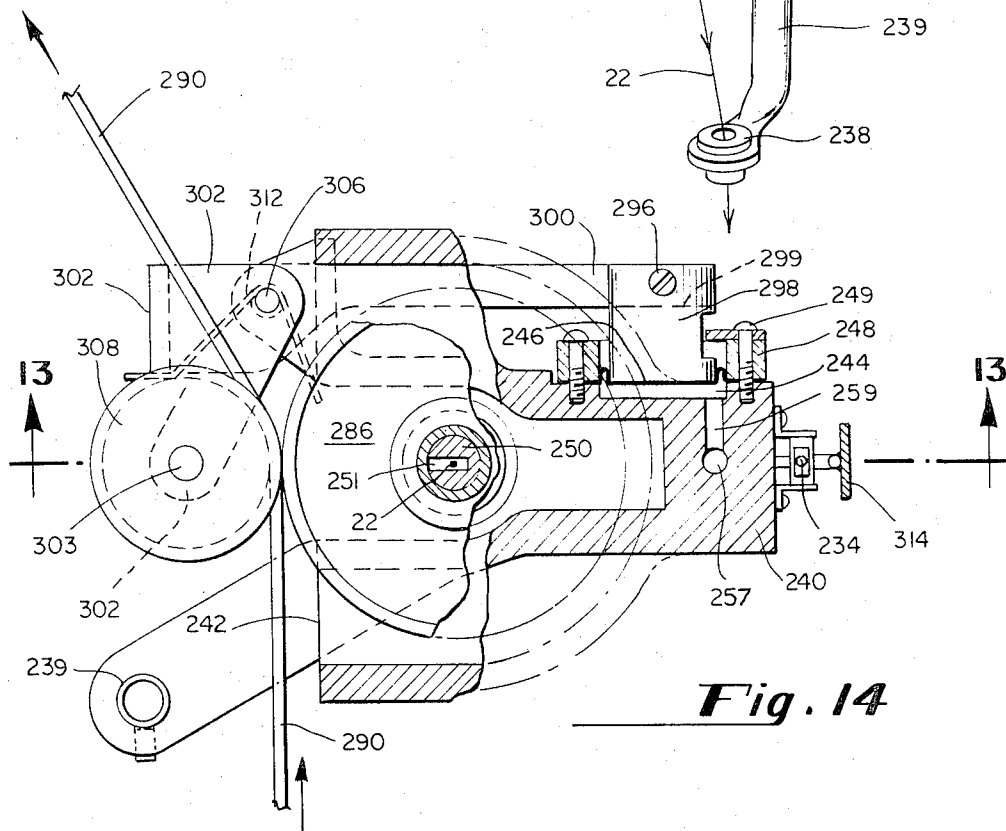
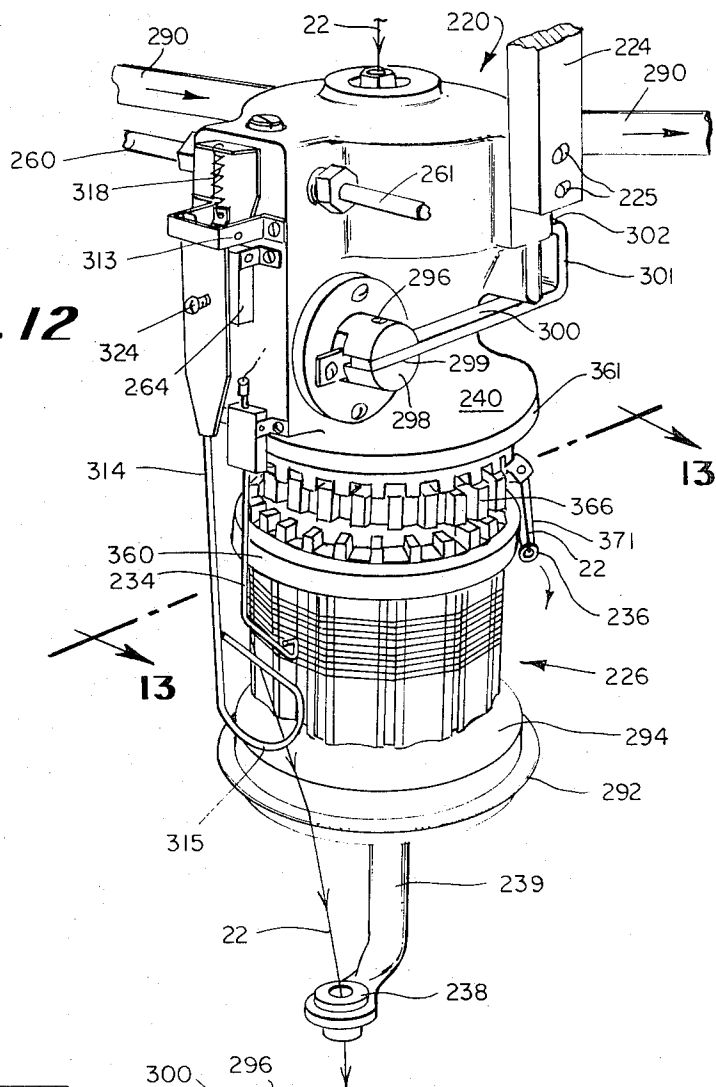
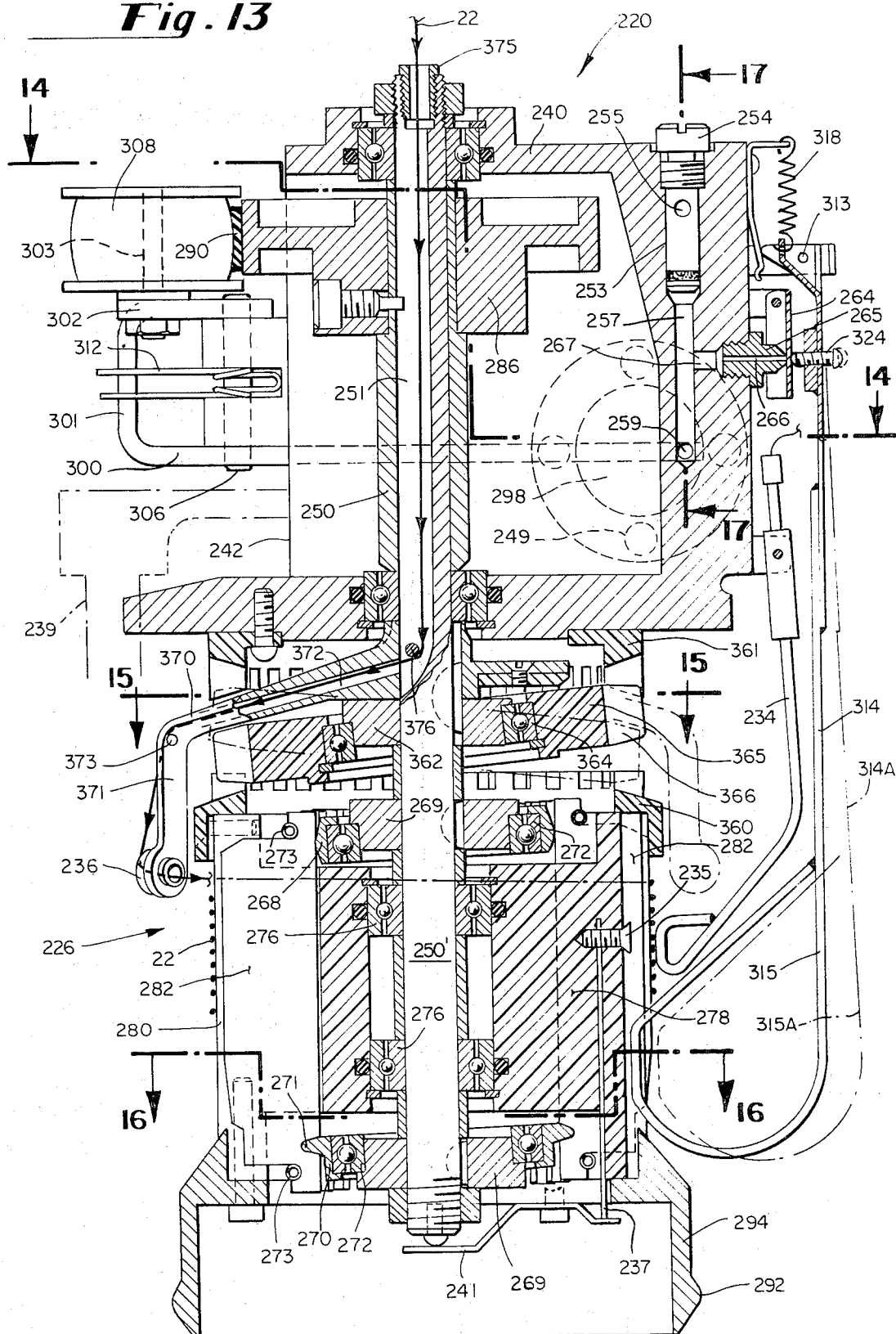


