

Dec. 29, 1959

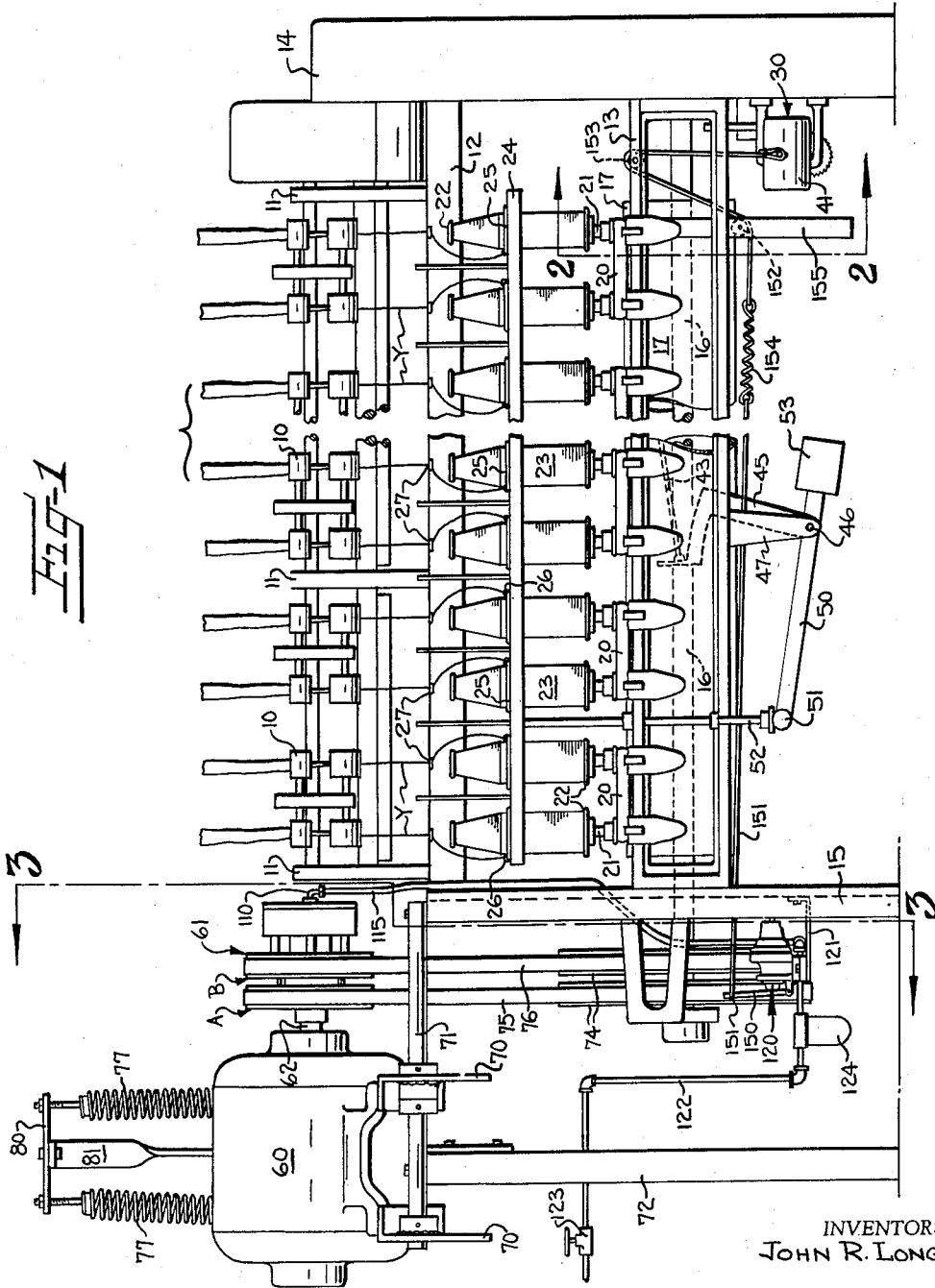
J. R. LONG

2,918,779

VARIABLE SPEED CONTROL FOR WINDING MACHINES

Filed Jan. 22, 1957

4 Sheets-Sheet 1



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VARIABLE SPEED CONTROL FOR WINDING MACHINES

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4 Sheets-Sheet 2

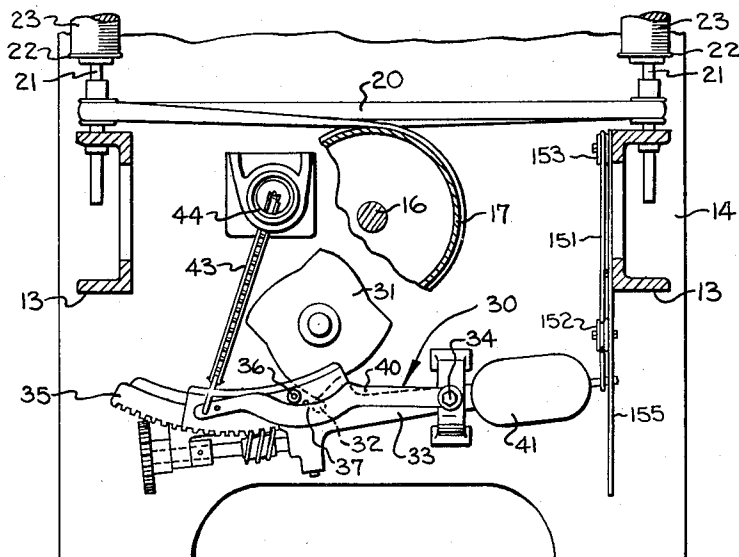


Fig-2

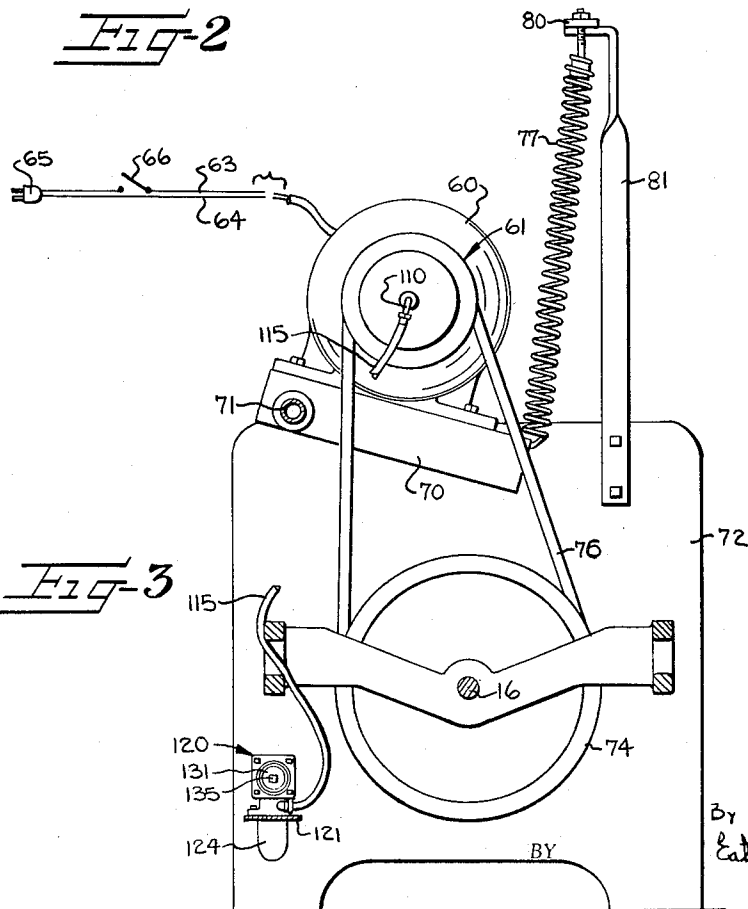


Fig-3

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4 Sheets-Sheet 3

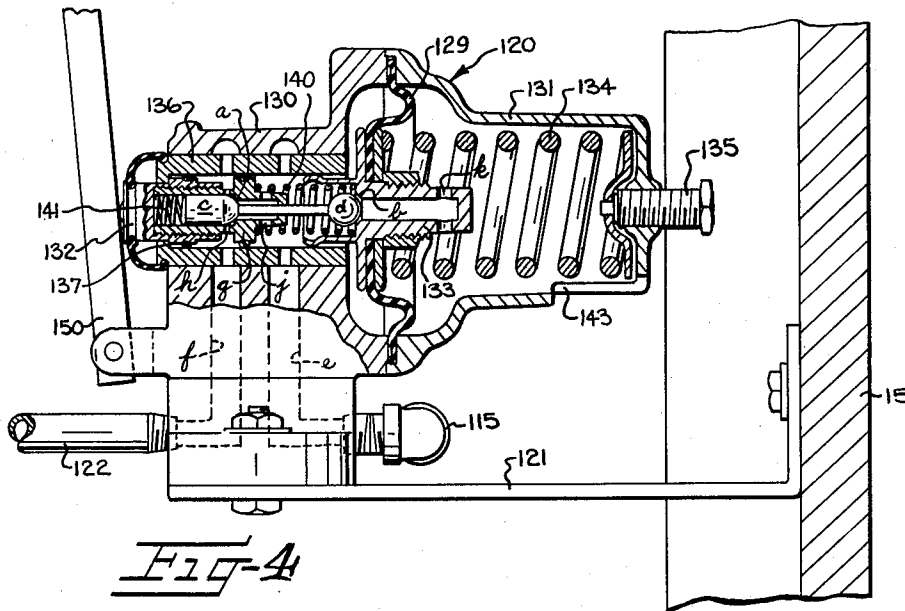


FIG-4

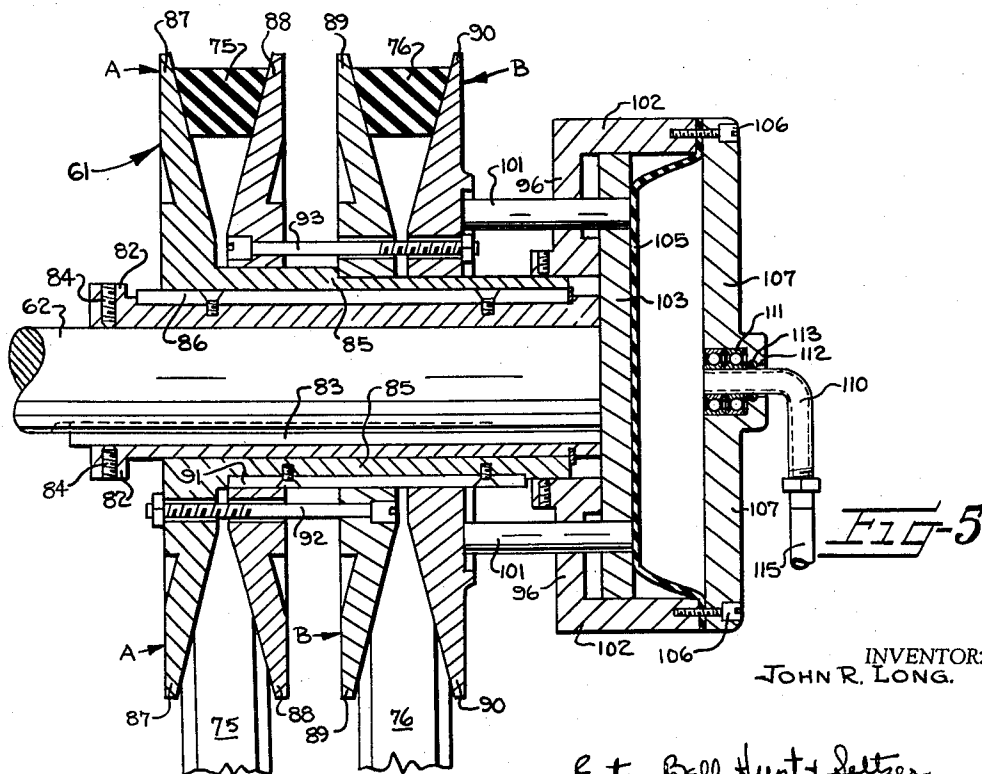


FIG-5

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VARIABLE SPEED CONTROL FOR WINDING MACHINES

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4 Sheets-Sheet 4

