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APPARATUS FOR WINDING THREADS, YARNS OR TAPES TO CROSSWOUND PACKAGES

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11 Claims

ABSTRACT OF THE DISCLOSURE

Driving means for thread winding apparatus comprising a bobbin spindle driven by a continuously variable gear the gear ratio of which is variable by means of a feeler member coacting with the package to be wound, the feeler acting to increase the gear ratio with the increasing diameter of the package. The continuously variable gear is a reversing gear and a knock-off motion is provided which, in response to breakage of the thread, causes reversal of the gear and actuation of means to become effective for relatively moving said feeler member and said bobbin shaft away from each other.

This invention relates to apparatus for winding threads yarns or tapes, herein, for the sake of convenience termed "threads," to crosswound packages on bobbins having a bobbin shaft driven by means of a continuously variable gear the gear ratio thereof increasing in response to the increasing diameter of the package, a feeler member arranged for cooperation with the growing package actuating a control member of the gear for varying the gear ratio.

It is an object of the invention to provide a winding apparatus of the above type with means permitting a rapid and simple tying of a broken thread by hand and a placing of the knot at one of the ends of the package being wound, so that the knot does not prevent a correct unwinding of the thread when the wound package later is used on a weaving loom or knitting machine. A placing of the knots at the ends of the package is particularly important and desirable for bobbins receiving a precision winding, from which the thread is unwound intermittently at high speed when they are used on shuttle-less looms.

According to the invention the continuously variable gear is formed as a reversing gear having a control member, and a knocking-off motion is provided which, in response to a breakage of the thread, causes said gear to be reversed and releases means to become effective for producing relative movement of said feeler member and said bobbin shaft away from each other.

The invention will be apparent from the following detailed description, reference being made to the accompanying drawings, in which,

FIGURE 1 is a view in elevation of the apparatus according to the invention, shown during a winding operation.

FIGURE 2 is a plan view of the apparatus partially shown in section along the line II—II of FIGURE 1.

FIGURE 3 is a fragment of FIGURE 1, showing the relative position of the parts with the bobbin shaft at a standstill after a breaking of the thread.

FIGURE 4 is a sectional view taken along the line IV—IV of FIGURE 2, showing a detail of the control device with the bobbin shaft at rest after a breakage of the thread.

FIGURE 5 is a view similar to FIGURE 4 during the winding operation.

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FIGURE 6 is a view in elevation and partial section along the line VI—VI of FIGURE 5 during the winding operation.

FIGURE 7 illustrates the top portion of the apparatus seen from the back of FIGURE 1.

Referring to FIGURES 1 and 2 of the drawings, the represented winding apparatus comprises a frame including a base plate 50 and upright columns 51 and 52 which carry cross supports 53 and 54. Longitudinal beams 55 and 56 are mounted on the cross supports 53 and 54, respectively. Near the bottom end of one of the columns 51 a bracket 57 is fixed which carries a support 60 for a supply bobbin 61 to be unwound.

The unwinding thread 62 is led through a thread tensioning device 63 and past a knock-off motion 64 to a thread support 65 and then is engaged by the thread guides 66 (FIG. 2) which deposit the thread crosswise on the turning package 67 to be wound. The package is placed on a bobbin shaft 68 which is rotatably carried by a rocking arm 70 mounted on a pin 69. The drive of the shaft 68 and of the thread guides in positive driving connection therewith is effected by a motor 71, by the intermediary of a transmission belt 72, a reversible friction gear drive 73 and an endless tooth belt 74 which meshes with a gear wheel 75 driving the thread guide arms 66, and with a gear wheel 76 connected with the bobbin shaft 68 by a further tooth belt 58 and a set of pinions 59. A suction device 77 operated by the knock-off motion 64 is provided for gripping the thread end of the package on the breaking of a thread.

The friction gear drive 73 comprises a gear box 78 through which extends a first shaft 79 (FIG. 2) both ends of which project out of the box. One end of the shaft 79 carries a pulley 80 engaging the driving belt 72 and the other end carries a drum 81. The shaft 79 is operatively connected by a set of gears 79' with a second shaft 82 mounted in the gear box 78 and extending parallel to the first shaft 79. The shaft 82 is driven in the same direction as the shaft 79. Within the gear box the shaft 82 carries a worm 83 meshing with a worm wheel 84. This latter is secured to a coupling sleeve 85 rotatably mounted on a control shaft 86 extending at right angles to the shaft 82 (FIGS. 4, 5 and 6). The sleeve 85 is provided with teeth or flutes and cooperates with a spring loaded ratchet segment 87 which is pivotally mounted on a flange 88 secured to the control shaft 86. During the winding operation, the ratchet segment 87 is maintained out of engagement with the coupling sleeve 85 by means of a spring loaded pin 89. The pin 89 is actuated by an electromagnet 127 controlled by the knock-off motion 64.

The end of the second shaft 82 projecting from the gear box 78 on the side of the drum 81 carries a conical head or collar 90. Between the drum 81 on the shaft 79 and the head 90 on the second shaft 82 is arranged a friction disc 91 the axis of which extends at right angles to the shafts 79 and 82 and carries a gear wheel 92 which engages the tooth belt 74 driving the thread guide arms and the bobbin shaft 68.

The friction disc 91 is rotatably carried by an arm 94' which is mounted for pivoting movement on a shaft 94 extending parallel to the shafts 79 and 82. The pivoting movement of the friction disc 91 is effected by the control shaft 86 as will be described later.