Fig. 14

Fig. 13



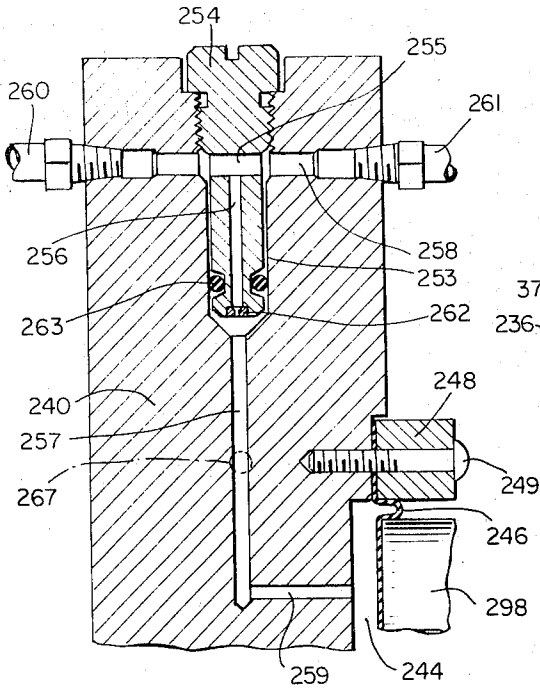


Fig. 17

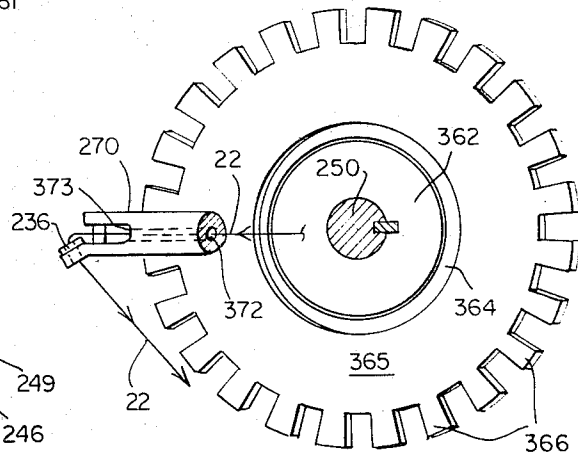


Fig. 15

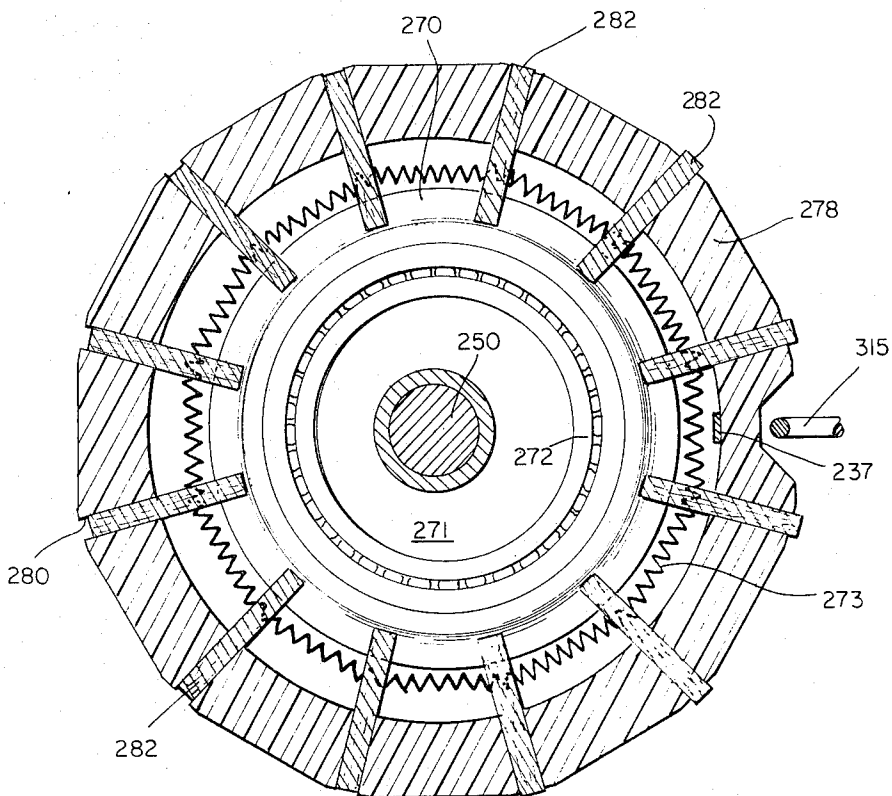


Fig. 16

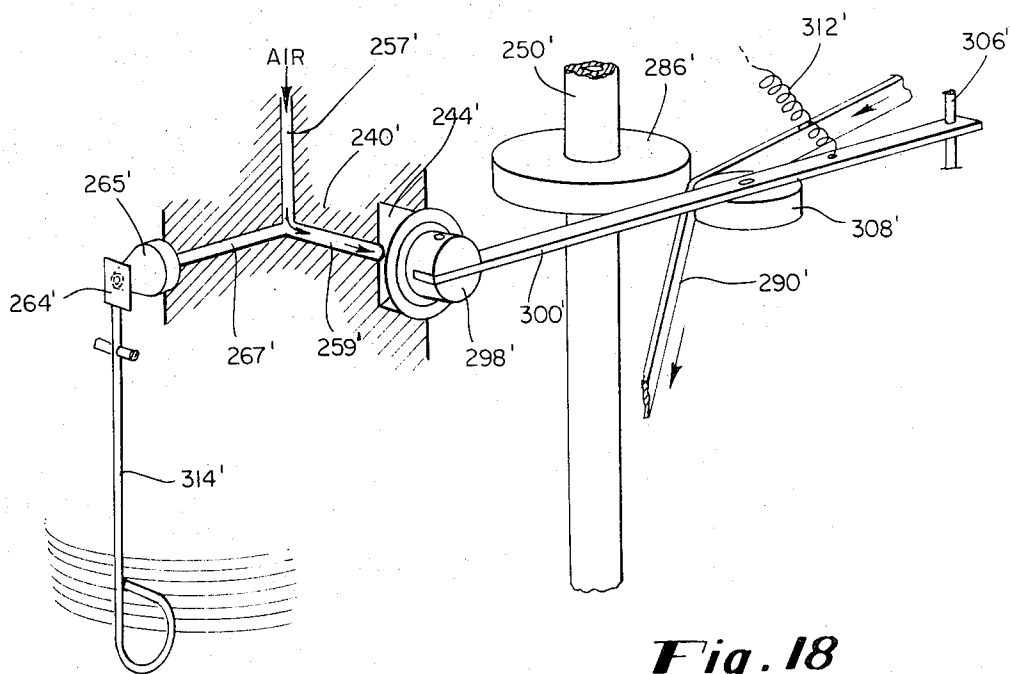


Fig. 18

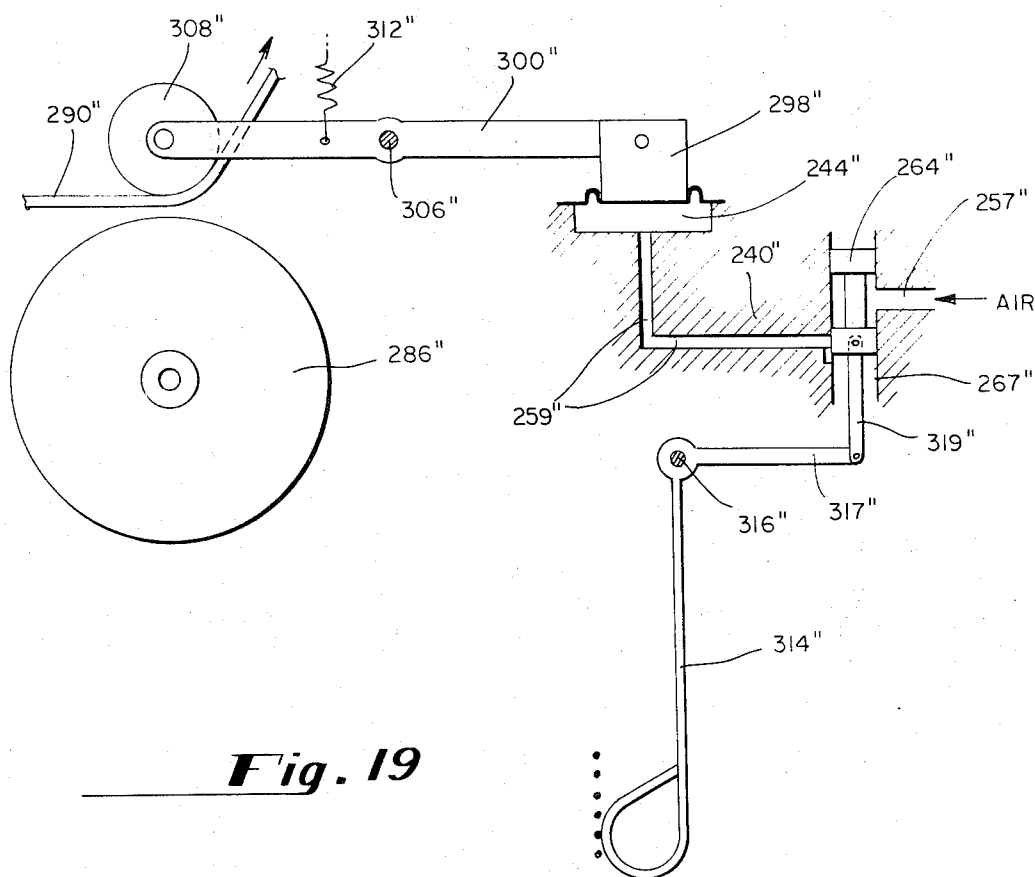


Fig. 19

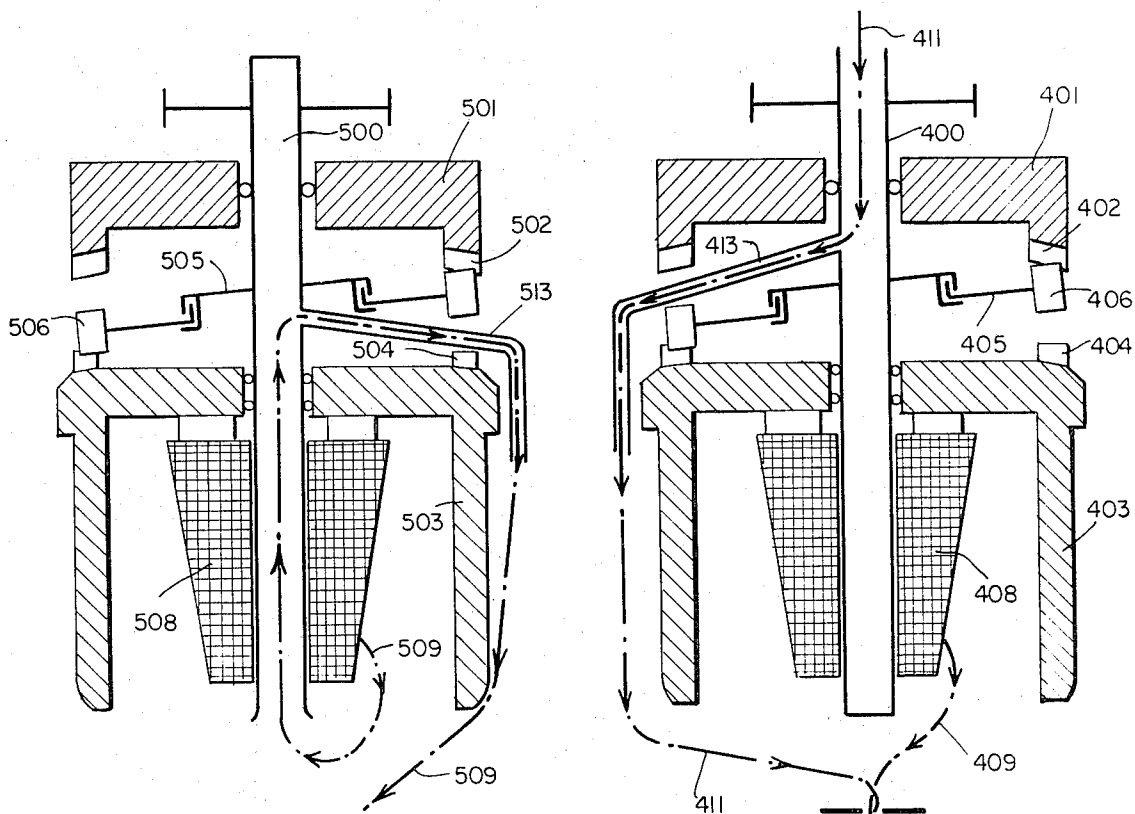


Fig. 21

Fig. 20

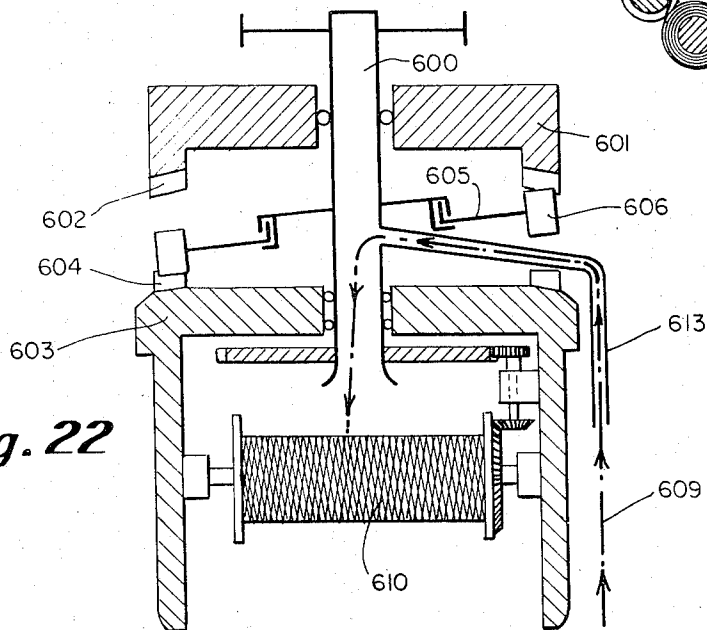


Fig. 22

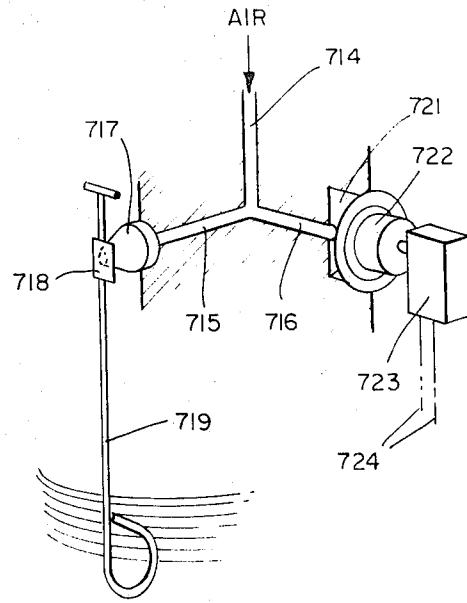
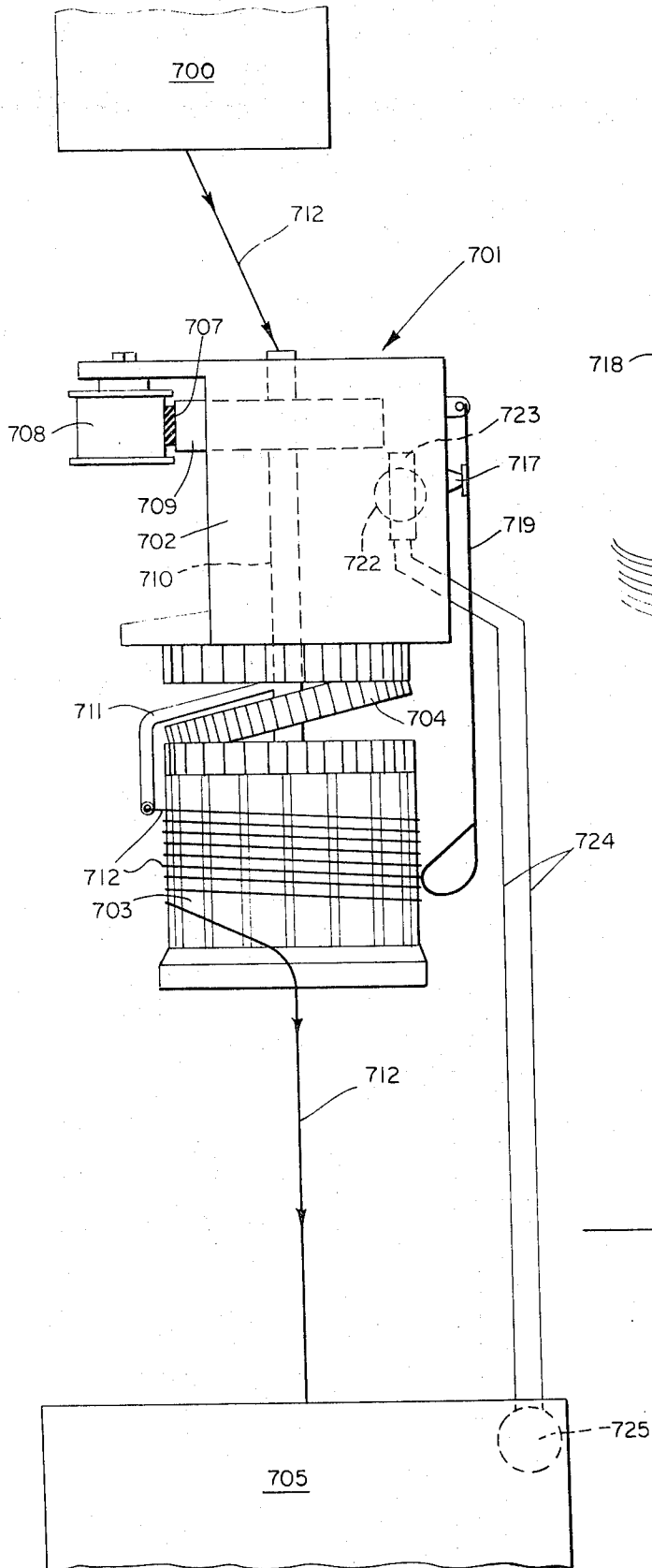


Fig. 24

Fig. 23

YARN HANDLING APPARATUS

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of my pending patent application Ser. No. 138,749, filed Apr. 29, 1971 and entitled "Yarn Tension Equalizer", now abandoned, and is a continuation of my pending patent application Ser. No. 230,257, filed Feb. 29, 1972 and entitled "YARN HANDLING APPARATUS," now abandoned.

SUMMARY OF THE INVENTION

The primary object of this invention is to provide a new and improved yarn handling apparatus by which yarn may be withdrawn from a source of supply, and so handled that wide variations in tension on the yarn are eliminated and the yarn then permitted to advance under a selected uniform tension to a suitable textile machine for further processing.

To achieve this desideratum, the invention, in its preferred form, comprises an automatic yarn tension equalizer, i.e. yarn storage feeder having a drum about which yarn is wound helically to form a plurality of yarn turns, to provide a temporary yarn store, and from which the yarn is removed in a generally axial direction at one end. A yarn guide directs yarn to the drum, and means are provided for rotating the guide and drum relative to each other, whereby the yarn is delivered tangentially to the drum. The drum preferably includes means for advancing the yarn turns thereon axially toward the yarn discharge end of the drum. A pneumatic system, under control of a yarn sensing means, is provided for imparting suitably controlled relatively rotational movement between the yarn guide and the drum, to ensure that a sufficient store of yarn is wound on the drum at all times to meet the demands of the textile machine to which the yarn is being delivered.