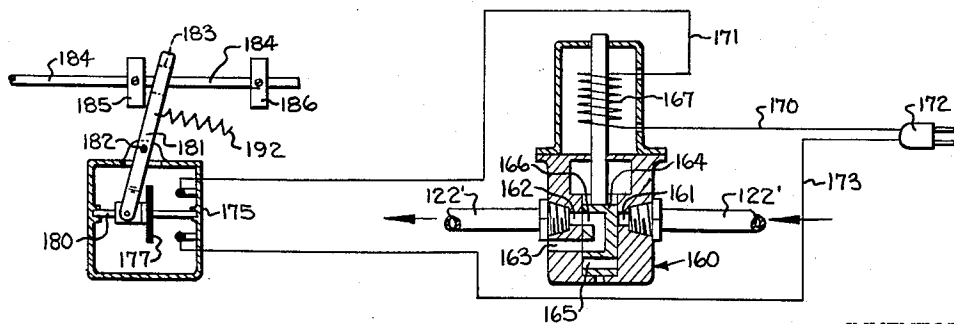


Fig-7

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2,918,779

VARIABLE SPEED CONTROL FOR WINDING MACHINES

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Application January 22, 1957, Serial No. 635,346

18 Claims. (Cl. 57—98)

This invention relates to machines having means for traversing yarn onto yarn carriers and particularly to spinning machines, twisting machines and other winding machines characterized by rings movable with a traversing ring rail for winding yarn on yarn carriers such as bobbins, spools and the like. The present invention is disclosed in association with a spinning machine, although it is to be understood that the present invention may be readily adapted to other types of winding machines.