The face of the friction disc 91 on the side of the drum 81 is plane and in one end position of the disc, corresponding to normal winding operation (FIG. 2), this face of the disc 91 is in frictional engagement with an endless belt 93 passing around the drum. In the other end position of the disc, its other face of truncated cone shape is in frictional engagement with the conical head 90 of the shaft 82 whereby the head 90 drives the disc

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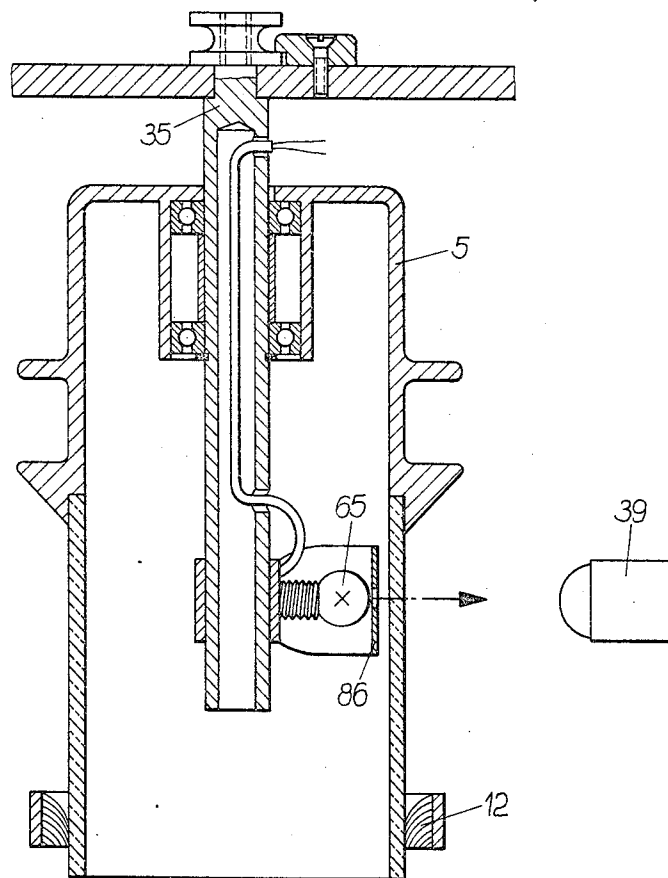
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AUTOMATIC THREAD DELIVERY DEVICE FOR TEXTILE MACHINES

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Fig. 3



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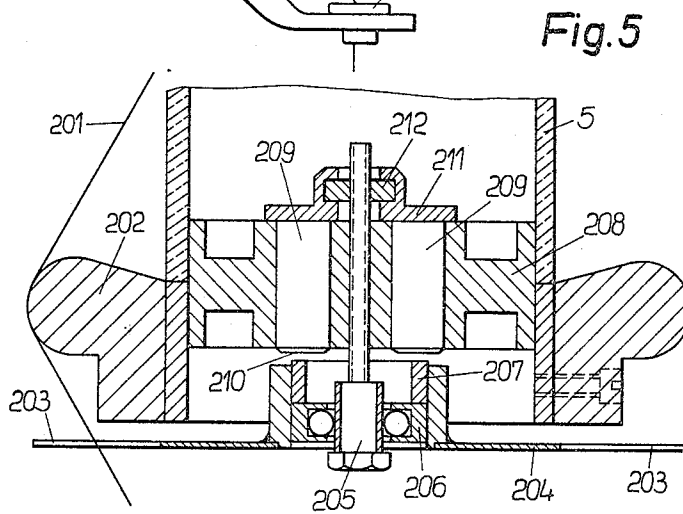
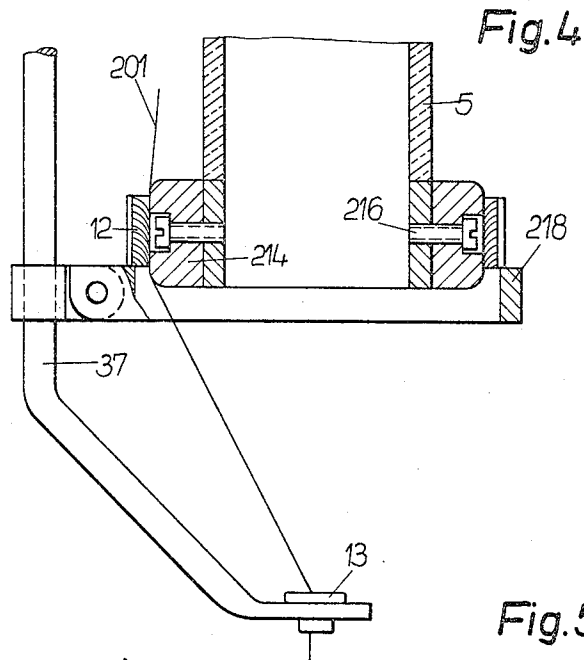
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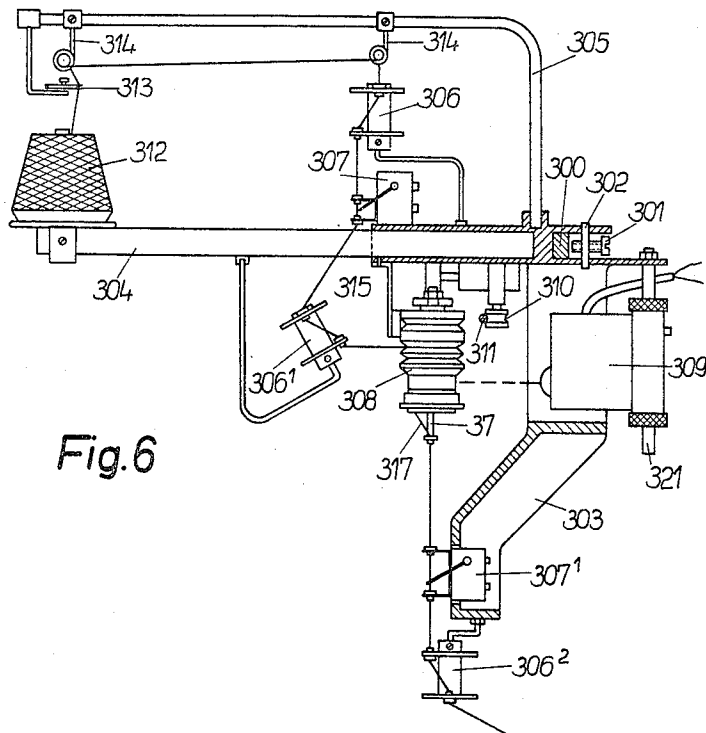