DESCRIPTION OF THE VIEWS OF THE DRAWING

FIG. 1 is a fragmentary view in perspective of a preferred embodiment of this invention.

FIG. 2 is a schematic front elevation of a circular knitting machine utilizing a plurality of devices of the type illustrated in FIG. 1.

FIG. 3 is a schematic illustration in top plan showing a preferred drive means for the devices of this invention illustrated in FIG. 2.

FIG. 4 is an enlarged, partially sectional view in side elevation indicated generally by the arrows 4—4 of FIG. 1.

FIG. 5 is a fragmentary view in perspective of the stop motion of the device of FIG. 1.

FIG. 6 is a fragmentary, partially sectional view in side elevation of the device shown in FIG. 1.

FIG. 7 is a cross section indicated by the arrows 7—7 of FIG. 6.

FIG. 8 is a fragmentary, partially sectional view in side elevation of a modification of the device shown in FIG. 1.

FIG. 9 is a cross section indicated by the arrows 9—9 of FIG. 8.

FIG. 10 is a fragmentary, partially sectional view in side elevation of a second modification of the device shown in FIG. 1.

FIG. 11 is a cross section indicated by the arrows 11—11 of FIG. 10.

FIG. 12 is a fragmentary view in perspective of a third modification of this invention.

FIG. 13 is an enlarged fragmentary, generally sectional view in side elevation indicated by the arrows 13—13 of FIGS. 12 and 14.

FIG. 14 is a cross section indicated by the arrows 14—14 of FIG. 13.

FIG. 15 is a cross section indicated by the arrows 15—15 of FIG. 13.

FIG. 16 is a cross section indicated by the arrows 16—16 of FIG. 13.

FIG. 17 is a fragmentary view in section indicated by the arrows 17—17 of FIG. 13.

FIGS. 18 and 19 illustrate modifications of the pneumatic system utilized in this invention.