This application is a continuation in part of my co-pending application entitled, Speed Control for Winding Machines, Serial Number 539,130, filed October 7, 1955, now Patent No. 2,803,107.

It is an object of this invention to provide a simple and inexpensive mechanism for varying the speed of spinning and twisting machines and the like during each reciprocation of the ring rail.

It is another object of this invention to provide a method of winding yarn and the like utilizing apparatus of the type described and including means under control of the traversing mechanism for varying the speed of the machine in a filling wind whereby the machine operates at a predetermined relatively high speed during winding of the yarn at the relatively large diameter of the package and operates at a relatively slow speed during winding of the yarn at a relatively small diameter of the package.

It is well known that the distance between the usual ring-traveler and the bobbin when initial turns of yarn are being wound thereon is much greater than it is when a relatively large number of turns of yarn has been wound on the bobbin so that, in machines which are driven at a constant speed, there is a much greater drag placed on the yarn by the traveler when the package is of relatively small diameter, or only a relatively few turns of yarn are wound on the bobbins, as compared to the drag on the yarn when a substantial number of turns of yarn have been wound on the bobbins, with the result that the yarn is relatively taut as it is initially being wound on the bobbin and the tautness of the yarn gradually diminishes as the diameter of the package increases. For this reason, it has been necessary, heretofore, to operate spinning machines and the like at relatively slow speeds in order to avoid placing excessive tension on the yarn during the initial winding of yarn on the bobbin. However, by providing means whereby the speed of the machine may be varied in the course of each reciprocation of the yarn traversing means or ring rail, this enables substantially higher production.

It is another object of this invention to provide means under control of the traversing mechanism or builder motion for gradually increasing the speed of the machine in the course of each downward stroke of the ring rail and for gradually decreasing the speed of the machine during each upward stroke of the ring rail during a filling wind. This is accomplished by correspondingly

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gradually changing the pressure admitted to a fluid operated variable speed drive mechanism for the machine.

It is another object of this invention to provide a method and apparatus of the character described with means to maintain the speed of the machine relatively slow during a given number of reciprocations of the ring rail upon the starting of the filling wind; that is, during the winding of the bunches on the lower portions of straight bobbins. Thereafter, the speed of the machine gradually increases with each downward stroke of the ring rail and gradually decreases with each upward stroke of the ring rail.

Some of the objects of the invention having been stated, other objects will appear as the description proceeds when taken in connection with the accompanying drawings, in which—

Figure 1 is a somewhat schematic side elevation of a spinning machine embodying the present invention;

Figure 2 is a fragmentary elevation, partially in section, taken substantially along line 2—2 in Figure 1;

Figure 3 is an elevation, partially in section, taken substantially along line 3—3 in Figure 1;

Figure 4 is an elevation of the valve assembly shown in the lower left-hand portion of Figure 1, and showing the operating parts thereof in longitudinal section, the valve assembly being closed;

Figure 5 is an enlarged longitudinal sectional view through the variable speed pulley assembly shown in the upper left-hand portion of Figure 1 and showing the same as though the valve assembly of Figure 4 is open;

Figure 6 shows a modified form of the invention illustrating a portion of the opposite side of a machine such as is shown in Figure 1 with parts broken away and showing, in particular, the means for maintaining relatively slow operation of the machine during the building of the bunch about each of the bobbins;

Figure 7 is a schematic diagram of the constant speed electrical control circuit.

Referring more specifically to the drawings, the machine shown comprises drafting rolls 10 supported on roll stands 11 fixed to a beam 12 spaced above a spindle rail 13. The beam 12 and spindle rail 13 are supported, at opposite ends thereof, on head-end and foot-end frame members 14 and 15. A main cylinder shaft 16 is journaled in the frame members 14, 15 and has a cylinder 17 thereon which drives belts or tapes 20 which, in turn, impart rotation to spindles 21 at opposite sides of the machine. The spindles are supported by the spindle rails 13 and have corresponding yarn carriers, bobbins or spools 22 mounted thereon about each of which yarn Y is wound to form a yarn package 23.

The machine includes a vertically reciprocable ring rail 24 mounted on each side thereof which supports a plurality of rings 25 which encircle the yarn packages 23, and each of which has a traveler 26 thereon for guiding the corresponding yarn from the drafting rolls 10 onto the corresponding bobbin 21. In its course from the drafting rolls 10 to the corresponding bobbin, each strand of yarn Y passes through a suitable guide 27 so the yarn balloons as it is guided through the corresponding traveler and inwardly to the corresponding bobbin.

The main cylinder shaft 16 drives the drafting rolls 10, through conventional mechanism enclosed in the head-end frame member 14, and also drives a builder motion for reciprocating the ring rail 24. The builder motion is best shown in Figure 2, this builder motion being of the conventional type used for building a filling wound package. That is, with each cycle of machine, the ring rails commence directing the yarn to the bobbins while in a relatively low position and the length of each vertical stroke thereof is substantially the same throughout

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formation of the packages 23. However, the ring rails are progressively stepped upwardly so that, with each upward stroke of each ring rail 24 the diameter of the packages gradually decreases and, conversely, with each downward stroke of each ring rail 24, the diameter of the packages gradually increases and, ultimately, the upper end of each package of yarn is tapered substantially as shown in Figure 1.

The builder motion, broadly designated at 30, may be of a type which includes a cam 31 driven to rotate continuously by conventional means, not shown, and which is engaged by a follower 32 projecting from a lever 33 pivotally mounted, as at 34, on the head-end frame member 14. A rack 35 carried by lever 33 has a roller or follower 36 thereon which engages a curved cam surface 37 on an auxiliary lever or builder arm 40 also pivotally supported at 34. The rack 35 is shifted, in a step-by-step manner, to gradually change the range of movement of the arm 40, although the length of each stroke of the free end of the arm 40 remains substantially constant, all of which is well known in the art.

The end of the lever 33 remote from the rack 35 preferably has a suitable weight 41 thereon to assist in maintaining the follower 32 in engagement with the lower surface of the cam 31. The cam surface 37 on the arm 40 is maintained in engagement with the follower 36 by the weight of the ring rail and intervening parts. These intervening parts may include a chain or pliable element 43, one end of which is connected to the free or forward end of the arm 40. The pliable element 43 extends upwardly and passes over a suitable guide means 44 carried by the head-end frame member 14 and the other end of the pliable element is connected to an arm 45 (Figure 1) whose lower end is fixed on a rocker shaft 46 journaled in brackets 47 depending from the spindle rails 13.