Fig. 6

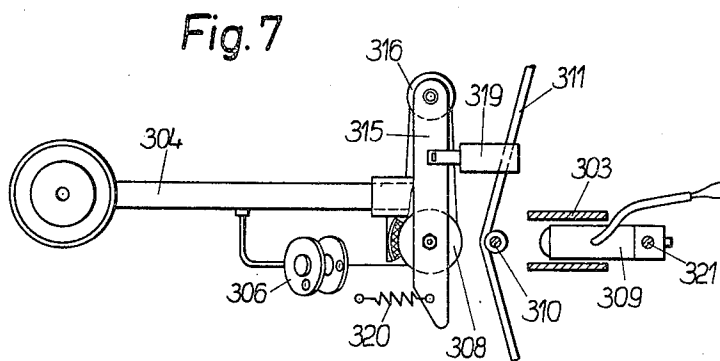


Fig. 7

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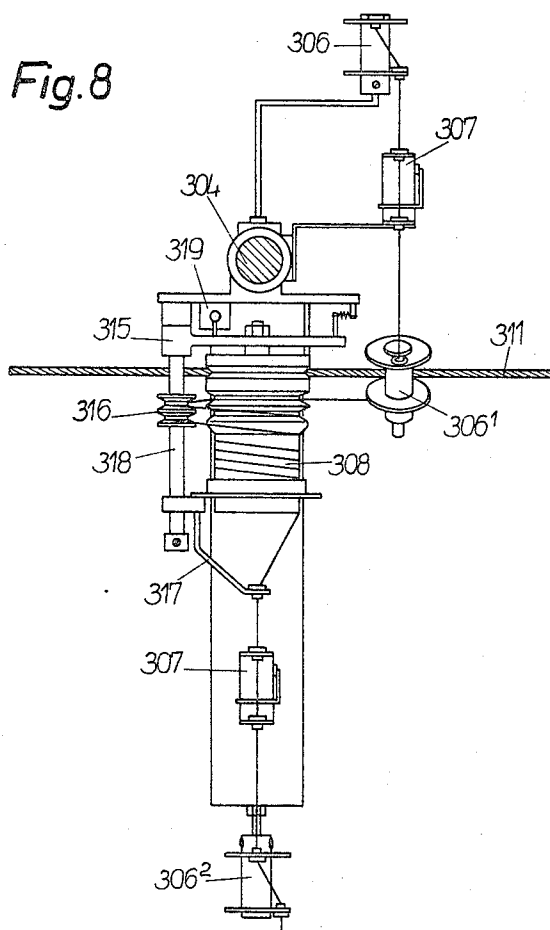
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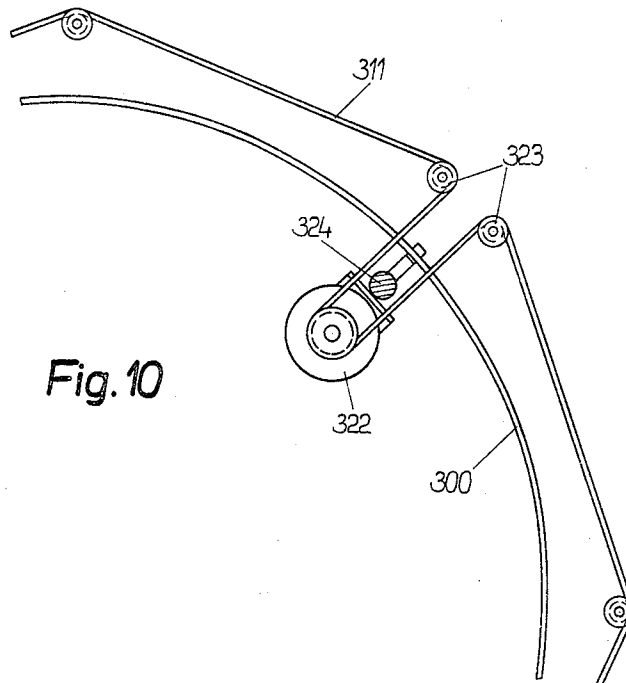
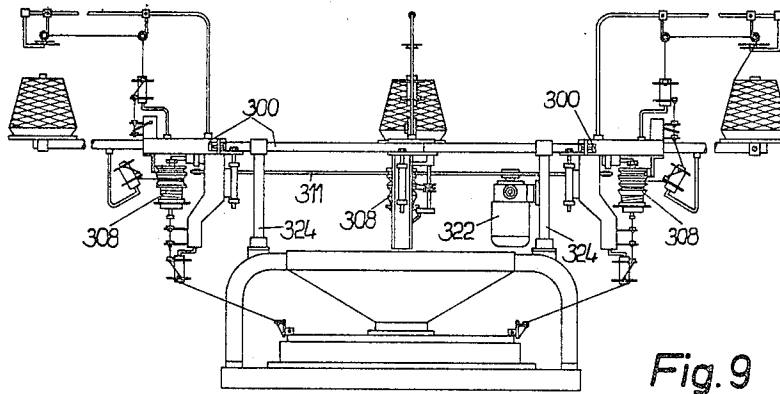
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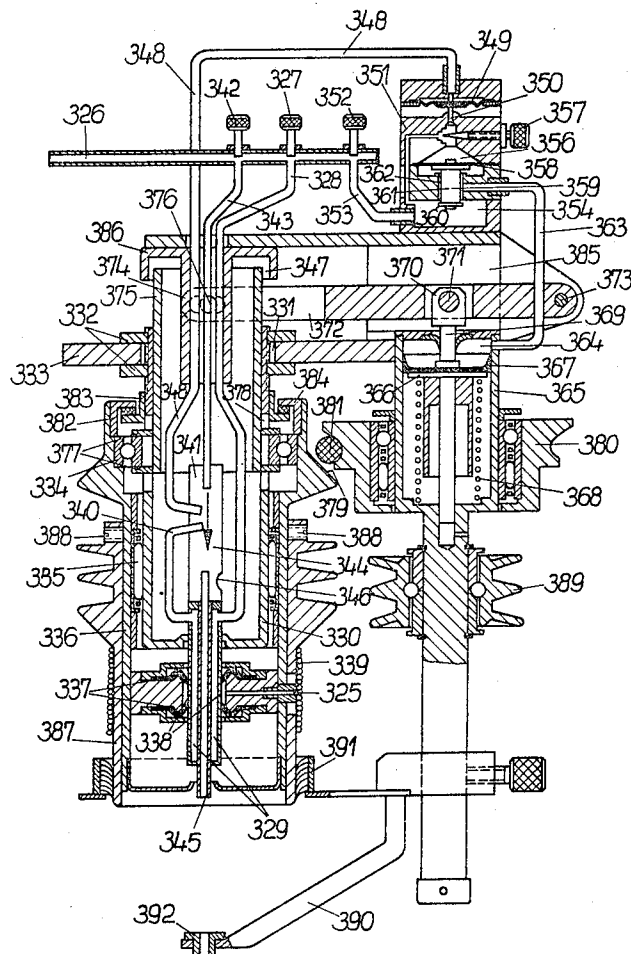
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Fig. 11