FIG. 20 is a fragmentary, inverted schematic view in section of a two-ply cord former incorporating the novel detent of this invention.

FIG. 21 is a fragmentary, inverted schematic view in section of a two-for-one twister incorporating the novel detent of this invention.

FIG. 22 is a fragmentary, inverted schematic view in section of a modified twister incorporating the novel detent of this invention.

FIGS. 23 and 24 are fragmentary, schematic views of yet another modification of this invention.

DETAILED DESCRIPTION OF THE INVENTION

In FIG. 1, there is shown a preferred form of yarn tension equalizer 20 embodying this invention. A plurality of such devices 20 may be mounted on a single textile machine, such as the multifeed circular knitting machine 142 shown in FIG. 2, for delivering yarn 22 thereto from a plurality of yarn cones or yarn packages 144. The several yarn tension equalizers 20 shown in FIG. 2 may be driven by a single endless belt 90, as shown in FIG. 3. The drive system, in addition to belt 90, may include an electric motor 146 driving a pulley 147, and a plurality of retractable idler pulleys 108. Belt 90 is entrained about the pulleys 108 and 147.

Referring now to FIGS. 1 and 4-7, the device 20 includes a stationary support 24 adapted to be secured, in a suitable manner and location, to, or adjacent to, the textile machine or apparatus to which the yarn 22 is to be delivered. Affixed to the upper end of support 24, by suitable means such as bolts 25 (FIG. 4), is a cup-shaped member 40 having a cylindrical cavity 44 (FIG. 4) formed in the bottom thereof. Cavity 44 is sealed at the top by a flexible diaphragm 46, which is secured in place by a retaining ring 48. A plurality of threaded bolts 49 secure ring 48 to the rim of the cavity 44.

The floor of the cavity 44 is formed with an aperture through which protrudes the upper end of a vertical stud shaft 50. The protruding upper end of shaft 50 is secured internally of cavity 44 by a nut 54 in the cavity. The engagement of shaft 50 within the floor of the cavity 44 and the nut 54 is air tight. Cavity 44, as will be explained presently, comprises an air chamber.

An axial bore 52 extends the entire length of shaft 50, and has its upper end in open communication with the cavity 44. A ball valve 64 is secured to the distal or lower end of shaft 50, and has a vertical passageway disposed between bore 52 and the ambient atmosphere. The passageway comprises an upper, constricted portion or orifice 66 in communication with

bore 52, and a lower, larger portion 67 which contains a pair of steel balls.

Valve 64 is closed by a lever 116 pivoted at 117 and having its distal end 120 formed into a reverse bend. Lever 116 is urged into valve closing position by leaf spring 122. Lever 116 mounts and adjustment screw 124 having a reduced, axial extension 125 adapted to engage within the lower portion 67 of the passageway of ball valve 64. When spring 122 is permitted to pivot lever 116 upwardly into valve closing position, as shown in FIG. 4, extension 125 engages within the passageway to force the balls therein to their uppermost position to seal orifice 66 and close the valve.

The cavity or air chamber 44 is connected to a source of compressed air (not shown) by means of a bore 58 in member 40 and a tube 60, the latter engaging in an airtight fit within bore 58. Disposed in the bore 58, between the air chamber 44 and the end of tube 60, is a plug provided with a small, axial orifice 62, through which compressed air passes from tube 60 to air chamber 44. The cross sectional area of orifice 62 is considerably smaller than the cross sectional area of the orifice 66 in ball valve 64. Preferably, the cross sectional area of orifice 66 is at least three times larger than that of the orifice 62.

Thus, the yarn tension equalizer illustrated in FIG. 1 incorporates a pneumatic system comprising a source of compressed air (not shown), an expansible air chamber 44 connected to said source, an axial bore 52 connecting the air chamber to the ambient atmosphere, a valve 64 for opening and closing the air chamber to the atmosphere and a spring-biased lever 116 for opening and closing the valve.

Stud shaft 50 supports a pair of vertically spaced ball bearings 76 on which is rotatably mounted a yarn collecting drum 26. The drum 26 includes a rotatable core 78 affixed to the roller bearings 76, a drive ring 86 affixed to the upper end of the core and a hollow housing 94 affixed to the lower end of the core. The ring 86 has a dependent, outwardly inclined skirt portion 88, the outer surface of which is adapted to engage frictionally the drive belt 90, to impart rotation to the drum 26. The housing 94 supports an annular rub rail 92 for the yarn 22, as it discharges from the drum 26.

The core 78 of drum 26 is formed with a plurality of vertical, peripherally spaced slots 80 in each of which is mounted a slidable flat bar or slat 82. The bars 82 are formed with inner, vertical extensions at their top and bottom edges for slidable engagement, respectively, within annular cam tracks in vertically spaced stationary cams 68 and 70 (FIGS. 4,6). The cams 68 and 70 are keyed to stud shaft 50, and are provided, respectively with opposed, complementary cam rings 72 and 73. The cam rings 72 and 73 are formed with complementary, undulating or sinuous flat surfaces which snugly engage the upper and lower edges, respectively, of the slats 82, thereby imparting to them a continuous up-and-down motion, as indicated by the vertical arrows in FIG. 6, when drum 26 rotates.

As will best be seen from FIG. 7, the cams 68 and 70 are mounted eccentrically of stud shaft 50. They are provided with opposed axial extensions, on each of which is mounted a ball bearing 74 (FIGS. 4,6). The bearings 74 are concentric with their respective cam rings 72 and 73, and are spaced radially inward thereof to provide the annular cam tracks for the vertical extensions of the slats 82. As drum 26 rotates, a horizon-

tal back-and-forth movement is imparted to the slats 82 by the bearings 74, as indicated by the horizontal arrows of FIG. 6. Thus, both horizontal and vertical reciprocatory movements are imparted to the slats 82 disposed in slots 80. The slats or bars 82 move in a cyclic motion, which is upwardly and inwardly of the slots 80 and then downwardly and outwardly thereof, as drum 26 rotates. The arrangement and dimensioning of the parts is such that when slats 82 are in their most advanced position, their outer vertical edges protrude slightly beyond the periphery of drum core 78, and when in their most retracted position, are withdrawn fully into slots 80 (see FIG. 6).

Mounted on the drum core 78, for rotation therewith, is a vertically disposed yarn sensing finger 114. The upper end of finger 114 is pivoted at 113 to core 78, while its lower portion extends through a slot in housing 94 and terminates therein in the form of an upwardly curved end 115. The latter is adapted to engage the distal end 120 of lever 116.

The upper portion of finger 114 is disposed inwardly of the periphery of core 78, while its lower portion is spaced outwardly from said periphery, the two portions being joined by a downwardly, outwardly inclined medial portion 114'. Finger 114 is urged outwardly of the drum 26, about pivot 113, by a spring 118 mounted in core 78. When finger 114 is in its outermost position, its distal end 115 disengages from the distal end 120 of lever 116, whereby the latter is pivoted upwardly by spring 122 to close ball valve 64.

Affixed to and depending from the bottom of the housing 94 is a vertical pin 132, to the lower end of which is affixed a shield 138. The shield 138 has an inverted, frusto-conical configuration, and supports, telescopically of pin 132, a tube 133 having a vertical slot 135 formed therein. Mounted rotatably on pin 132, in a narrow space between the bottom of housing 94 and the top of shield 138, is a flyer 32 composed of a wire element 126 affixed in a clamp 128. Flyer 32 is rotatable about pin 132 against a selective frictional force imposed on clamp 128 by spring 130 disposed about pin 132. A vertically slidable knurled ring 134, secureable on pin 132 by a set screw 136, is utilized to vary selectively the frictional force exerted by the spring on the clamp 128, against which the flyer 32 is rotatable.

The drum 26 is driven intermittently by belt 90, utilizing a driving and braking means indicated generally by reference numeral 28 (FIGS. 1, 4). the driving and braking means 28 includes a vertically movable piston 98 mounted slidably within air chamber 44 and its superimposed ring 48. Diaphragm 46 is interposed between the bottom of the piston 98 and the interior of the air chamber 44, but because of its elastic quality, permits the piston to slide vertically within the air chamber 44. Formed in the top of piston 98 is a slot 99, which is aligned with a slot 42 (FIG. 1) in the distal wall portion of the cup-shaped member 40. A lever 100 is pivoted at approximate its mid-point in slot 42 about a pin 101. The inner end of lever 100 is connected pivotally to pin 96 within slot 99 of piston 98. The outer end of lever 100 is connected pivotally to a vertical link 102 which, at its lower end, mounts a vertical stud shaft 103 for rotatable idler pulley 108, about which belt 90 passes (FIGS. 3,4).

Pivoted to the lower end of link 102 is a lever 104 which forms into a trifurcated component having elements 104', 104'' and 104''' (FIG. 1). The elements or

extensions 104' and 104''' of lever 104, at their respective distal ends, each support brake shoes 106 adapted to engage frictionally the top surface of drive ring 86 and thereby stop the rotation of drum 26 when drive belt 90 is retracted. The outer cylindrical wall of member 40 is undercut to accommodate the distal ends of elements 104' and 104''' and their respective brake shoes 106.

Element or extension 104'' of lever 104 is pivoted at its inner end within the bottom portion of slot 42 of member 40 by means of a pin 105 (FIG. 4). The inner end of element 104'' is formed with a vertically upstanding portion 107. Lever 100 is provided with a depending portion 109 spaced from the upstanding portion 107 of element 104''. The portions 107 and 109 are provided with opposing, cylindrical recesses or openings in which is retained a coil spring 112. The function of spring 112 is to urge the lever mechanism 100, 102, 104 of linkage means 28 in a generally clockwise direction, to retract idler pulley 108 and drive belt 90 away from the drive ring 86. It also urges the linkage means 28 into drum braking position while, at the same time, urging piston 98 downward into air chamber 44.

The yarn tension equalizer 20 is made ready for use by passing yarn 22 through upper yarn guide 36 in support 24, under the sensing finger 140 of the stop motion 34, around the periphery of drum 26 a plurality of turns, thence over rub rail 92, under flyer 32 and through the lower yarn guide 38 on support 24 for delivery to the yarn consuming apparatus. As the number of yarn turns on the drum increase and advance downwardly thereof, they bear upon the exposed portion of yarn sensing finger 114, and force it, against spring 118, to pivot inwardly of the drum. As a result, the curved distal end of finger 114 slides against the reverse bent distal end 120 of lever 116, forcing the same to pivot downwardly, against the force of spring 122, to open ball valve 64. Compressed air now passes through tube 60, bore 58, orifice 62, air chamber 44, bore 52 and valve 64 to the atmosphere. By reason of spring 112, the pulley 108 and drive belt 90 are retracted from the drive ring 86, and piston 98 is retracted into the recess of air chamber 44.