The rocker shaft 46 also has a lifter arm or lever 50 fixed thereon beneath each of the spindle rails 13, and one end of which has a follower or roller 51 thereon upon which rests the lower end of a corresponding lifter rod 52. A plurality of said lifter rods 52 is provided at each side of the machine and these lifter rods are guided for vertical movement in the corresponding spindle rails 13 and support, at their upper ends, the ring rails 24. The lifter arm or lever 50 is also provided with a weight 53 which, with other similar weights, not shown, normally urges the corresponding ring rail 24 upwardly, as is conventional, and thereby maintains the curved surface 37 (Figure 2) of the builder arm 40 in engagement with the follower 36 of the builder motion 30. Since the builder motion 30 and the other parts of the machine heretofore described are conventional, a further detailed description thereof is deemed unnecessary. It is with a machine substantially of the character thus far described that the present invention is particularly adapted to be associated.

It is a well known practice to drive spinning machines and the like by means of an electric motor, such as the motor indicated at 60 in Figures 1 and 3. However, the electric motor 60 is preferably mounted in the manner shown in the present drawings or in substantially the manner shown in said copending application so the motor 60 may move toward and away from the main shaft 16 of the machine as the effective diameter of a variable speed pulley assembly 61 is varied in a manner to be later described during reciprocation of the ring rail 24. The motor employed is preferably of the constant speed type and the variable speed pulley assembly 61, mounted on the shaft 62 of the motor 60 (Figure 5) is preferably of a type such as is disclosed in my copending application, Serial Number 418,536, filed March 25, 1954, now Patent No. 2,810,296. The pulley assembly 61 may be mounted on either shaft 62 or 16 without departing from the spirit of the invention. The electric motor 60 may be connected to a suitable source of electrical energy by

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means of a pair of conductors 63, 64 having a plug or electrical connector 65 on the free ends thereof. The conductor 63 may have a manually operable switch 66 interposed therein for controlling the flow of current to the electric motor 60.

The electric motor 60 is fixed on a pivoted support shown in the form of a pair of arms 70 (Figures 1 and 3), corresponding ends of which are pivotally mounted on a horizontal shaft 71 carried by the foot-end frame member 15 and an outboard frame member or standard 72. The main cylinder shaft 16 has a pair of V-pulleys 74 fixed thereon and endless V-belts 75, 76 connect the pulleys 74 with the variable speed pulley assembly 61. In order to maintain the belts 75, 76 taut and thereby insure that the desired changes are made in the speed of the machine as the effective diameters of the pulleys of the pulley assembly 61 are varied, the free ends of the motor supporting arms 70 are resiliently supported by respective tension springs 77. There are two such springs 77 shown in Figure 1, the lower ends of the tension springs 77 being connected to the free ends of the corresponding motor supporting arms 70. The upper ends of the tension springs 77 are connected to a bracket 80 carried by a post 81 whose lower end is fixed to the standard 72 (Figure 3). Although not limited thereto, the pulley assembly 61 is shown as being of a type disclosed in my said copending application, Serial Number 418,536 and, accordingly, only so much of the variable speed assembly 61 will be described as is necessary to a clear understanding of the present invention.

The variable speed pulley assembly 61 (Figure 5) comprises a sleeve 82 which is fixed on the motor shaft 62, as by a key 83 and set screws 84. A second sleeve or tubular hub 85 is keyed, as at 86, for axial movement on the sleeve 82. The hub 85 has four cones or inclined flanges 87, 88, 89 and 90 thereon. The belt 75 is entrained over the pulley A formed of flanges 87, 88 and the belt 76 is entrained over the pulley B formed of flanges 89, 90. Flange 87 is fixed to or formed integral with the inner end of the hub 85 and the flange 89 is fixed on the hub 85. The two flanges 88, 90 are keyed, as at 91, for axial movement on the hub 85 and relative to the corresponding mating flanges 87, 89.

The flanges 87 and 89 are held in fixed relation with each other by means of a plurality of bolts 92 which loosely penetrate the flange 87 therebetween, only one of the bolts 92 being shown in Figure 5. The flanges 88, 90 are prevented from moving apart from each other, to cause them to move together axially of the hub 85, by means of a plurality of circularly spaced bolts 93, which loosely penetrate the flange 89 therebetween. Only one of the bolts 93 is shown in Figure 5. The bolts 93 also prevent relative rotational movement between the flanges 88, 90.

The outer end of the flange 90 is engaged by a plurality of circularly arranged legs or piston rods 101 which loosely penetrate the closed inner end 96 of a cylinder 102 and are fixed to a piston 103 movable within the cylinder 102. The inner end 96 of the cylinder 102 is fixed on the end of the hub 85 remote from the flange 87 so the flanges 87, 89 are maintained in fixed relation with the cylinder 102. The cylinder 102 is provided with a flexible diaphragm 105 whose outer edge is fixed to the outer end of the cylinder 102 by a plurality of screws 106 which are also used for securing a cylinder head or outer closure 107 against the outer end of the cylinder 102.

A pipe fitting 110, which is shown as being substantially L-shaped in Figures 1 and 5, is connected to the central portion of the cylinder head 107, for communication with the interior of the cylinder 102, in such a manner as to form a rotary connection between the cylinder head 107 and the fitting 110, since the cylinder 102 rotates with the pulley assembly while the fitting 110 does not rotate. To this end, it will be noted that the

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inner end of the fitting 110 is fixed, as by a pressed fit, in the inner races of antifriction or ball bearings 111 positioned in the cylinder head 107 and the fitting 110 extends outwardly from the bearings 111 and loosely through an opening 112 formed in head 107. A suitable seal or O-ring 113 may be provided between the fitting 110 and the wall of the opening 112 to prevent leakage of pressure from within the cylinder 102.

From the foregoing, it is apparent that, when the pulleys A, B occupy the position shown in Figure 5 and fluid pressure is released from cylinder 102, the tension in the belts 75, 76 forces the flanges 87, 89 away from the respective flanges 88, 90 and/or vice versa, thereby reducing the effective diameter of the pulleys A, B. Conversely, when pressure is introduced into cylinder 102, the cylinder 102 exerts a pulling force on hub 85 and flanges 87, 89 while the piston 103 and piston rods 101 exert a pushing force against the flanges 88, 90. This causes the motor 60 and pulley assembly 61 to move toward the pulleys 74, due to the tension in the belts 75, 76, thereby increasing the effective diameter of the pulleys A, B of the assembly 61.

The invention resides in the combination with a variable speed pulley assembly of substantially the character described with means for automatically varying the amount of pressure in the cylinder 102 substantially in accordance with variations in the diameter of each yarn package or, in other words, in accordance with vertical reciprocatory movements of the ring rails 24, when operated in a filling wind, to correspondingly vary the effective diameter of the pulleys A, B and to, in turn, correspondingly vary the speed of the machine.

Broadly, the invention includes a variable pressure control valve interposed in a fluid pressure or compressed air system to the cylinder 102 and wherein means are provided whereby the amount of pressure in the cylinder 102 is gradually decreased to a predetermined minimum with each upward stroke of the ring rail 24 and the pressure admitted to the cylinder 102 is gradually increased with each downward stroke of the ring rail 24. As heretofore stated, a decrease in pressure in the cylinder 102 decreases the effective diameter of the pulleys A, B and thereby decreases the speed of the machine, while an increase in pressure in the cylinder 102 serves to increase the effective diameter of the pulley assembly 61 to thereby proportionally increase the speed of the machine.

It will be observed in Figures 1 and 5 that the pipe fitting 110 serves to communicatively connect one end of a conduit or fluid pressure line 115 to the cylinder 102 and the other end of conduit 115 is connected to one side of a pressure control or regulator valve broadly designated at 120 (Figures 1 and 4) which is fixed, by means of a bracket 121, to the foot-end frame member 15. The other side of the pressure regulator valve 120 has one of a conduit or pressure line 122 connected thereto which extends from a suitable source of fluid pressure, not shown, such as compressed air. The conduit 122 preferably has a manually operable shut-off valve 123 and a trap 124 interposed therein. The pressure regulator valve 120 may be of conventional or any desired construction. However, in order that the intricacies of the present invention may be clearly understood, a somewhat detailed description of the pressure regulator valve 120 will now be given.

The pressure regulator valve 120 is shown in the form of a housing comprising a front or primary part 130 and a rear or secondary part 131 having a flexible diaphragm 129 fixed therebetween. A pair of valve plungers are mounted for relative coaxial movement in the housing of the valve 120, the front or primary valve plunger being indicated at 132 and the rear or secondary valve plunger being indicated at 133. Both of the valve plungers 132, 133 are of hollow construction.

The valve plunger 133 is also of built-up construction and is fixed to the central portion of the diaphragm 129.

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One end of a relatively heavy regulator spring 134 bears against the inner valve plunger 133. The pressure of spring 134 against the valve plunger 133 and diaphragm 129 is manually controlled by means of an adjustment screw 135. The housing part 130 of the regulator valve 120 has a sleeve or tubular guide 136 fixed therein in which the outer or front valve plunger 132 is mounted for longitudinal sliding movement, said outer valve plunger 132 being reduced at its outer end and loosely penetrating the corresponding end of sleeve 136 to form a shoulder 137 on the outer valve plunger 132 for limiting outward movement thereof. A compression spring 140 normally urges the shoulder 137 against the restricted end of the sleeve 136, the end of the spring 140 opposite from the outer plunger being seated against the corresponding end of the inner plunger 133. The left-hand end of plunger 133 is loose in the sleeve 136 so that air may pass therebetween.

As heretofore stated, the outer and inner valve plungers 132, 133 are of hollow construction and are provided with respective valve seats *a*, *b* against which respective interconnected valve members *c*, *d* are adapted to be seated. A compression spring 141, positioned within the outer plunger 132, normally urges the valve member *c* against its seat *a*. The part 130 of the pressure regulator valve housing has a pair of passageways *e*, *f* therein which communicate with the respective conduits 115, 122 and extend through the sleeve 136 at opposite sides of an enlarged medial portion *g* of the outer valve plunger 132. The hollow outer valve plunger 132 has one or more passageways *h* therein for establishing communication between the passageway *f* and the valve seat *a*, while the portion of the valve plunger 132 to the right of the enlarged portion *g* thereof in Figure 4 has one or more passageways *j* therein establishing communication between the passageway *e* and the interior of the right-hand portion of the outer valve plunger 132. The right-hand housing part 131 of the pressure regulator valve 120 has an opening 143 therein which communicates with the atmosphere and the right-hand end of the inner plunger 133 also has openings *k* therein which communicate with the housing part 131.

The pressure regulator valve 120 is controlled by the builder motion 30. To this end, the part 130 of the housing of pressure regulator valve 120 has one end of a control lever 150 pivotally connected thereto whose medial portion is adapted to engage the outer end of the outer plunger 132. The other end of the control lever 150 has one end of a cable or pliable element 151 connected thereto (Figure 1) which extends longitudinally of the machine and passes under and over respective guides or rollers 152, 153 (Figure 1 and 2) and then downwardly where it is connected to the rear end of the lever 33 of the builder motion 30. The rollers 152, 153 are suitably journaled on a bar or frame member 155 and one of the spindle rails 13. The bar 155 is suitably secured to and depends from the corresponding spindle rail 13. The cable 151 preferably has a tension spring 154 interposed therein.

Since the left-hand end of the builder motion lever 33 (Figure 2) moves upwardly with each downward stroke of each ring rail 24, the rear or right-hand end of the lever moves downwardly, placing the spring 154 under tension and gradually moving the valve control lever 150 in a clockwise direction in Figures 1 and 4 to gradually open the pressure regulator valve 120. In so doing, the pressure in the cylinder 102 of the variable speed pulley 61 is gradually increased, thereby gradually increasing the effective diameter of the pulleys A and B. The manner in which the valve 120 operates will be later described.

On the other hand, as the cam 31 of the builder motion 30 moves the lever 33 downwardly at its left-hand end in Figure 2, this raises the ring rail 24 as the cable 151 and spring 154 are relaxed, thereby permitting the

valve control lever 150 to gradually move outwardly to closed position. It is apparent that this gradually reduces the pressure in the cylinder 102.

Due to the tension springs 77 lifting the motor 70, when the pressure in the cylinder 102 is lowered, the belts 75 exert sufficient pressure on the proximal inclined surfaces of the respective flanges 87, 88 and 89, 90 to cause the respective flanges to move apart from each other and thereby reduce the effective diameter of the pulleys A, B formed from these flanges. When the effective diameter of the pulleys A, B is decreased, the machine is driven at a relatively slow speed and, as the effective diameter of the pulleys A, B is increased, the speed of the machine is proportionately increased.