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ABSTRACT OF THE DISCLOSURE

A thread storage drum is arranged to have thread wound thereon when rotating, and thread removed therefrom, when stationary, by peeling it off a free end; a sensing mechanism—electro-optical, or pneumatic in the examples—senses the amount of thread wound on the drum and, when the amount drops below a certain limit, causes engagement of the drum with a continuously and rapidly driven belt, to replenish the wound-up supply.

This invention relates to an automatically controlled delivery means for textile machines and more particularly to a thread delivery system having a reserve of thread, and automatically refilling as thread is being withdrawn by the machine, for use with circular knitting machines. Automatically controlled thread delivery including thread loops are known. In one form, a driven rotary body is disposed between the thread spool and the needles. The thread is fed from the windings on the body, by peripheral friction, and thence fed to the stitch-forming parts of the machine. The degree of the frictional force depends on thread tension. If it disappears there is no more pickup, and thread delivery ceases. These devices have various disadvantages; one being that the delivery rollers rotating at high speed and with a smooth surface become unreliable as yarn lubricants increasingly adhere to them and constant cleaning of the delivery rollers and tension adjusters is thus necessary.

Self-adjusting thread delivery means have also been constructed wherein thread is supplied without slippage from a drum-shaped delivery member. The thread is supplied from a feed roller driven from a power source through a slip coupling whose drive is controlled by a thread-sensing switch. A disadvantage of delivery means controlled by thread tension or continuity is, that they are too slow to control large machines and in particular are unsuitable for wide variations in the delivery rate. Such wide variations occur all the time on machines operating with a varying thread requirement at the individual knitting point, such as with Jacquard machines. All the thread delivery means described have in common that machines fitted therewith must have a tall spool frame, since the thread path from spool to delivery means must not be under a certain minimum value, otherwise the thread reserve provided by the length intermediate the delivery means will not suffice to make enough thread available so that holes in the goods are prevented when the thread breaks and before the thread controller can stop the machine. Since the height from floor to ceiling in the usual factory building is limited, the height of the machine is limited by the height of the spool frame. This is undesirable since this also limits the size of the roll of knitted material which is normally disposed below the needle cylinder. In addition, setting-up of the threads, which must be done with long forked rods is tedious.

It is an object of the present invention to provide a thread-delivery apparatus, especially for machines having constantly varying thread requirements at the individual working points, which automatically provides cor-

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rect thread supply, is reliable in operation and permits elimination of a long thread path between spool-holder and thread delivery means, thus giving a compact, low, machine construction, while still supplying thread, practically tension-free, to the machine working points.

Subject matter of the invention

A self-adjusting thread delivery means for circular weaving and knitting machines has a substantially drum or roll-shaped deliverly member, rotatable about a stub shaft, and withdrawing thread from the spool at its periphery when needed; rotation of the delivery member is controlled by the thread, by coupling or uncoupling the drum, when required, to a separate drive source to thus build up a reserve of thread. The delivery member has a peripheral zone for receiving a number of adjacently disposed turns of thread which form a thread reserve. Detector means are provided responsive to the number of turns of thread, to bring the rotatably mounted delivery member into or out of engagement to the drive source, which drives the delivery member (when engaged therewith) at a peripheral speed exceeding the thread delivery rate, to the machine; the thread supplied to the machine is withdrawn from the delivery drum over its end, without requiring any rotation thereof.