With the device thus prepared, motor 146 is started to activate drive belt 90. The yarn consuming apparatus then is started, and begins to draw yarn 22 from the drum 26. As the number of yarn turns on the drum 26 are reduced, yarn sensing finger 114 is caused to pivot outwardly by spring 118, thereby permitting lever 116 to pivot upwardly to close valve 64. As a result, compressed air no longer escapes from the air chamber 44, and the air pressure increases therein, to raise piston 98 against the force of spring 112. Movement of piston 98 imparts a generally counter-clockwise movement to the driving and braking linkage 28, to advance pulley 108 toward drum 26 and bring drive belt 90 into contact with drive ring 86 (FIG. 4). As a result, rotation is imparted to drum 26 to draw a fresh supply of yarn 22 from the yarn source, and wrap it helically about the drum 26.

As the drum 26 rotates, the slats 82 in slots 80 move outwardly and downwardly and then upwardly and inwardly to advance the yarn turns on the drum 26 axially toward the draw-off end of the drum. The slats 82 serve as a yarn advancing means, to ensure that the plural yarn turns on the drum do not overlap while they are stored on it.

When sufficient yarn turns again have been wound on the drum 26, the yarn sensing means 114 again is depressed by the yarn, so that its distal end 115 engages lever 116 to open the valve 64. Once again, the compressed air escapes to the atmosphere through valve 64, to reduce air pressure in air chamber 44. Piston 98 then retracts into the chamber 44, under the influence of spring 112, while the drive belt 90 once again is retracted from the drive ring 86. Simultaneously, the brake shoes 106 are brought into contact with drive ring 86 to stop rotation of drum 26.

Thus, in response to the amount of air pressure in chamber 44, intermittent rotation is imparted to drum 26 by drive belt 90, to provide at all times a temporary yarn store for the immediate use of a yarn consuming apparatus, such as a knitting machine. Spring 118 for the yarn sensing finger 114 is designed to permit the finger to pivot inwardly, to open valve 64, after a pre-determined maximum number of yarn turns are on the drum 26 and, likewise, to cause finger 114 to pivot outwardly after the number of yarn turns on the drum have been reduced to a pre-determined minimum. The selection of the minimum and maximum number of yarn turns to accomplish this is a matter of choice, but should be sufficient to ensure that there is an ample supply of yarn at all times on the drum 26 to meet the demands of the yarn consuming apparatus.

The yarn passing through guide 36 is wrapped tangentially about the drum 26, and is withdrawn therefrom through guide 38 in a generally axial direction. A uniform, pre-determined yarn tension is imposed on the yarn 22, as it advances to guide 38, by the flyer 32 under the control of spring 130.

In the modification shown in FIGS. 8 and 9, the core of rotatable drum 26' comprises a plurality of upright, circularly arranged, rotatable rollers 148 about which the yarn is wrapped. Rollers 148 have axes of rotation offset a few degrees from the vertical, in the direction of drum rotation (FIG. 9), to ensure that the yarn turns are advanced downward, to the discharge end of the drum 26'. Rollers 148, at their upper ends, are journaled in the drive ring 86, and at their lower ends are journaled in an annular plate 149 mounted on top of the housing 94.

A sun gear 150 is affixed to the lower portion of stud shaft 50, above valve 64. Affixed to each of the rollers 148, at the bottom thereof, for rotation therewith, is a gear 153, adjacent pairs of which mesh with a single idler gear 152. The three idler gears 152 also mesh with sun gear 150. When drive belt 90 is brought into driving engagement with drive ring 86, to rotate drum 26', the interengagement of gears 150, 152 and 153 causes the rollers 148 to rotate in a direction opposite to the direction of rotation of drum 26'. The arrangement causes the plural yarn turns wrapped about the several rollers 148 to advance axially downward of the drum 26', to the yarn discharge end of the drum. Except as just described, the yarn tension equalizer of FIGS. 8 and 9 is substantially identical in structure and operation to the device of FIG. 1.

In the modification of FIGS. 10 and 11, the core of the rotatable drum 26'' is composed of a plurality of vertical, circularly arranged endless belts 154 about which the yarn 22 is wrapped. The belts 154 are similar in purpose and structure to the endless belts illustrated and described in a A. H. Junkers U.S. Pats. Nos. 1,851,252 and 1,960,743. The belts 154 are supported

on rotatable pulleys and are driven at a constant, relatively slow rate of speed, with the outermost portions advancing downwardly, to thereby uniformly advance the yarn turns axially toward the yarn discharge end of the drum 26". The upper pulleys 155 of the belts 154 are formed with spaced flanges 156 comprising worm gears meshing with a stationary worm 157 affixed to shaft 50. Thus, as drum 26" rotates, the intermeshing of worm gears 156 with the stationary worm 157 drives the belts 154. Except for the substitution of the endless belts 154 for the drum core 78, the device of FIGS. 10 and 11 is substantially identical to the yarn tension equalizer illustrated in FIG. 1.

If desired, the yarn tension equalizer of this invention may be readily converted to a positive yarn feeding device. As illustrated in FIG. 4, to accomplish this, a mechanism such as toggle linkage 160 may be mounted pivotally on support 24, immediately below an extension 161 of lever 100. The toggle is provided with a protrubance 162 adapted to engage into a complementally formed notch 163 in the underside of lever extension 161. When the toggle is raised, to engage protrubance 162 into notch 163, the linkage means is caused to shift in a generally counter-clockwise direction to bring drive belt 90 into driving contact with ring 86. The force of spring 112 serves to retain protrubance 162 in engagement with notch 163, and hence retains the driving contact between belt 90 and ring 86 to impart continuous rotation to drum 26.

To complete the conversion of device 20 to a positive yarn feeding device, the yarn must be arranged to be discharged tangentially from the drum 26, rather than axially thereof. To provide for this, a yarn guide 165 is mounted on support 24 opposite from the lower portion of drum 26, so that the yarn passes from the periphery of the drum to guide 165 in a more or less horizontal direction, and thence proceeds downwardly to and through yarn guide 38, as indicated by the shadow line of FIG. 4.

FIGS. 12-17 illustrate a modified yarn tension equalizer 220 in which the yarn collecting drum 226 is stationary and the yarn guide 236 is revolvable about the drum. In this embodiment (FIG. 12), rotatable yarn guide 236 wraps the yarn 22 tangentially around the drum 226. The plural yarn turns are advanced axially of the drum to the draw-off end thereof by yarn advancing slats 282, and then are discharged axially of the drum through the stationary yarn guide 238. The flyer is omitted from this modification, so that the yarn passes directly from drum 226 over rub rail 292 to the yarn guide 238. Stationary support 224 mounts the device to, or adjacent to, the textile apparatus to which yarn 22 is to be delivered.

Affixed to support 224 by bolts 225 is a hollow housing 240 having a vertical opening 242 (FIGS. 13, 14) facing toward drive belt 220 entrained about idler pulley 308. A vertical shaft 250 is supported rotatably in the housing 240, and has a dependent portion 250' extending below the housing. A drive wheel 286 is affixed to the upper portion of shaft 250, inside shaft support 240, and is adapted to transmit rotation to the shaft when the peripheral surface of the wheel is in driving contact with drive belt 290, as shown in FIG. 13.

The lower portion 250' of shaft 250 supports the stationary drum 226. The top of drum 226 is spaced from the bottom of the support or housing 240 to provide clearance for mechanism to be described hereinafter in

more detail. The drum 226 includes a rotatable core 278 affixed to the outer races of spaced ball bearings 276 mounted on shaft portion 250', and a hollow housing 294 having its outer periphery formed as an annular bead 292 to provide the yarn rub rail.

The core 278 of drum 226 is formed with a plurality of vertical, peripherally spaced slots 280 in each of which is mounted a slidable flat bar or slat 282. Horizontal and vertical reciprocatory movements are imparted to slats 282, for advancing the yarn turns on the drum axially toward the discharge end thereof, by means of annular cams 268 and 270. The bars 282 are formed with inner, vertical extensions of their top and bottom edges for reception of annular coil springs 273 to retain the slats at all times in contact with the cams 268, 270.

The cams 268 and 270 are secured to and concentric with the outer races of ball bearings 272. The inner races of the ball bearings 272 are secured angularly to hubs 269 keyed to shaft extension 250'. Both hubs 269 are mounted eccentrically of shaft 250 (FIGS. 13, 16). The bearings 272 are mounted in angular grooves in the hubs 269 so that cams 268, 270 are angular, i.e., inclined, with respect to shaft portion 250'. Thus, as shaft 250 rotates, the annular cams 268, 270 are caused to wobble vertically in a cyclic, circular progression.

The outer periphery of cam 268 is beveled, while the outer periphery of cam 270 is formed with a protruding lip 271 which engages snugly within complementary notches formed in the lower portions of the inner vertical edges of the slats 282 (FIG. 13). By reason of the eccentric mounting of the hubs 269, a horizontal reciprocatory motion is imparted by cams 268, 270 to the slats 282 and, by reason of the wobbling motion of cams 268, 270, a vertically reciprocatory movement is imparted to slats 282, when shaft 250 rotates.

Affixed to the top of stationary drum 226 is a ring 360 formed with a plurality of uniformly spaced, circularly arranged, upstanding teeth. Similarly, affixed to the bottom of the support housing 240 is a ring 361 having a plurality of uniformly spaced, circularly arranged, depending teeth. The tooth rings 360, 361 are concentric, are coaxial with shaft 250, and have the same number of spaced teeth. Preferably, the bottoms of the spaces between the teeth are inclined outwardly to prevent the accumulation of foreign matter. The two rings of teeth 360, 361 are spaced axially from each other, and their respective teeth are disposed in opposing relation.