It is thus seen that, with each upward stroke of the ring rail 24, the speed of the machine is gradually decreased to avoid placing the yarn under excessive tension and, as the ring rail 24 moves downwardly, the speed of the machine is gradually increased so the yarn does not become unduly slackened as the diameter of the yarn packages 23 increases relative to the rings 25. This insures that the yarn is of more uniform tension throughout each package 23 and is more tightly wound on each package so that each package actually contains more yarn than would be the case if the machine operated at a constant speed. Also, by varying of the speed of the machine with each stroke of the ring rail according to the present invention the overall speed of the machine may be relatively higher than has been possible heretofore. This is due to the fact that, heretofore, the speed of the machine was limited only to the maximum tension that could be placed on the yarn during the winding of the coils of small diameter about the spool or bobbin.

The filling-wound packages 23 shown in Figures 1 and 2 are shown as being straight at the lower portion thereof, as would be the case in the event of the bobbins or yarn carriers each having a cone-shaped or tapered lower portion about which the yarn is initially wound. However, it is not unusual to form filling-wound packages on straight bobbins or yarn carriers as shown in Figure 6. In the modified form of the invention shown in Figure 6, those parts shown therein which are identical to corresponding parts shown in others of the drawings will bear the same reference characters with the prime notation added. It is to be understood that the structure for controlling the ring rail during the bottom portion of its traverse (Figure 6) is used in association with the structure shown in Figures 1 through 5, but is used only in the event that bobbins or yarn carriers are not equipped with a cone-shaped or tapered lower portion.

If so desired, the operator may disconnect the cable 151 from the builder motion lever 33 during the forming of the "bunches" at the lower portions of the yarn carriers so the pressure regulator valve 120 will then remain open. However, the structure shown in Figure 6 causes the air to be exhausted from the cylinder 102 automatically during the traversing of the ring rail in the forming of the bunches on the lower portions of the yarn carriers.

To this end, an auxiliary control valve 160, shown in the form of a solenoid-operated valve, is interposed in the conduit 122' at a point between the source of pressure and the pressure regulator valve 120'. The solenoid valve 160 may be of any desired or conventional structure and is shown schematically in Figure 7 wherein it will be observed that the housing thereof is provided with inlet and outlet ports 161, 162 with which the corresponding portions of the conduit 122' communicate, and the housing of valve 160 is also provided with an exhaust port 163. A valve plunger or core 164 is mounted for vertical movement in the housing of valve 160 and is provided with a pair of passageways 165, 166 therein. The valve 160 is normally closed, at which time the passageway 166 establishes communication between the out-

let port 162 and the exhaust port 163 to exhaust compressed air from the pressure regulator valve 120'.

The upper portion of the valve core 164 is reduced and is encircled by a solenoid coil 167, to opposite ends of which electrical conductors 170, 171 are connected. The passageway 165 is so located that, when the coil 167 is energized and the valve 160 is open, the passageway 165 is aligned with the inlet and outlet ports 161, 162 to thereby admit fluid pressure to the pressure regulator valve 120'. The conductor 170 extends to one side of a suitable source of current embodied in a plug 172, to the other side of which a conductor 173 is connected. The conductors 171, 173 lead to opposed terminals of a switch, generally designated at 175, suitably secured to the foot-end frame member 15' (Figure 6), as by means of a bracket 176.

A movable element or bus bar 177 is suitably supported for movement into and out of engagement with the terminals of the switch 175. In this instance, the housing of switch 175 has a shaft or bar 180 fixed therein on which the bus bar 177 is slidably mounted. The bus bar 177 has one end of a switch lever 181 pivotally connected thereto which extends upwardly through a suitable opening provided in the upper wall of the housing of switch 175 and whose medial portion is pivotally mounted, as at 182, on the housing of the switch 175. The upper end of lever 181 is slotted, as at 183, and the slot 183 is loosely penetrated by a connecting rod or link 184. The link 184 has a pair of relatively adjustable stops 185, 186 fixed thereon which are positioned astraddle the upper portion of lever 180 and are adapted to alternately engage, and thereby impart movement to, the lever 181 with movement of the connecting rod or link 184.

Referring to Figure 6, it will be observed that the arm 45' has an extension 187 thereon which is loosely penetrated by the rod 184. The left-hand portion of the rod 184 in Figure 6 is encircled by a compression spring 190, one end of which is adapted to bear against the extension 187 of arm 45' and the other end of which bears against an adjustable stop or retainer 191 adjustably mounted on the rod 184.

Now, it is apparent that the builder motion, such as the builder motion 30 shown in Figure 2, will impart reciprocatory movement to the arm 45' as the ring rail 24' is reciprocated and effects progressive movement of the arm 45' in a counterclockwise direction in Figure 6 during reciprocation of the arm 45', although the arm 45' moves in strokes of substantially uniform length during each reciprocation thereof. Accordingly, during the traverse of the ring rail 24' adjacent the lower portions of the bobbins 22', the spring 190 may not engage extension 187 or, at least, the pressure exerted on the link or rod 184 by the compression spring 190 is negligible. Also, the distance between the stops 185, 186 relative to the switch lever 181 is such that the switch 175 will remain open during a predetermined number of reciprocations of the ring rail 24' so the valve 160 remains in its normal closed position and exhausts compressed air from the pressure regulator valve 120' to, in turn, permit compressed air to be exhausted from the cylinder 102'. It is apparent that the machine will then operate at a relatively slow speed; during the building of the bunches on the lower portions of the straight bobbins 22'.

Upon a predetermined number of reciprocations of the ring rail 24', the stop 186 on the link 184 engages and imparts counterclockwise movement to the lever 181 to close the switch 175 and open the solenoid valve 160, whereupon the machine functions throughout the remainder of the wind in the manner described with respect to the original form of the invention shown in Figures 1 through 5. The spring 190 permits the arm 45' and its extension 187 to move a substantial distance in a counterclockwise direction in Figure 6 after the stop 186 has engaged and imparted movement to the switch lever 181.

When the winding cycle has been completed and the builder motion, such as builder motion 30, is wound back

in the usual manner preparatory to initiation of another cycle in the operation of the machine, the switch lever 181 may be manually returned to open position or a spring, such as that indicated at 192, may be provided for returning the switch lever 181 to open position. Also, the switch 175 may be in the form of a toggle switch so it will remain in closed or opened position when moved to either of these positions by the stops 185, 186.

In order that the manner in which variation in the pressure in cylinder 102 of the variable speed pulley assembly 61 is effected may be clearly understood, a description of the operation of the pressure regulator valve 120 will now be given.

When the regulator valve 120 is closed, the parts thereof occupy substantially the position shown in Figure 4 and, at this time, the pressure regulator spring 134 is under relatively light compression or, in other words, may be in a relaxed state. Also, at this time, the spring 141 maintains the outer valve member *c* against its seat *a* while the inner valve member *d* may be spaced outwardly from its seat *b*, due to the compression spring 140 maintaining the shoulder 137 of the outer valve plunger 132 against the restricted outer end of the sleeve 136. It is apparent that air could then be exhausted from the cylinder 102 of the variable speed pulley assembly 61 so the effective diameter of the pulleys *A*, *B* would be substantially less than that shown in Figure 5. Of course, the minimum diameter of these pulleys may be determined by adjustment of the screw 135 in the right-hand portion of Figure 4, which would cause the inner plunger 133 to seat against the valve member *d* before the pressure exhausted from the cylinder 102 was lowered to atmospheric pressure.

In any event, when the inner valve member *d* is spaced from the valve seat *b*, air may flow from the cylinder 102, through fitting 110 and conduit 115, through passageway *e*, through the right-hand portion of the sleeve 136, past the valve member *d*, through the hollow inner valve plunger 133, through the exhaust port *k* to be finally exhausted through the exhaust opening 143 in the housing part 131 of the pressure regulator valve 120. The air will be exhausted from the cylinder 102 until it reaches atmospheric pressure or until the pressure acting against the left-hand side of diaphragm 129 and plunger 133 decreases to the extent that the seat *b* of the inner plunger 133 is moved against the inner valve member *d* by the compression spring 134.

When the valve control lever 150 is moved in a clockwise direction in Figure 4, this moves the outer valve plunger 132 inwardly toward the inner valve plunger 133 until the ball or inner valve member *d* seats against its valve seat *b*. Thereupon, the valve seat *a* moves away from the outer valve member *c* with further movement of the outer valve plunger 132, and this movement of the valve seat *a* away from the outer valve member *c* is gradual in accordance with the rate of movement of the valve control lever 150. As the valve seat *a* moves away from the outer valve member *c*, compressed air may flow from the source, through the conduit 122, through passageway *f* into the sleeve 136 and, thence, through passageways *h* in the reduced medial portion of the outer plunger 132, past the valve seat *a*, through the ports or passageways *j*, through the passageway *e*, through conduit 115 and fitting 110 and into the cylinder 102.

In the event that line pressure is greater than the amount of pressure desired to be admitted to the cylinder 102 for obtaining the desired maximum speed of the machine; that is, the desired maximum effective diameter of the pulley assembly 61, the screw 135 in the right-hand portion of Figure 4 may be so adjusted that, upon a predetermined amount of pressure being present in the cylinder 102 and, consequently, in the right-hand portion of the sleeve 136, the pressure present in the right-hand portion of the sleeve 136 may then be such, relative to the pressure exerted by the regulator spring 134, as to

move the inner valve plunger 133 away from the inner valve member *d* and permit excess pressure to escape from the pressure regulator valve 120.

The pressure exerted by the spring 134 can be adjusted by the screw 135 for only one of the above conditions and, normally, the minimum effective diameter of the variable speed pulley assembly 61 is determined by the maximum extent to which the flanges 88, 90 may move away from the respective flanges 87, 89, as limited by the stroke of the piston 103. The maximum effective diameter of the variable speed pulley assembly 61 may also be determined by the stroke of the piston 103, but since this may, in some instances, cause the machine to run at an excessive speed, the screw 135 may be adjusted to regulate the maximum amount of pressure which may enter the cylinder 102 and correspondingly regulate the maximum effective diameter of the variable speed pulley assembly 61. Of course, this maximum pressure would be determined, to some extent, by the force exerted by the tension springs 77 on the motor support.

It is thus seen that I have provided a novel method of and means for automatically increasing and decreasing the speed of a spinning or similar machine with respective downward and upward movements of a ring rail during a filling wind, and for also regulating the speed of the machine to obtain either a minimum or a maximum speed of the machine, and for maintaining the speed of the machine constant during the building of the bunches on the lower portions of straight bobbins during a predetermined number of reciprocations of the ring rails following initiation of each package-winding cycle of the machine.

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

I claim:

1. A spinning machine having spindles and a reciprocating ring rail, a builder motion for reciprocating said rail and including a reciprocating arm, a main shaft adapted to rotate said spindles and to drive said builder motion, a fluid-pressure-operated variable speed drive for driving said main shaft, a pressure regulator valve interposed in a fluid pressure system to said drive, and means operatively connecting the reciprocating arm to said valve and so arranged as to close said valve with each movement in one direction and to open said valve with each movement in the other direction to thereby decrease the speed of the machine with each movement of the ring rail in one direction and increase the speed of the machine with each movement of the ring rail in the opposite direction.

2. A textile machine having spindles and at least one ring rail, means for driving the spindles and reciprocating the rail, pneumatically actuated means for regulating the speed of the spindles and the ring rail, a valve adapted to produce variation of pressure in said pneumatically actuated means, and means responsive to movement of said rail in one direction for opening said valve and being responsive to movement of said rail in the opposite direction to close said valve.

3. A textile machine having spindles and at least one ring rail, means for driving the spindles and reciprocating the rail, pneumatically actuated means for regulating the speed of the spindles and the ring rail, a valve adapted to produce variation of pressure in said pneumatically actuated means, and means responsive to movement of said rail in one direction for gradually opening said valve and being responsive to movement of said rail in the opposite direction to gradually close said valve.

4. A textile machine having spindles, at least one ring rail, a builder motion having a reciprocatory arm coupled to said rail for reciprocating the rail, means for driving;

said builder motion and said spindles, means responsive to fluid pressure to regulate the speed of said motion and said rail, a valve adapted to produce variation of pressure at said pressure-responsive means, movable means on said valve for controlling the same, means interconnecting the arm and the movable means whereby the arm produces an increase in pressure in said pressure-responsive means with movement in one direction, and whereby the arm effects reduction in pressure in said pressure-responsive means with movement in the opposite direction.

5. A structure as claimed in claim 4 having yieldable means in said interconnectig means whereby the strokes of the arm may exceed in length the strokes of said movable means.

6. A structure according to claim 4 wherein said valve is provided with means independent of said movable means for governing the maximum pressure admissible to said pressure-responsive means.

7. A structure according to claim 4, wherein said valve is provided with means independent of said movable means for governing the minimum pressure at said pressure-responsive means.

8. A spinning machine having spindles and a reciprocating ring rail, a main shaft adapted to rotate said spindles and to reciprocate said rail, a driven shaft disposed adjacent said main shaft, a first pulley fixed on one of said shafts, a fluid-pressure-operated expansible pulley mounted on the other of said shafts, at least one V-belt entrained over said pulleys, a conduit extending from a source of fluid pressure to said fluid-pressure-operated expansible pulley, means responsive to movement of said ring rail in one direction for increasing the amount of pressure directed into the fluid-pressure-operated expansible pulley, said means being responsive to reciprocation of said ring rail in the opposite direction for decreasing the amount of pressure directed to the fluid-pressure-operated expansible pulley, and said expansible pulley being so arranged that increased pressure correspondingly changes the effective diameter of the expansible pulley and decreased pressure inversely changes the effective diameter of the expansible pulley to thereby effect corresponding changes in the speed of the machine.

9. A spinning machine having spindles and a reciprocating ring rail, a main shaft adapted to rotate said spindles and to reciprocate said rail, a driven shaft disposed adjacent said main shaft, a first pulley fixed on one of said shafts, a fluid-pressure-operated expansible pulley mounted on the other of said shafts, at least one V-belt entrained over said pulleys, a conduit extending from a source of fluid pressure to said fluid-pressure-operated expansible pulley, means responsive to each movement of said ring rail in one direction for gradually increasing the amount of pressure directed into the fluid-pressure-operated expansible pulley, said means being responsive to reciprocation of said ring rail in the opposite direction for gradually decreasing the amount of pressure directed to the fluid-pressure-operated expansible pulley, and said expansible pulley so arranged that increased pressure correspondingly changes the effective diameter of the expansible pulley and decreased pressure inversely changes the effective diameter of the expansible pulley to thereby effect corresponding changes in the speed of the machine.

10. A spinning machine having spindles and a reciprocating ring rail, a main shaft adapted to rotate said spindles and reciprocate said ring rail, a driven shaft disposed adjacent said main shaft, a first pulley fixed on one of said shafts, a fluid-pressure-operated expansible pulley mounted on the other of said shafts, at least one V-belt entrained over said pulleys, conduit means extending from a source of fluid pressure to said expansible pulley, a pressure regulator valve interposed in said conduit means, means for opening said pressure regula-

tor valve to correspondingly increase the amount of pressure directed into the expansible pulley with movement of said ring rail in one direction with each reciprocation thereof, said last-named means also being operable for closing said pressure regulator valve to correspondingly decrease the amount of pressure directed into the expansible pulley with movement of said ring rail in the opposite direction with each reciprocation thereof, and said expansible pulley being so arranged that increased pressure increases the effective diameter of the pulley and decreased pressure decreases the effective diameter of the pulley and thereby respectively increases and decreases the speed of the machine.

11. A spinning machine having spindles and at least one reciprocating ring rail, a main shaft adapted to rotate said spindles and reciprocate said ring rail in a filling wind, a driven shaft disposed adjacent said main shaft, a first pulley fixed on one of said shafts, a fluid-pressure-operated expansible pulley mounted on the other of said shafts, at least one V-belt entrained over said pulleys, conduit means extending from a source of fluid pressure to said expansible pulley, a pressure regulator valve interposed in said conduit means, means for gradually opening said pressure regulator valve to gradually increase the amount of pressure directed into the expansible pulley with each movement of said ring rail in one direction, said last-named means also being operable for gradually closing said valve to gradually decrease the amount of pressure in the expansible pulley with each intervening movement of said ring rail in the opposite direction, and said expansible pulley being so arranged that increased pressure increases the effective diameter of the pulley and decreased pressure decreases the effective diameter of the pulley and thereby respectively increases and decreases the speed of the machine.

12. A textile machine having spindles and at least one ring rail, means for driving the spindles and reciprocating the rail, pneumatically actuated means for regulating the speed of the spindles and the ring rail, a first valve adapted to produce variation in pressure in said pneumatically actuated means, means responsive to movement of said rail in one direction for gradually opening said valve and being responsive to movement of said rail in the opposite direction to gradually close the valve, and means to render said valve ineffective during certain successive reciprocations of said rail.

13. A textile machine having spindles and at least one ring rail, means for driving the spindles and reciprocating the ring rail, pneumatically actuated means for regulating the speed of the spindles and the ring rail, a first valve adapted to produce variation in pressure in said pneumatically actuated means, means responsive to movement of said rail in one direction for opening said valve and being responsive to movement of said rail in the opposite direction to close said valve, and a second valve for rendering said valve ineffective during a predetermined number of reciprocations of the ring rail occurring upon initiation of each cycle in the operation of the machine and to thereby maintain the speed of the spindles and rail constant during the latter reciprocations.

14. A spinning machine having spindles and a reciprocating ring rail, a builder motion for reciprocating said ring rail and including a reciprocating arm, a main shaft adapted to rotate said spindles and to drive said builder motion, a fluid-pressure-operated variable speed drive for driving said main shaft, means to maintain the pressure in said variable speed drive substantially constant during a predetermined number of reciprocations of said ring rail upon the initiation of a winding cycle in the operation of the machine, and means operable thereafter for gradually increasing the amount of pressure in said variable speed drive with each movement of the ring rail in one direction and for decreasing the pressure in said variable speed drive with each movement of the ring rail in the

other direction throughout the remainder of the corresponding cycle of the machine.

15. A structure according to claim 14 wherein said last-mentioned means includes a pressure regulator valve interposed in a fluid pressure system to said drive, means 5 operatively connecting the reciprocating arm to said valve and so arranged as to close said valve with each movement of the arm in one direction and to open said valve with each movement in the other direction, and said first-mentioned means comprises a normally closed second 10 valve interposed in said fluid pressure system with means responsive to a predetermined number of movements of said reciprocating arm, following initiation of a winding cycle, for opening said second valve, and said second 15 valve being arranged to exhaust pressure from the variable speed drive when closed whereby, when the second valve is open, the pressure regulator valve determines the amount of pressure in the variable speed drive.

16. A structure according to claim 15 wherein said second valve is in the form of a normally closed solenoid 20 operated valve, a normally open switch interposed in an electrical circuit to said second valve, and means operable automatically upon a predetermined number of reciprocations of said arm, following initiation of a winding cycle, for closing said switch to open said second valve. 25

17. In a machine having means for traversing yarn onto a rotating yarn carrier in a reciprocatory manner 30 while maintaining the strokes of the traversing means substantially constant and progressively advancing the traversing means in one direction to form a filling-wound package on the carrier, the combination therewith of fluid-pressure-operated means for regulating the speed of

the yarn carrier and the traversing means, valve means adapted to produce variation of pressure in said fluid-pressure-operated means, and means responsive to movement of said traversing means in one direction for opening said valve means and being responsive to movement of said traversing means in the opposite direction to close said valve means.

18. In a machine having means for traversing yarn onto a rotating yarn carrier in a reciprocatory manner while maintaining the strokes of the traversing means substantially constant and progressively advancing the traversing means in one direction to form a filling-wound package on the carrier, the combination therewith of fluid-pressure-operated means for regulating the speed of the yarn carrier and the traversing means, valve means adapted to produce variation of pressure in said fluid-pressure-operated means, and means responsive to movement of said traversing means in one direction for gradually opening said valve means and being responsive to movement of said traversing means in the opposite direction to gradually close said valve means.

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