The delivery member thus retains a certain reserve of thread wrapped thereon, whose amount is continuously monitored by the detector means. When the removed thread takes the reserve below a certain value, the delivery member is coupled with the drive means and the thread store is again made up.

The time of refilling the drum is determined by the removed thread, so it is immaterial how much thread is used at the individual working points, since the individual thread storage is automatically replenished as required. If thread consumption at a point is zero, delivery stops completely automatically. Normally, the delivery member is still while thread is taken therefrom, for example, held by a brake.

The thread delivery apparatus for the present invention provides positive withdrawal of thread from the drum, so that variable thread tension conditions are not communicated to the stitch-forming point; in other words, the thread is supplied practically tension-free or with uniform tension from the storage drum. Appropriate dimensioning of the drum can readily provide an adequate reserve when a thread breaks. The long thread path and consequent high spool frame in known machines are thus not needed, which enables the machine base to be made higher, thus providing more space for withdrawal and rolling up of the product.

According to a further aspect of the invention, a circular weaving or knitting machine, with the new thread delivery means can be constructed with the thread delivery means affixed adjacent to each other on a common support ring. Further, the spool holders with the corresponding thread guides can be put within reach of attending personnel. Since all the dust collecting points on such a machine are within a small area, better cleanliness from fluff can be achieved with a smaller sized suction device, while manual cleaning is also easier because of the improved spatial arrangement. In addition, the thread delivery means, each with a spool holder and all the appropriate thread guide and control devices, can be assembled into a structural unit affixable to the machine frame adjacent the drive means, for example, on an arm held on bearings. When assembling the machine it is then sufficient to affix a suitable number of these arms on the common support ring. Manufacture and maintenance of the machine are thus considerably simplified.

The drawings show examples of embodiments of the invention. In these:

FIG. 1 is a side elevation of a thread delivery means according to the present invention, assembled with corresponding thread guide and monitoring means into a constructional unit, showing the thread path;

FIG. 2 is a plan view of the device of FIG. 1;

FIG. 3 is the delivery member of the thread delivery device in FIG. 1, in axial section and on a different scale;

FIG. 4 is a thread brake for the thread delivery means of FIGS. 1 and 2, shown in part, in axial section and on a different scale;

FIG. 5 is a different form of thread brake for the thread delivery means of the invention in FIGS. 1 and 2, shown in part, in axial section and on a different scale;

FIG. 6 is a part sectional side elevation of a thread delivery means of the invention similar to the embodiment of FIGS. 1 and 2, wherein spool carrier, thread guide, thread brake and cut-out means are joined in a structural unit;

FIG. 7 shows a part sectional plan view of the thread delivery means of FIG. 5;

FIG. 8 is the thread delivery means of FIGS. 5 and 6 in a sectional front elevation and on a different scale;

FIG. 9 is a side elevation of the upper part of a circular knitting machine with three-thread delivery means as in FIGS. 5-7, showing the common drive;

FIG. 10 shows a sectional plan view of the arrangement for the common drive of the thread delivery means in FIG. 8; and

FIG. 11 is a pneumatically controlled thread delivery means of the invention, in axial section.

In the embodiment of FIGS. 1 and 2: A pivot 74 is firmly affixed to a base plate 75, rotatably mounting a support arm 72 carrying a bolt 75 acted on by a solenoid or magnet 30 mounted on the plate 75 and acting against a tension spring 8 anchored to plate 73. A drum axle 85 carrying a delivery member in the form of a drum 5 and mounted to rotate freely on drum axle 85, is releasably connected to support arm 72. The drum 5 has an associated thread guide roller 35 and an eye-arm 37, both affixed to the arm 72 and thus following its swinging movement about the pivot 74, together with the drum 5.

As seen particularly in FIG. 3, drum 5 is built in shell fashion; its lower half, 150, is formed of transparent material. Inside on the fixed drum axle 85 and adjacent to the transparent material 150, a light bulb 65 is mounted in a socket, with a shutter 86 in front, producing a radially outwardly directed beam which can impinge on a photocell 39 outside drum 5. In its upper area the drum 5 has a guide channel 551, limited at the bottom by a bead 55 of substantially triangular cross-section.

The drum 5 is driven by a continuously rotating belt 6 (FIGS. 1 and 2) running over rollers 80 which support it adjacent to the drum surface. Power is frictionally transmitted by pressing the drum surface against belt 6 adjacent the areas of support by rollers 80.

The movement of the drum against the belt is effected by the magnet 30, and when this is de-energized, the return spring 8 takes drum 5 back to the position shown in FIG. 1 wherein its periphery lies against a brake-shoe 9 so that the drum is rapidly halted.

Base plate 73 is affixed by a clamp 83 to a heavy support ring 82 concentric with the machine axis, the ring being particularly used to take all the devices, assembled into units of the type seen in FIGS. 1 and 2 for delivering thread to individual knitting points. Clamp 83 also holds a corresponding spool support rod 84, of which part only is shown in FIGS. 1 and 2.

The thread moves as follows:

Coming from a spool (not shown) the thread passes through an eye 76 and through a knot detector 77 between the brake plates of a first thread brake 78, through an electrical thread-break detector 79 to a second thread-

brake 78 and from there through guide channel 551 of drum 5 to an upper groove 112 of thread guide roller 35. From there the thread returns to drum 5, being looped almost completely round drum 5 in guide channel 551 in a so-called take-up area 502, whereupon it passes to a lower groove 111 in guide roller 35, where it is fed over the inclined part of bead 55 on drum 5, which leads the thread to the upper cylindrical part of drum 5, forming the so-called thread reserve zone 500.

To provide sufficient thread reserve, the thread is wound around drum 5 a number of turns depending on the amount of reserve needed, whereafter it is fed to the stitch forming point through a plush-covered brake ring at the bottom of drum 5, and two central co-axial eyes 13 mounted on the holder 37. An electric thread cut-out 79¹ detects, by means of lever 79² the thread stretched between the two eyes 13 and immediately stops the machine if the thread breaks or the spool is empty.

The light beam from bulb 65, supplied by electric leads running in the hollow shaft 85, passes through the transparent part of drum 5 and reaches a photocell 39 when the reserve thread turns in area 500 of drum 5 drops below a lower limiting value so that the beam is no longer covered by the thread turns. When the light beam reaches the photocell 39, magnet 30 is energized, for example, through an amplifier or relay, and forces drum 5 against the continuously rotating belt 6, thus causing refilling of the thread reserve until there are again sufficient turns in area 500 to cover the light beam. Running down of the thread reserve, with drum 5 stationary, and building it up, with drum 5 rotating, automatically provides a uniform yarn supply to the stitch-forming section of the machine, regardless of the variation depending on thread consumption.

FIG. 4 shows a somewhat different embodiment of the thread brake formed by plush ring 12. Adjacent this ring, a bead 214 is firmly affixed to drum 5 by bolts 216. The plush ring 12, mounted on bead 214, rotates with drum 5, since it is only loosely supported on a fixed ring 218. The brake or plush ring 12 is necessary for the moving thread 201, since the thread will otherwise be flung outwards by centrifugal force, e.g., when drum 5 starts to rotate and looping around eye holder 37 causing thread breakage. Brake ring 12 is also needed for building up the thread turns or layers in reserve area 500, especially if the reserve in area 500 needs being built up afresh, as may be the case after disruptions such as thread breakage.

A fundamentally different construction of thread brake in conjunction with drum 5 is seen in FIG. 5. Thread 201, coming from reserve area 500 of the drum, runs over a bead 202 rigidly connected to drum 5, and over a plate 204 with teeth 203. The plate 204 is mounted with ball bearings 206 to rotate freely on a bolt 205 connected to the drum 5. It is carried along by thread 201 as the thread winds on. Plate 204 also carries an iron ring 207 acted on by magnetic fields produced by a permanent magnet 209 mounted in a plastic support ring 208. Movement of the iron ring 207 in these magnetic fields induces eddy currents therein which have a braking effect, so plate 204 is slowed down and the required braking of the uncoiling thread loop is effected. The braking effect can be increased or reduced by increasing or decreasing an air gap 210 between the permanent magnet 209 and the iron ring 207. The air gap is adjusted by turning the threaded bolt 205 into a corresponding threaded portion of the support ring 208. A plastic disc 212 mounted in a flange 211 and tightly surrounding the thread of bolt 205 prevents the bolt from unintentionally loosening. The thread then runs from plate 204 through the central eye 15 (not shown) to the thread consuming point.

FIGS. 6, 7 and 8 show a complete thread delivery unit, whose main component, the thread delivery drum 308, together with the auxiliary elements corresponds in main

features with the corresponding parts of the embodiment shown in FIGS. 1, 2 and 3. Concentric with the knitting machine a support 303 is affixed by a bridge clamp 302 and a belt 301 to a ring 300. Support 303 acts as a common holder for a spool carrier bar 304, and eye bar 305, thread brakes 306, an electrical thread break cut-out 307, the thread delivery member comprising a drum 308, its auxiliary parts and a photocell 309. All the said elements are assembled into a structural unit which can be very rapidly mounted on the machine or removed therefrom. Such a thread delivery unit is allotted to each thread-using point in the machine, the common electrical leads supplying all the delivery units being preferably mounted in a cable conduit, not shown. The common drive source for all drums 308 is a circumferential belt 311 which rotates continuously while the machine is operating and is supported by rollers 310.

Thread delivery and reserve holding take place in substantially similar manner to that described for FIGS. 1 to 5:

The thread 317 coming from a spool 312 runs through a knot detector 313, a double guide loop 314, a first thread brake 306, then the eye of an electrical thread break cut-out 307 to a second thread brake 306¹. The elements so far mentioned are of known construction and hence need no detailed description.

From the exit eye of the second thread brake 306¹ the thread runs, in the way explained in reference to FIGS. 1 and 2 around a shiny drum 308 and its corresponding guide roller 316 which, as seen especially from FIGS. 7 and 8, is mounted on a common tubular shaft 318 along with the pivot lever 315 carrying drum 308 and the eye-loop 317. In contrast to the device in FIGS. 1 to 3, the photoelectric means for the detection of the size of thread reserve on drum 308, operates by the reflection system. The detecting light beam is projected by the photocell unit shown at 309, adjustable mounted to move up and down on a spindle 321 so that the amount of thread reserve on drum 308 can be regulated. The emitted light beam is reflected from the shiny surface of drum 308 in its thread reserve area so that it can be received by the photocell in unit 309, if the number of loops of thread on the drum is less than a certain minimum. If the thread reserve is filled, the reserve area of drum 308 is covered with turns so that no light reflection occurs. On receiving a light signal, the photocell unit 309 energizes a magnet 319 which can turn pivot lever 315 against the force of a return spring 320, so that drum 308 is pressed against the continuously rotating belt 311 and the thread store is filled.

Otherwise drum 308 corresponds fully in structure to drum 305 (FIGS. 1 to 3). To simplify the drawings, FIGS. 6 and 8 do not show in detail the parts corresponding to bead 55, guide channel 551, brake ring 12, etc. shown especially by FIG. 8; they are nevertheless present.

FIG. 9 shows the upper part of a circular knitting machine with three delivery units, clamped to support ring 300, of the type shown in FIGS. 6 to 8. Belt 311 which drives all the drums 308 is itself driven by a continuously controllable motor 322. In a simple construction making no great demands on precision of control, motor 322 may be a single fixed speed motor. This speed must, however, be high enough to drive drums 308 at a speed which ensures that they can accumulate more thread reserve in a given period when driven than they must give up for consumption by the machine in the same period.

FIG. 10 shows in detail the arrangement of the drive motor in the circular knitting machine of FIG. 9. At the drive point the flexible belt 311 is inwardly deflected by rollers 325 disposed between two thread delivery units, passing round the drive pulley of motor 322. This motor is itself mounted with a flange on a plate supplied on a machine support column 324. These columns 324 uni-

formly distributed round the machine perimeter also serve to support the ring 300 where to all the delivery units are affixed, as shown in FIG. 9.

In the apparatus so far described (FIGS. 1-8), the size of the thread reserve is electro-optically controlled. According to the invention, the amount of thread is controlled by pneumatic means. Elements previously described will not be again shown or discussed in detail.

FIG. 11 shows the pneumatic sensing and control arrangement. An air jet emerges from a fine nozzle 325 on the perimeter of drum 336, which is mounted on ball bearings 334 and needle bearings 335 on a fixed tube 330 provided at the top with a threaded portion 331 and fixed by two nuts 332 to a support 333. An air distributor chamber 329, connected to nozzle 325 by conduits in the form of apertures, projects into tubular axis 330. Chamber 329 is also connected to a main air pipe 326 by a conduit 328 running inside axis 330 and a throttle valve 327 for adjusting the air jet emerging from nozzle 325. The fixed distributor chamber 329 is sealed from the rotating nozzle 325 by two sealing sleeves 337 having a gap so that air emerging from apertures reaches nozzle 325 via a cavity bounded by sealing sleeves 337. On drum 339 is mounted another casing 387 having a small longitudinal hole at the position of nozzle 325 and fixed relative to drum 336 by set-screws 388. In its external shape, casing 387 corresponds to drum 5 in FIGS. 1 to 3 though naturally there is no transparent area as at 150 in FIG. 3. For clarity of FIG. 11, parts which are the same as in FIGS. 1 and 2 have been omitted, e.g., parts corresponding to guide channel 551 or bead 55.

The turns 339 of the thread reserve applied to easing 387 in the manner explained with FIGS. 1 to 3 close nozzle 325 when the reserve has reached a certain size, as indicated in FIG. 11. Pressure then builds up in distributor chamber 329 so that pressure also rises in an exhaust conduit 340 branched off from chamber 329, and connected to a turbulence amplifier. Such amplifiers are pneumatic units known per se, operating by the so-called Coanda effect and corresponding in principle to a compressed air switch without movable parts. They use the physical fact that a laminar current of a medium bridging a free space is converted into an eddy, or turbulence, if a very small impulse in the form of a compressed air stream is directed across its path. This laminar current is derived from the main air pipe 326 by a pipe 343 and control valve 342. In the turbulence amplifier 341 the laminar current emerging from pipe 343 jumps in the direction of the arrow across the free space shown in a turbulence chamber 344, whereafter it escapes into the atmosphere through an exit pipe 345. If the laminar current is interrupted on its way through the chamber 344 by a lateral air stream from conduit 340, the laminar current flows through a large aperture 346 in the wall of chamber 344 into the inside of tube 330, in its turn releasing air through an annular gap 347. The air eddies caused by this disturbance of laminar flow in amplifier 341 cause a pressure change in chamber 344 which is transmitted through a control pressure pipe 348 to a membrane 349 of a pressure amplifier 351. The pressure increase presses this membrane down into a nozzle holder 350 which is closed. On the other side amplifier 351 is connected via a pipe 353 and control valve 352 to the main pressure pipe 326, so that a space 354 in the pressure amplifier builds up to the pressure prevailing in the pipe 353. From space 354 a further pressure pipe goes to a conically shaped cavity 356 normally exhausted through nozzle hole 350 and also sealed by an elastic valve membrane 358. The pressure head in the cavity 356 can be adjusted by a throttle needle 357.

If the pressure in control pipe 348 now rises and nozzle hole 350 is closed by the membrane 349, pressure also rises in cavity 356 and causes the elastic valve membrane 358 to deflect. A valve body 359 with its valve plate 560, mounted on the valve membrane 358, is also then lifted

from its valve seating, so that through this annular valve opening and a tubular space 362 surrounding the valve body 359 high pressure air can pass from space 354 into a pipe 363 connected to the pressure cavity 364 of a pressure cylinder 365. This cylinder contains a piston plate 366 with a sealing sleeve 367, which because of the pressure rise in pipe 363 is moved down against the force of spring 368. Piston plate 366 carries a piston rod 369 provided at its top with a bearing head 370 connected by a bearing bolt 371 to a double-armed lever 372 whose axis comprises a fixed bolt 373. Because of the downward movement of piston rod 369 the opposite end 374 of double-armed lever moves down like a balance. This lever and 374 comprises a fork enclosing on both sides a movable pipe 375 mounted in tubular axle 330 and protruding therefrom and is connected to pipe 375 by an axial pin 376 mounted thereon.

As lever end 374 moves downward, pipe 375 also descends, taking downwards in its turn, by means of projections 377 engaging through longitudinal slots 378, the ball bearing 334 on which drum 336 is mounted. The whole drum 336 thus moves axially downwards, so that a conical drive surface 379 which was in contact with a round drive belt 381 continuously driven on roller 380 to drive the drum 336 by friction, is lowered from said belt 381 and thus uncoupled, until exit nozzle 325 is again freed by the reducing thread reserve.

An annular brake layer 362, on to which an annular flange 384 of drum 336 descends, is used to halt the drum quickly after its uncoupling from drive belt 361.

For a complete understanding of the description of the construction of the device, it should also be mentioned that in a housing 385, on which pressure cylinder 365 is held and the pivot bolt 375 for the double-armed lever 372 is mounted, there is also disposed a cover sleeve 386 of flexible plastic material which serves to hold pipe conduits 328, 343, and 348 and to shield moving pipe 375 from dust. The size of thread reserve, i.e., the number of thread turns 339 can be varied by moving an outer casing 387 axially up or down relative to drum 336. For this purpose set screws 388 are provided to hold the casing 387, while a small longitudinal hole is cut away from the exit nozzle 325 in the outer casing 387.

The other parts, such as a thread guide roller 389, an adjustable eye-loop 390, and a brake-ring 391 correspond in function to the equivalent parts 111, 112; 13; and 12, respectively, in the thread delivery means of FIGS. 1 to 6, already described.

The device of FIG. 11 has the advantage that the air stream emerging from exit nozzle 325 keeps the thread eye 392 free of the fluff which would otherwise readily accumulate there. A thread brake (FIG. 5), thread guide bead, guide channels, guide roller (FIG. 1), endless drive belt (FIG. 10), are specifically described above and may, of course, also be used in the device of FIG. 11. Some arrangement must be provided when using the thread brake of FIGURE 5 in the embodiment of FIGURE 11 for permitting the air to exhaust from pipe 345, such as apertures in the plastic support ring 208.

The apparatus has been described in connection with electro-optical, and pneumatic sensing and control of thread reserve. Other systems known in the art of detection of the presence of material, and control action to be taken, as determined by specific design requirements, within the inventive concept, may be used.

What is claimed is:

1. Automatic thread delivery device for textile machines comprising
 - a drum-shaped thread delivery member (336) having a peripheral zone capable of storing a number of adjacently disposed turns of thread forming a thread reserve, and being rotatable about an axis to withdraw thread from a supply spool and wind it on its periphery when needed;
 - a separate drive source (381);

operating means controlled by a predetermined amount of turns of thread to bring the delivery member into or out of engagement with said drive source, said drive source (311) driving the delivery member when engaged therewith, at a speed exceeding the thread delivery rate;

said operating means including an internal pneumatic pressure chamber (329) formed in said drum-shaped delivery member (336) and being continuously supplied with a gaseous medium; at least one nozzle bore (325) branching from said chamber, the effective cross-section of said nozzle bore (325) being controlled by the number of thread turns wound on the peripheral zone (387) service as a thread reserve; means utilizing the pressure level in said nozzle bore to control coupling of the delivery member (336) with the drive source (380); and means guiding the thread for withdrawal over the end of said delivery member.

2. Device as in claim 1 wherein said drive source includes an endless belt (381) driven at a constant speed extending along the machine periphery; said operating means engaging part of the peripheral surface (379) of the drum-shaped member (336) against said belt.

3. Device as in claim 2 for assembly with other like devices, to a circular knitting machine, wherein the endless belt extends along at least two adjacent devices, and rollers (380) are provided on said machine acting as abutments located in the region where said belt is pressed against the delivery member.

4. Device as in claim 1 wherein said drum-shaped delivery member is formed with a peripheral thread guide bead and at least one U-shaped guide channel, and a freely rotatable thread guide roller (389) formed with thread guide channels is provided located adjacent the guide channels of the delivery member.

5. Device as in claim 1 including a plush-coated ring (391) mounted, with play, coaxially with the drum-shaped delivery member to form a thread brake.

6. Device as in claim 1 wherein the nozzle bore (325) opens on the peripheral zone (387) for the thread reserve and is adapted to be covered by the thread turns.

7. Device as in claim 6 including pneumatic pressure amplifier (341, 351) connecting said pressure chamber (329) with a servo cylinder (365); said cylinder (365) having a working piston (366, 367) therein; a lever mechanism (370-374) connecting said piston with the delivery member (336, 379) to couple or uncouple the drive source (381) and the delivery member in dependence on the pressure of the medium in the pressure chamber (329).

8. Device as in claim 7 including a turbulence amplifier (341) connected to said pressure chamber (329), and means coupling said amplifier to a subsequent membrane pressure amplifier (361) said membrane pressure amplifier being connected to the servo cylinder (365).

9. Device as in claim 7 wherein the outer periphery of the delivery member (336, 379) is formed with an inclined surface (379) and is mounted to be axially movable, said inclined surface (379) being coupled to the drive means (381), or uncoupled by axial movement caused by the servo cylinder (365).

10. Device as in claim 6, wherein the drum-shaped delivery member (336) comprises a drum body (336) and a coaxial casing (387) axially adjustable thereon and carrying the turns (339) of the thread reserve.

11. Device as in claim 1, including a thread brake comprising a notched metal plate rotatably mounted on the free end of the delivery member and acted on by fixedly mounted brake magnets.

12. Device as in claim 11 wherein the effective air gap of the brake magnets is adjustable.

13. Device as in claim 1 for assembly to a circular knitting machine including a thread spool holder, said thread spool holder, thread guide, and said thread delivery de-

vice being assembled into a constructional unit; and securing means to affix said constructional unit to the knitting machine framework adjacent the drive source (FIG. 9).

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