Keyed to the shaft 250, midway of the space between rings 360 and 361, is a hub 362. Angularly affixed to hub 362 in the inner race of a ball bearing 364, whereby bearing 364 is inclined at an angle to the axis of the shaft 250. Affixed to the outer race of bearing 364, and co-planar with said bearing, is a disc 365 having a plurality of uniformly spaced circularly arranged, radial teeth 366 formed on its outer rim. The size, depth and spacing of the teeth 366 is such as to enable them to mesh with the teeth of the rings 360 and 361. Disc 365 comprises the novel locking means or key of this invention. The hub 362 and bearing 364 together serve to suspend disc 365 angularly of the shaft 250.

By reason of the angular mounting of disc 365 on shaft 250, a vertical rhythmic wobbling motion is imparted to the disc as the shaft rotates. However, disc 365 does not rotate. The wobbling movement of disc 365 is progressively undulating or cyclic, as shown by

the shadow lines in FIG. 13. The vertical spacing between the circular rows of teeth on rings 360 and 361 is such as to permit the teeth 366 of disc 365 to engage simultaneously, at diametrically opposite locations of the disc, both the teeth of ring 360 and those of ring 361. This inter-engagement of the teeth of disc 365 with the teeth of rings 360 and 361 operates to retain yarn collecting drum 266 stationary when shaft 250 rotates.

Thus, disc 365 acts as a detent or connector or wobble key to lock drum 226 to the stationary housing or support 240 and thereby prevent rotation of the drum. As shaft 250 rotates, causing disc 365 to wobble progressively about the axis of the shaft, the teeth 366 of the disc engage progressively, and mesh simultaneously with, the teeth of rings 360 and 361, at diametrically opposite locations of the disc, thereby to lock the drum at all times to the stationary support or housing 240.

Keyed to shaft 250, for rotation therewith, just below the bottom of housing 240, is an outwardly extending, downwardly sloping yarn guiding arm 370. The yarn arm 370 extends outwardly of disc 365 and drum 226, and has at its distal end a vertically depending extension 371 which terminates adjacent the periphery of drum 226 and supports yarn guide 236. Yarn arm 370 is provided throughout its length with a bore 372, the outer end of which is provided with an opening 373.

It is to be noted (FIG. 13) that rotatable yarn arm 370 is disposed between upper toothed ring 361 and the toothed disc 365, and emerges from between the two above the lowest point of disc 365, where teeth 366 are in engagement with the upstanding teeth of lower ring 360. This relationship between the parts is maintained at all times, since the rotation of arm 370 is in unison with the cyclic wobbling motion of disc 365. Thus, the disc 365 functions to provide, at all times, a rotating opening for the yarn arm 370 extending from shaft 250, as shaft 250 rotates.

The inner end of bore 372 of yarn arm 370 is in communication with a vertical slot 251 formed in rotatable shaft 250. The slot 251 extends from a location just below bore 372 upward of shaft 250 to the top thereof. The upper end of shaft 250 is counter-sunk and threaded to receive a hollow threaded nipple 375, serving as a yarn guide. A transverse pin 376 is disposed in slot 251 immediately above the location where the slot communicates with bore 372 of yarn arm 370.

As shown in FIG. 13, the yarn 22 which is to be stored temporarily on drum 226 passes downwardly through nipple 375, through slot 251 in shaft 250, around pin 376, then through bore 372 and opening 373 to and through yarn guide 236 to drum 226. When belt 290 is brought into driving contact with wheel 286, yarn arm 370 is caused to revolve about drum 226 to wrap the yarn about the drum. The result is to deliver the yarn tangentially to the drum for temporary storage thereon.

The pneumatic system of yarn tension equalizer 220 is generally similar to that of the device 20 illustrated in FIG. 1. Support 240 includes a horizontal axis, cylindrical cavity 244 (FIG. 14) which serves as an air chamber. Cavity 244 is sealed at the top by a flexible diaphragm 246, the latter being secured by means of a retaining ring 248 and threaded bolts 249. A piston 298 is axially slidable within air chamber 244 and ring 248.

Diaphragm 246 is interposed between the bottom of the piston and the interior of the air chamber 244.

The pneumatic system includes a source of compressed air (not shown) which is connected to horizontal bore 258 in support housing 240 by means of air tubes 260 and 261 (FIG. 17). The bore 258 is intercepted axially by a vertical bore 253, the upper portion of which is counter-sunk and threaded. Bore 253 is adapted to receive an elongated threaded plug 254 having a transverse bore 255 generally axially aligned with bore 258. Plug 254 further includes an axial bore 256, the upper end of which is in communication with bore 255 and the lower end of which terminates in orifice 262. O-ring 263 provides an air tight seal between the lower portion of plug 254 and vertical bore 253.

The bottom of vertical bore 253 is connected to the air cylinder 244 by means of reduced vertical bore 257 and horizontal bore 259. As is best shown in FIG. 13, vertical bore 257 is intercepted intermediate bores 253 and 259 by horizontal bore 267. The latter is counter-sunk and threaded to receive a threaded plug 265 having an axial bore or elongated orifice 266. The cross sectional area of the bore or orifice 266 preferably is at least three times larger than the cross sectional area of orifice 262 in plug 254. Orifice 266 is adapted to be closed by a pivotal, vertically depending valve 264. Compressed air in the system urges valve 264 to open position.

Thus, the yarn tension equalizer 220 illustrated in FIGS. 12-17 incorporates a pneumatic system comprising a source of compressed air (not shown), an expandable air chamber 244 connected to said source, means comprising bores 259, 257, 267 and orifice 266 connecting the air chamber to the ambient atmosphere and a valve 264 for closing the air chamber to the atmosphere.

Mounted on the stationary support 240 is a vertically disposed yarn sensing finger 314 (FIG. 13). The upper end of finger 314 is pivoted at 313, while its lower portion is in the general form of an intumed bow 315. The latter is adapted to rest against the yarn turns on the stationary drum 226, after the yarn turns have advanced a pre-determined distance downward of the drum. The position of finger 314, when resting on the yarn turns, is shown by the shadow lines 314A and 315A in FIG. 13.

A spring 318 urges the yarn sensing means 314 in a clockwise direction about pivot 313, whereby its distal end 315 is urged toward the periphery of the drum 226. When the number of yarn turns on drum 226 are reduced to a predetermined minimum, spring 318 forces finger 314 inwardly in respect of drum 226, until a threaded screw 324, mounted on finger 314, strikes valve 264 and causes the same to pivot to close orifice 266, sealing air cylinder 244 from the atmosphere as shown in FIG. 13. As a result, compressed air no longer escapes from the pneumatic system to the atmosphere, and the air pressure in air chamber 244 increases therein to advance piston 298.

The brakes used in device 20 of FIG. 1 are omitted from yarn tension equalizer 220, and the linkage mechanism connecting piston 298 to idler pulley 308 is simplified. Formed in the top of piston 298 is a slot 299 (FIG. 12). Secured pivotally within piston slot 299, by pin 296, is one end of a lever 300, the opposite end of which is formed with an upturned portion 301. As best shown in FIGS. 13 and 14, lever 300 is mounted for

pivotal movement about pin 306 secured in an extension of support 240. The upturned end 301 of lever 300 is bent into a horizontal support 302 mounting a vertical stud shaft 303 for the rotatable idler pulley 308. A spring 312 urges pulley 308 and lever 300 in a clockwise direction about pin 306, as viewed in FIG. 14, to retract belt 290 from wheel 286. When the air pressure in air chamber 244 increases to advance piston 298, the piston causes lever 300 and pulley 308 to pivot in the opposite direction around pin 306. This brings belt 290 into driving contact with wheel 286, to impart rotary motion to shaft 250 and yarn arm 370 and cause a fresh supply of yarn 22 to be delivered to and wound upon drum 226.

Thus, in response to the amount of air pressure in chamber 244, intermittent rotation is imparted to shaft 250 and yarn guide 236 by drive belt 290 to provide at all times a temporary yarn store for the immediate use of a yarn consuming apparatus. As in the case of the device 20 of FIG. 1, yarn sensing finger 314 of the device 220 monitors the amount of yarn stored on the drum, so that when the number of yarn turns are reduced to a minimum, the pneumatic system is activated to cause a fresh supply of yarn to be wound on the drum. As the newly supplied yarn turns increase and advance axially downward of the drum, toward the yarn discharge end thereof, under the influence of slats 282, the yarn turns force sensing means 314 to pivot outwardly, to open valve 264 and permit reduction of the air pressure in air chamber 244. As the air pressure reduces in chamber 244, spring 312 causes pulley 308 and its drive belt 290 to retract from wheel 286 while, at the same time, causing piston 299 to retract into the air chamber.

As shown in FIG. 13, the device 220 preferably incorporates a stop motion comprising a vertically pivotal sensing finger 234 adapted to swing inwardly to strike contact 235 mounted in drum core 278, in the event of yarn breakage. Contact 235 is grounded through conductors 237 and 241.

FIG. 18 illustrates schematically a modification of the pneumatic system and retractable linkage means of device 220. Lever 300' extending from the piston 298' is pivoted about fixed pin 306', beyond pulley 308'. Spring 312', therefore, urges drive belt 290' into driving relationship with wheel 286' while, at the same time, retracting piston 298' into the air chamber 244'. When valve 264' on yarn sensing means 314' is closed, the air pressure builds up in the air chamber 244', to advance the piston 298' and retract belt 290' from wheel 286'. This halts the flow of yarn to the drum.

In FIG. 19 there is shown schematically a pneumatic system slightly modified from that shown in FIGS. 13, 14 and 17. In this instance, yarn sensing means 314'' is pivoted at 316'', and is formed with a right angled extension 317'' pivotally connected to a link 319''. The latter is connected pivotally to a spool-like slidable valve 264'' in bore 267'' in support 240''. When the yarn sensing means 314'' is in contact with the yarn turns, valve 264'' is moved upwardly in bore 267'' to seal the air chamber 244'' from the source of compressed air (not shown) and to open the chamber to the atmosphere. When the yarn turns are reduced to a minimum and yarn sensing means 314'' caused to pivot toward the yarn collecting drum, valve 264'' slides down bore 267'', whereby the air chamber 244'' is sealed from the atmosphere while, at the same time, placed in communication with the source of com-

pressed air. As a result, compressed air flows through bore 257'', valve 264'' and bore 259'' to air chamber 244''. The increase in the air pressure in the chamber causes piston 298'' to advance to bring belt 290'' into driving contact with wheel 286'' and cause a fresh supply of yarn to be wrapped about the collecting drum.

FIGS. 20, 21 and 22 illustrate schematically the use of the novel detent or locking means 365 of this invention for other textile machines. The three machines shown in FIGS. 20, 21 and 22 are all illustrated in the inverted or upside down position for the purpose of illustration.

In FIG. 20, there is disclosed a two-ply cord former having a rotatable shaft 400 mounted in stationary support 401 having a ring of uniformly spaced teeth 402. Shaft 400 passes through a drum 403 having a similar ring of uniformly spaced teeth 404. The two rings of teeth 402, 404 are spaced sufficiently to permit the interposition therebetween of angularly disposed disc 405 having a ring of uniformly spaced teeth 406 disposed about its rim. In the manner previously explained, the disc or detent 405, through the engagement of its teeth 406 with the teeth 402, 404, locks drum 403 to support 401 to prevent rotation of the drum.

A yarn package 408 is supported in drum 403 axially of shaft 400. Yarn 409 is withdrawn from package 408 by means of a winder 410. A second yarn 411 passes through a bore in shaft 400, thence through a bore in rotatable yarn arm 413 to the winder 410. The two yarns 409, 411, as they are taken up by winder 410, are plied in the usual manner.

FIG. 21 illustrates the utilization of the angular, toothed disc or detent in a conventional two-for-one twister having a rotatable shaft 500 supported in stationary support 501 having a ring of uniformly spaced teeth 502. Supported on rotatable shaft 500, and spaced from support 501, is a drum 503 having a ring of uniformly spaced teeth 504. Rotation of drum 503 is prevented by the locking effect of the angularly disposed disc or detent 505 having a ring of uniformly spaced teeth 506 formed along its rim and engaging, respectively, with teeth 502 of stationary support 501 and teeth 504 of drum 503.

Disposed axially of rotatable shaft 500 in drum 503 is a yarn package 508 from which yarn 509 is withdrawn by means of a winder (not shown). Yarn 509 passes from the package 508 through a bore in shaft 500 and thence through a bore of the outwardly extending, rotatable yarn arm 513 to the winder.

FIG. 22 shows a modified twister wherein the yarn 609 travels in the opposite direction from that of yarn 509 in FIG. 21. The machine of FIG. 22 includes a rotatable shaft 600 mounted in stationary support 601 having a ring of teeth 602. Disposed axially of shaft 600 and spaced from support 601 is a drum 603 having a ring of teeth 604. Disposed between the rings of teeth 602 and 604 is an angularly mounted disc or detent 605 having a ring of teeth 606 formed about its rim and engagable, respectively, with the teeth 602, 604 to lock drum 603 to stationary support 601 to prevent rotation of the drum.

Rotatably mounted in drum 603 is a winder or other yarn take-up means 610 connected by suitable gearing to rotatable shaft 600. Rotation of winder 610 draws yarn 609 from a yarn supply (not shown) through the bore of rotatable yarn arm 613 and thence through a

bore in shaft 600 to be formed into a suitable yarn package.

FIGS. 23 and 24 illustrate schematically yet another embodiment of this invention. In FIG. 23 there is shown a yarn source 700, such as a yarn extruder, from which the yarn must be drawn at a uniform and continuous rate, a yarn tension equalizer 701, having a stationary support 702 and a stationary drum 703, and a yarn consuming textile apparatus 705, such as a winder. The toothed disc 704 disposed between support 702 and drum 703 locks the latter against rotation.

In this embodiment, the drive belt 707 passing about pulley 708 is maintained continuously in driving contact with wheel 709, to impart continuous, constant rotation to shaft 710 and yarn arm 711. Thus, the equalizer 701 draws yarn at a constant rate from extruder 700, and delivers it to drum 703 for temporary storage en route to winder 705.

The pneumatic system for this modification is illustrated in FIG. 24, and includes a bore 714 in support 702 connected to a source of compressed air (not shown). Bore 714 bifurcates into bores 715 and 716 in support 702. Bore 715 communicates with the atmosphere through an orifice in plug 717 which is adapted to be closed by valve 718 mounted on the yarn sensing finger 719. Bore 716 leads to air chamber 721, having mounted therein piston 722. Spaced a short distance from the outer end of piston 722 is a microswitch 723 connected by electrical conduits 724 to a two speed electric motor 725 which drives the winder 705.

In the event the yarn store on drum 703 should fall below a selected minimum number of turns, the yarn sensing finger 719 is caused to pivot inwardly in respect of drum 703, to close valve 718 in the pneumatic system. This causes the air pressure to rise in air chamber 721 to advance piston 722 into contact with microswitch 723. Microswitch 723 transmits an electric signal through conduits 724 to motor 725, to slow down the motor and reduce the rate at which yarn is withdrawn from drum 703 by the winder. When a sufficient number of yarn turns have been restored to drum 703, the yarn turns cause yarn finger 719 to pivot outwardly of the drum to open valve 718. Air pressure then is reduced in the chamber 721 and the piston 722 permitted to retract from the microswitch 723. This action transmits a new signal through conduits 724 to the motor 725 to cause winder 705 to resume its former speed. Thus, the yarn sensing finger 719 and the pneumatic system of the yarn tension equalizer 701 serve to slow down and speed up the winder 705 in response to the number of yarn turns on the drum 703, thereby maintaining at all times an ample store of yarn for delivery to the winder.

Although certain preferred embodiments of this invention have been shown and described for purposes of illustration, it is to be understood that this invention may be applied to many other uses, and that various changes and modifications may be made therein without departing from the spirit and utility of the invention, or the scope thereof as set forth in the appended claims.

I claim:

1. In an automatic yarn tension equalizer having a drum about which yarn is wound helically to form a plurality of turns and from which yarn is drawn off in a generally axial direction at one end thereof, a yarn guide for delivering yarn to the drum, means for urging

the yarn turns axially along the drum toward the yarn draw-off end of the drum and retractable drive means for rotating the drum and the yarn guide relative to each other, means for advancing intermittently the drive means relative to the drum to cause the drum and the yarn guide to rotate relative to each other comprising:

- a. a pneumatic system having
 1. a source of compressed air,
 2. an air chamber connected to the source of compressed air,
 3. a valve for the air chamber and
 4. means for opening and closing the valve to vary air pressure in the chamber,
- b. a piston slidably disposed within the air chamber and movable therein in response to the amount of air pressure in the chamber,
- c. yarn sensing means disposed adjacent the periphery of the drum for collecting the valve, said sensing means being operative to
 1. permit said valve to open to reduce air pressure in the air chamber when a maximum of yarn turns are on the drum and
 2. permit said valve to close to increase air pressure in the air chamber when a minimum of yarn turns are on the drum, and

- d. retractable lever mechanism connected to the piston and operative to advance and retract the drive means in response to movements of the piston.

2. In an automatic yarn tension equalizer having a drum about which yarn is wound to form a plurality of turns and from which yarn is drawn off at one end thereof, a yarn guide for delivering yarn to the drum and drive means for rotating the drum and the yarn guide relative to each other, means for engaging the drive means to cause the drum and yarn guide to rotate relative to each other comprising:

- a. a pneumatic system having
 1. a source of compressed air,
 2. an air chamber connected to the source of compressed air,
 3. a valve for the air chamber and
 4. means for opening and closing the valve to vary air pressure in the chamber,
- b. a piston slidably disposed within the air chamber and movable therein in response to the amount of air pressure in the chamber,
- c. yarn sensing means disposed adjacent the periphery of the drum for controlling the valve, said sensing means being operative to
 1. permit said valve to open to reduce air pressure in the air chamber when a selected quantity of yarn turns are on the drum and
 2. permit said valve to close to increase air pressure in the air chamber when a second selected quantity of yarn turns are on the drum, and

- d. retractable lever mechanism connected to the piston and operative to engage and disengage the drive means in response to movements of the piston.

3. In an automatic yarn tension equalizer having a drum about which yarn is wound to form a plurality of turns and from which yarn is drawn off at one end thereof, a yarn guide for delivering yarn to the drum and drive means for rotating the drum and the yarn guide relative to each other, means for engaging the

drive means to cause the drum and the yarn guide to rotate relative to each other comprising:

- a. a pneumatic system having
 1. a source of compressed air,
 2. an air chamber connected to the source of compressed air,
 3. a valve for the air chamber and
 4. means for opening and closing the valve to vary air pressure in the chamber,
- b. yarn sensing means disposed adjacent the periphery of the drum and responsive to the number of yarn turns on the drum for controlling the valve, said sensing means causing said valve to open when a selected number of yarn turns are on the drum to reduce air pressure in the chamber, and
- c. retractable linkage means operative to engage and disengage the drive means in response to the amount of air pressure in the chamber.
4. The yarn tension equalizer of claim 3, wherein the drum is rotatable and the yarn guide is stationary.
5. The yarn tension equalizer of claim 4 further including:
 - a. a yarn sensing finger pivotally mounted on the drum,
 - b. resilient means operative to cause the finger to pivot outwardly of the drum when the yarn turns on the drum are reduced to a selected minimum,
 - c. a lever connecting the finger to the valve and
 - d. resilient means operative to urge the lever into valve closing position when the finger is pivoted outwardly of the drum.
6. The yarn tension equalizer of claim 3 wherein the drum is stationary and the yarn guide is rotatable about the drum.
7. The yarn tension equalizer of claim 6 further including:
 - a. a yarn sensing finger pivotally mounted adjacent the drum,
 - b. resilient means operative to cause the finger to pivot inwardly of the drum when the yarn turns on the drum are reduced to a selected minimum and
 - c. means on the finger operative to close the valve when the finger is pivoted inwardly of the drum.
8. The yarn tension equalizer of claim 3 having:
 - a. a piston slidably mounted within said air chamber,
 - b. a lever mechanism connecting the piston to the drive means and
 - c. resilient means connected to the lever mechanism operative to retract the drive means when the valve is opened.
9. The yarn tension equalizer of claim 3 having:
 - a. a piston slidably mounted within said air chamber,
 - b. a lever mechanism connecting the piston to the drive means and
 - c. resilient means connected to the lever mechanism operative to advance the drive means when the valve is open.
10. The yarn tension equalizer of claim 3 wherein the drum has a plurality of arcuately spaced, axially extending slots formed therein, and includes slidable bars mounted in the slots and means to advance and retract the bars to advance the yarn turns toward the yarn drawoff end of the drum.
11. The yarn tension equalizer of claim 3 wherein the drive means includes:
 - a. a rotatable idler pulley mounted on the linkage means and

- b. a driven belt passing continuously around the pulley,
- c. the linkage means being operable to advance and retract the belt in response to the amount of air pressure in the chamber.

12. The yarn tension equalizer of claim 3 wherein the pneumatic system includes:

- a. a first orifice between the air chamber and the source of compressed air and
- b. a second orifice through which air is discharged from the chamber,
- c. said second orifice having a cross sectional area larger than that of the first orifice and adopted to be opened and closed by the valve in response to the number of yarn turns on the drum.

13. The yarn tension equalizer of claim 3 further including means for converting the same to a positive yarn feeding device, said means comprising:

- a. linkage means for engaging the drive means to cause the drum and yarn guide to rotate continuously relative to each other and
- b. means for withdrawing the yarn generally tangentially of the drum.

14. The yarn tension equalizer of claim 3 wherein the drum comprises a plurality of circularly arranged spaced rotatable rollers having axes inclined relative to the axis of the drum, and includes means to drive said rollers to advance the yarn turns toward the yarn draw-off end of the drum.

15. The yarn tension equalizer of claim 3 wherein the drum comprises a plurality of circularly arranged spaced endless belts, and includes means to drive said belts to advance the yarn turns toward the yarn draw-off end of the drum.

16. In a textile machine,
 - a. a shaft,
 - b. a support for the shaft,
 - c. a yarn passage in the shaft,
 - d. a drum mounted on the shaft and spaced from the support,
 - e. a yarn arm fixed to and extending from the shaft between the support and the drum for guiding the yarn radially outward of the shaft,
 - f. means for advancing the yarn axially about the drum from the arm to a point beyond the drum,
 - g. a detent mounted on the shaft and disposed between the support and the drum for locking the drum to the support while providing an opening for the yarn arm extending from the shaft and
 - h. means for rotating the shaft and support relative to each other.

17. The machine of claim 16 wherein the shaft is rotatable and the support and the drum are stationary.

18. The machine of claim 16 wherein:

- a. the detent comprises a disc having teeth engagable with teeth disposed on the support and teeth disposed on the drum, the teeth of the detent, the drum and the support all being arranged circularly, and
- b. the machine includes means for mounting the detent on the shaft angularly of the axis thereof, whereby the teeth of the detent engage progressively the teeth of the drum and the teeth of the support at diametrically opposed locations in the circle of teeth of the detent as the shaft rotates relative to the support.

19. A yarn tension equalizer having:

- a. a shaft,
 - b. a support for the shaft,
 - c. drive means for rotating the shaft relative to the support,
 - d. a yarn passage in the shaft,
 - e. a drum mounted on the shaft and spaced from the support,
 - f. a yarn arm fixed to and extending from the shaft between the support and the drum for guiding yarn radially outward of the shaft,
 - g. a connector disposed between the support and the drum for locking the drum to the support while providing an opening for the yarn arm as it rotates with the shaft relative to the support,
 - h. a pneumatic system having:
 - 1. a source of compressed air,
 - 2. an air chamber connected to the source of compressed air,
 - 3. a valve for the air chamber and
 - 4. means for opening and closing the valve,
 - i. yarn sensing means disposed adjacent the periphery of the drum responsive to the number of yarn turns on the drum for controlling the means for opening and closing the valve to vary air pressure in the chamber and
 - j. retractable linkage means operative to engage intermittently the drive means with the shaft in response to the amount of air pressure in the chamber.
20. The yarn tension equalizer of claim 19 wherein:
- a. the connector comprises a disc having teeth engageable with teeth disposed on the support and on the drum and
 - b. the equalizer includes means for mounting the disc on the shaft angularly of the axis thereof, whereby teeth of the disc engage progressively teeth of the drum and teeth of the support at spaced locations on the disc as the shaft rotates relative to the support.
21. The yarn tension equalizer of claim 19 wherein the shaft is rotatable and the support for the shaft is stationary.
22. Yarn handling apparatus having
- a. a rotatable shaft,
 - b. a yarn passage in the shaft,
 - c. a stationary support for the shaft,
 - d. a drum mounted on the shaft and spaced from the support,
 - e. a yarn guide arm disposed between the support and the drum and affixed to the shaft for rotation therewith,
 - f. said arm extending from the shaft to a point radially outward of the drum,
 - g. said arm having a yarn passage communicating with the yarn passage in the shaft,
 - h. a locking device in the space between the support and the drum,
 - i. said locking device comprising a disc having a circle of teeth,
 - j. a plurality of teeth on the support and on the drum and
 - k. support means affixed to the shaft for mounting the disc angularly of the axis of the shaft, to maintain the teeth of the disc engaged with the teeth of

the support and with the teeth of the drum at diametrically spaced locations on the disc, to lock the drum to the support as the shaft rotates while maintaining an opening for the yarn guide arm.

23. In yarn handling apparatus having a shaft, a support for the shaft having a plurality of circularly-arranged teeth, a drum mounted on the shaft and spaced from the support, said drum having a plurality of circularly-arranged teeth, a yarn guide extending from the shaft between the support and the drum for directing yarn generally radially of the shaft and means for rotating the shaft and the support relative to each other,

- a. a locking device mounted on the shaft and disposed between the support and the drum for locking the drum to the support while providing an opening for the yarn guide,
- b. said locking device comprising a disc having peripheral teeth, and
- c. support means affixed to the shaft mounting the disc angularly of the axis of the shaft to maintain the teeth of the disc engaged with the teeth of the support and with the teeth of the drum at diametrically spaced locations on the disc to lock the drum to the support, while maintaining an opening for the yarn guide.

24. The apparatus of claim 23 wherein

- a. the shaft is provided with an internal yarn passage and
- b. the yarn guide comprises a yarn arm extending from the shaft and having a yarn passage communicating with the yarn passage in the shaft,
- c. said yarn arm extending from the shaft to a point radially outward of the drum.

25. The apparatus of claim 24 wherein

- a. the shaft is rotatable and the support for the shaft is stationary and
- b. the yarn arm is fixed to the shaft for rotation therewith relative to the support.

26. In textile apparatus having a rotatable shaft, a fixed support for the shaft and a drum mounted on the shaft and spaced from the support,

- a. yarn guiding means providing an uninterrupted yarn path extending from a location internally of the shaft to and externally of the drum to a location spaced axially from the drum, said yarn guiding means including
 - 1. an internal yarn passage in the shaft and
 - 2. a yarn conduit fixed to and extending from the shaft to a location radially outward of the drum,
- b. a lock for locking the drum to the support, said lock comprising:
 - 1. a disc having locking means disposed about its rim and
 - 2. locking means disposed on the support and on the drum for engaging the locking means of the disc
- c. and support means suspending the disc angularly of the shaft in locking relationship with the support and with the drum whereby, as the shaft and yarn conduit rotate, an angular undulating motion is imparted to the disc to provide a rotating opening for the yarn conduit extending from the shaft.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,776,480 Dated December 4, 1973
Inventor(s) John B. Lawson

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

Column 1, line 20, "disideratum" should read -- desideratum
-- Column 4, line 8, "dismensioning" should read
-- dimensioning --. Column 6, line 20, "finter" should read
-- finger --. Column 7, line 55, "avertical" should read -- a
vertical --; line 56, "220" should read -- 290 --. Column 8,
line 52, "in" should read -- is --. Column 9, line 14,
"pregressively" should read -- progressively --; line 40,
"50" should read -- 250 --. Column 15, line 37, "adjacent"
should read -- externally of --. Column 16, line 57, "durm"
should read -- drum --. In the claims, Claims 1, 2, 3, 5, 8, 9,
10, 11, 12, 14 and 15 should be canceled, and Claims 35 and 36,
should be added,

35. An automatic yarn tension equalizer having:
- a) a drum about which yarn is wound to form a plurality of turns and from which yarn is drawn off at one end.
 - b) a plurality of axially extending bars mounted in slots spaced circumferentially about the drum,
 - c) cam means to advance and retract the bars to advance the yarn turns on the drum toward the draw-off end thereof,
 - d) a yarn guide for delivering yarn to the drum,
 - e) drive means for rotating the drum and yarn guide relative to each other and
 - f) means for engaging the drive means to cause the drum and yarn guide to rotate relative to each other comprising:
 - (1) a pneumatic system having an air chanber connected to a source of compressed air, a valve for the air chamber and means to open and close the valve to vary air

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,776,480 Dated December 4, 1973
Inventor(s) John B. Lawson Page - 2

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

- pressure in the chamber,
- (2) a yarn sensing finger pivotally mounted adjacent the drum, said yarn sensing finger being operative to cause said valve to open to reduce air pressure in the chamber when a maximum number of yarn turns are on the drum and being operative to cause said valve to close to increase air pressure in the chamber when a minimum number of yarn turns are on the drum,
 - (3) resilient means operative to urge the yarn sensing finger to pivot into valve closing position and
 - (4) retractable linkage means operative to engage and disengage the drive means in response to the amount of air pressure in the chamber.
36. A yarn tension equalizer according to claim 35 wherein the drum is stationary and the yarn guide is rotatable about the drum, further including
- a) a fixed support spaced from the drum and
 - b) a disc disposed between the support and the drum for locking the drum to the support,
 - c) said disc being mounted angularly with respect to the axis of the drum and having locking means about its rim engagable with the support and with the drum.

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,776,480 Dated December 4, 1973
Inventor(s) John B. Lawson Page - 3

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

The Claims should be renumbered as follows:

Patent Claims	New Number
35-----	1
36-----	2 (depend from 1)
4-----	3 (depend from 1)
6-----	4 (depend from 1)
7-----	5 (depend from 4)
13-----	6 (depend from 1)
16-----	7
17-----	8 (depend from 7)
18-----	9 (depend form 7)
19-----	10
20-----	11 (depend from 10)
21-----	12 (depend from 10)
22-----	13
23-----	14
24-----	15 (depend from 14)
25-----	16 (depend from 15)
26-----	17

On the cover sheet, "26 Claims" should read -- 17 Claims --.

Signed and sealed this 1st day of October 1974.

(SEAL)

Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents