Jan. 2, 1962 J. R. LONG 3,015,204

SPEED CONTROL FOR SPINNING MACHINES AND THE LIKE

Filed Dec. 22, 1959 4 Sheets-Sheet 1

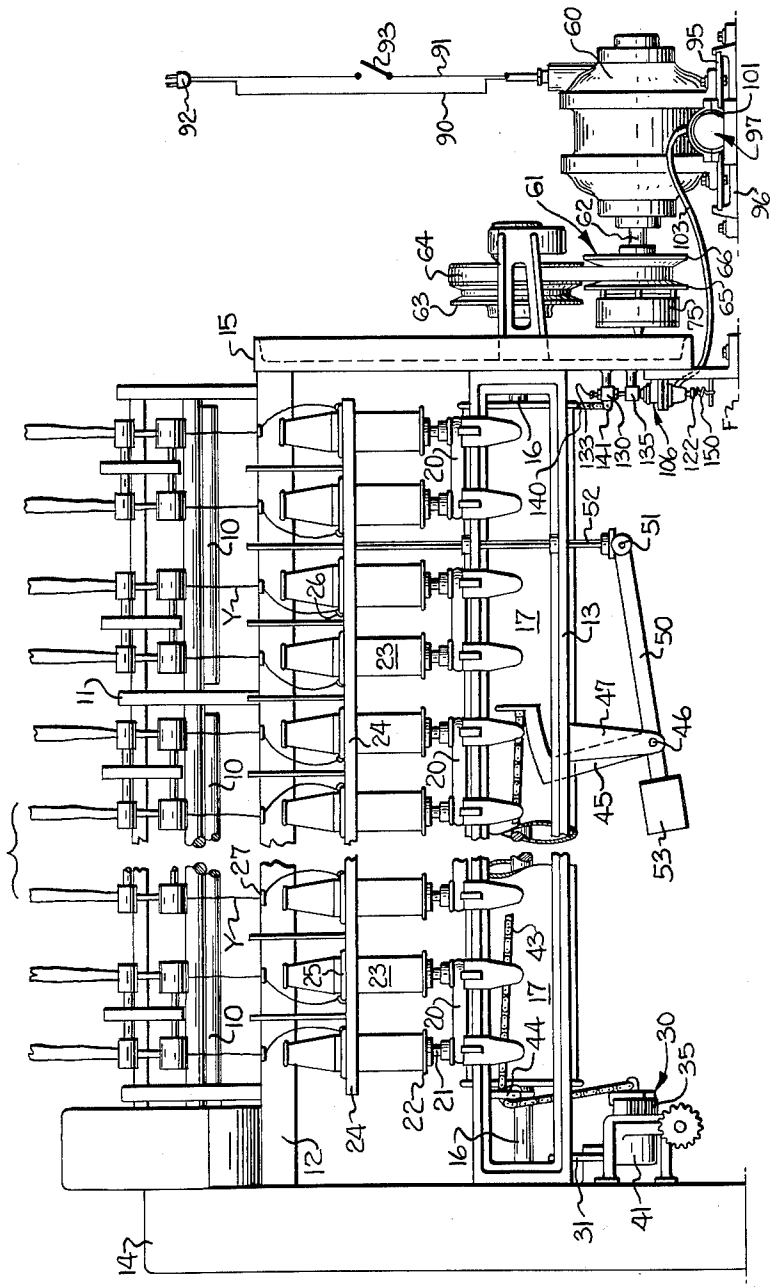


Fig. 1

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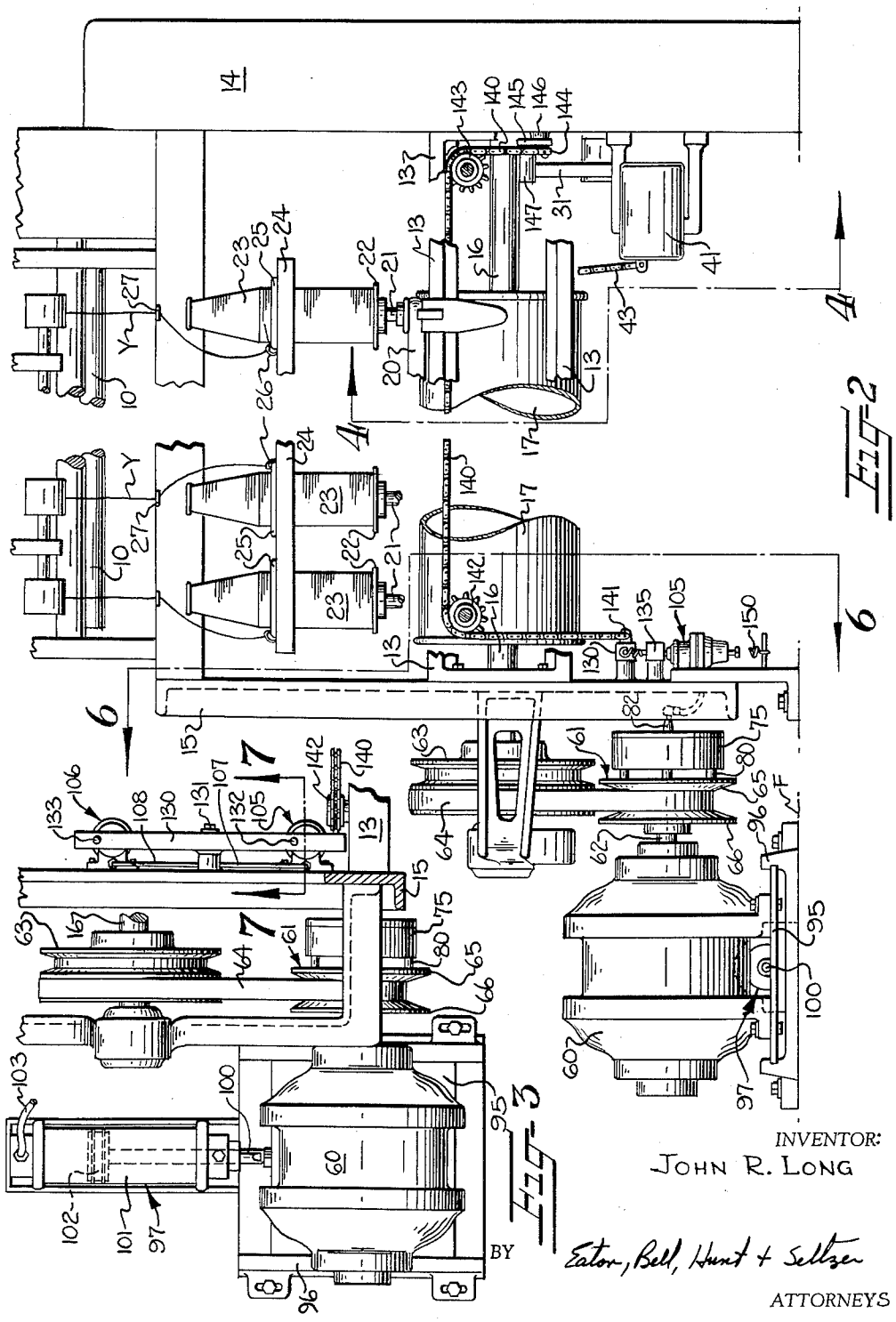


FIG-2

FIG-3

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Filed Dec. 22, 1959 4 Sheets-Sheet 3

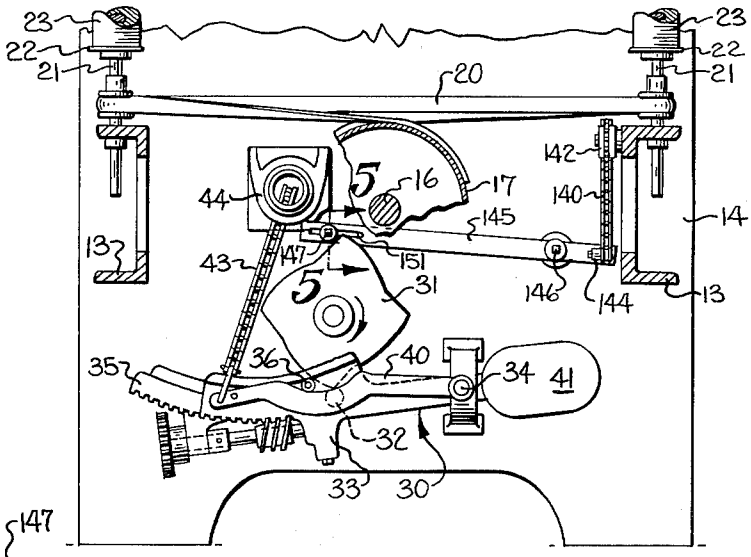


Fig-4

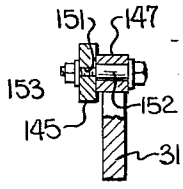


Fig-5

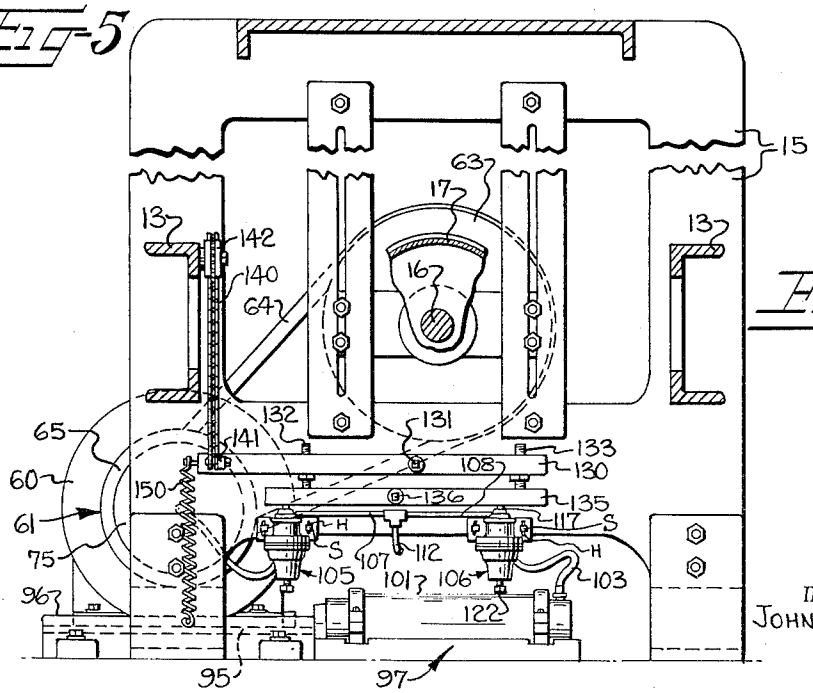


Fig-6

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SPEED CONTROL FOR SPINNING MACHINES AND THE LIKE

Filed Dec. 22, 1959 4 Sheets-Sheet 4

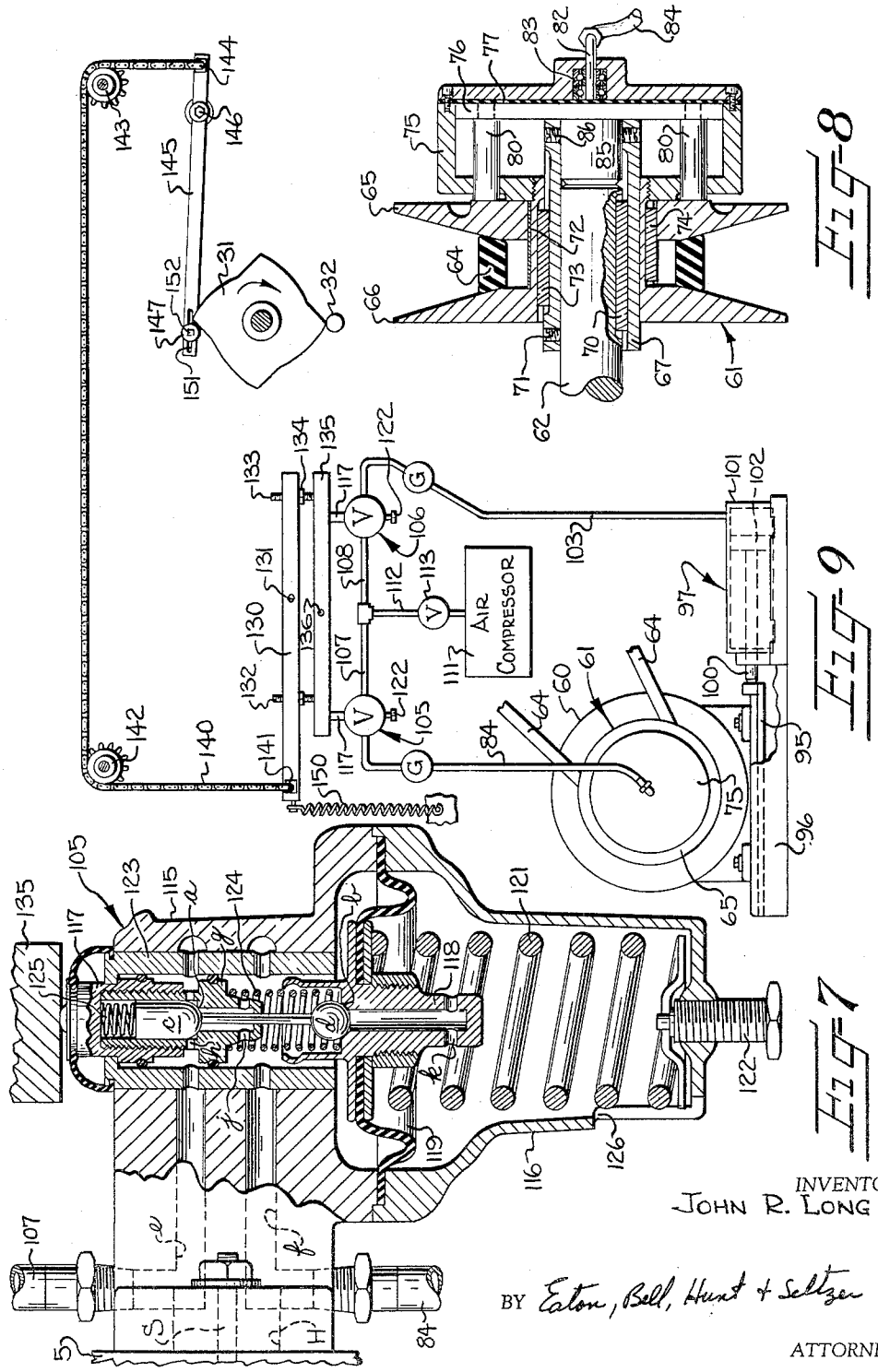


FIG-8

FIG-9

FIG-7

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United States Patent Office 3,015,204 Patented Jan. 2, 1962

3,015,204

SPEED CONTROL FOR SPINNING MACHINES AND THE LIKE

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Filed Dec. 22, 1959, Ser. No. 861,318
22 Claims. (Cl. 57—98)

This invention relates to an improved apparatus for controlling the speed of spinning machines, twisting machines and other winding machines charac erized 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 readily be adapted to other types of textile winding machines.

This application is a continuation-in-part of my copending application entitled Variable Speed Control for Winding Machines, Serial No. 635,346, filed January 22, 1957, now Patent No. 2,918,779.

The distance between the usual ring-traveler of a spinning machine, or the like, 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 have been wound on the bobbin. Thus, in machines which are driven at a constant speed, there is a much greater drag placed on the yarn by the traveler when only a 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. Accordingly, 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, the speed with which the usual spinning machine could be operated had to be limited in order to avoid placing extensive tension on the yarn during the initial winding of the yarn on the bobbin.

In order to facilitate faster operation of such machines, various means have been provided for progressively increasing the speed of the machine with increases in the diameter of the yarn wound on the bobbins thereof.

One type of apparatus used for progressively increasing the speed of the machines is disclosed in my United States Patent No. 2,803,107 granted August 20, 1957, and wherein the speed of the machine is increased each time the ring rail moves in one direction only, with each reciprocation thereof, by increasing the amount of pressure directed into a fluid-pressure-operated expansible or variable speed pulley which drives the machine.

My said copending application discloses and claims apparatus for regulating the speed of the spindles and the ring rail, with means responsive to movement of said ring rail in one direction for opening a valve interposed in a pressure line to a variable speed pulley of the character described, and means responsive to movement of the rail in the opposite direction for closing the valve. Generally, the direction of flow of pressure is reversed in the valve controlling the variable speed pulley disclosed in said copending application, each time the ring rail starts to move upwardly or downwardly with each reciprocation of the ring rail or builder motion. While this has been satisfactory in many respects, it has been found desirable to vary the time at which the increased and decreased pressure in the variable speed drive is initiated, in each instance, relative to the operation of the builder motion and ring rail, so the variable speed drive is more efficient in changing the speed of the machine precisely at the instant desired.

It is therefore an object of this invention to provide an improved apparatus for controlling a fluid-pressure-operated variable speed drive for a spinning machine or

the like, which apparatus includes means for increasing and decreasing the speed of the machine predetermined amounts at predetermined intervals relative to respective movements of a reciprocating ring rail in opposite directions.

For example, in forming a filling wind, the present apparatus produces gradual increases and decreases in machine speed relative to a preconceived optimum speed. A gradual increase in speed is initiated immediately before the ring rail starts each downward stroke, and a gradual decrease in machine speed is initiated immediately before the ring rail starts each upward stroke. The changes in speed are initiated by effecting corresponding changes in the direction of flow of fluid pressure to the variable speed drive, and may be effected within any reasonable range of variation during each movement of the ring rail in each direction.

The variable speed drive of the present invention includes a variable speed pulley provided with relatively movable cones or flanges about which a tensioned V-belt is entrained, with fluid pressure means for moving the cones toward each other. The V-belt is also entrained about a pulley fixed on the main shaft of the machine and separates said cones when fluid pressure is released from the variable speed pulley. Variable speed pulleys of this type are disclosed in my United States Patent Nos. 2,810,296 and 2,877,528. From the foregoing, it is apparent that the variable speed pulley must move, as a unit, relative to the fixed pulley and in direct relation to changes in the relative positions of the cones so the belt is properly tensioned at all times.

It is therefore another object of this invention to provide a fluid-pressure-operated support for said variable speed pulley, wherein fluid pressure is applied to said support in predetermined proportion to the discharge or release of pressure from the cones of said variable speed pulley, so as to move the support away from the fixed pulley and thus tighten the belt and separate the cones. Conversely, as pressure increases in the variable speed pulley and moves the cones thereof toward each other, pressure is proportionally released from said support so the belt may readily pull the support toward the fixed pulley as the effective diameter of the variable speed pulley is increased.

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 side elevation of a spinning machine, omitting the creel, and showing my improved variable speed control in association therewith;

FIGURE 2 is an enlarged fragmentary view looking at the opposite side of the machine from that shown in FIGURE 1, but omitting the central portion thereof;

FIGURE 3 is a fragmentary sectional plan view, partially in section, showing the variable speed drive mechanism in the left-hand portion of FIGURE 2;

FIGURE 4 is a somewhat schematic vertical sectional view showing the builder motion and parts of the improved control mechanism and being taken substantially along line 4—4 of FIGURE 2;

FIGURE 5 is a fragmentary vertical sectional view taken along line 5—5 in FIGURE 4;

FIGURE 6 is a transverse vertical sectional view taken substantially along line 6—6 in FIGURE 2;

FIGURE 7 is an enlarged longitudinal vertical sectional view through one of the regulator valves taken substantially along line 7—7 in FIGURE 3;

FIGURE 8 is a longitudinal vertical sectional view through the variable speed pulley shown in the lower left-hand portion of FIGURE 2;

FIGURE 9 is a schematic diagram of the improved variable speed control apparatus.

Referring more specifically to the drawings, the machine shown comprises drafting rolls 10 (FIGURE 1) supported on roll stands 11 fixed to a beam 12 spaced above a spindle rail 13 at each side of the machine. Opposite ends of beams 12 and spindle rails 13 are supported on head-end and foot-end frame members 14, 15. A main cylinder shaft 16 is journaled in frame members 14, 15 and has a cylinder 17 thereon which drives belts or tapes 20. Tapes 20 impart rotation to spindles 21 at opposite sides of the machine. Spindles 21 are supported by 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 yarn traversing means embodied in a vertically reciprocable ring rail 24, mounted on each side thereof, which supports a plurality of rings 25. Rings 25 encircle yarn packages 23. Each ring 25 has a traveler 26 thereon for guiding yarn from drafting rolls 10 onto the corresponding bobbin or spool 22.

In its course from drafting rolls 10 to the bobbins 22, each strand of yarn Y passes through a guide 27 so the yarn balloons as it passes through a corresponding traveler 26 and inwardly to the corresponding bobbin 22.

Main cylinder shaft 16 drives drafting rolls 10, through conventional mechanism enclosed in the head-end frame member 14, and also drives a builder motion for reciprocating ring rail 24. The builder motion is best shown in FIGURE 4, this builder motion being of a conventional type used for building a filling-wound package. That is, with each cycle of the machine, ring rails 24, rings 25 and travelers 26 commence directing yarns to the bobbins while in a relatively low position and the length of each vertical stroke thereof is substantially the same throughout formation of the packages 23.

However, ring rails 24 are progressively stepped upwardly so that, with each upward movement of each ring rail 24, the diameter of the package gradually increases. 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 FIGURES 1 and 2. The lower portions of bobbins 22 may be tapered so the lower end of each filled package 23 is straight.

The filling-wind 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, connected with main shaft 16. The periphery of cam 31 is engaged by a builder follower 32 projecting from a main builder lever 33 pivotally mounted, as at 34, on head-end frame member 14.

A rack 35, carried by lever 33, also has a roller or rack follower 36 thereon which engages a curved upper surface on an auxiliary builder lever or builder arm 40 also pivotally supported at 34. Rack 35 is shifted, in a step-by-step manner, to gradually change the range of movement of arm 40, although the length of each stroke of the free end of arm 40 may remain substantially constant, all of which is well known in the art.

The end of main builder lever 33 remote from rack 35 is usually provided with a weight 41 to assist in maintaining follower 32 in engagement with the lower surface of cam 31. The curved upper surface on arm 40 is maintained in engagement with follower 36 by the weight of ring rails 24 and intervening parts. Such intervening parts may include a chain or pliable element 43, one end of which is connected to the free or forward end of builder arm 40. Pliable element 43 extends upwardly, passes over a suitable guide means 44 carried by the head-end frame member 14, and then extends to an arm 45 (FIGURE 1) whose lower end is fixed on a rocker shaft 46 journaled in brackets depending from spindle rails 13.

Rocker shaft 46 also has a lifter arm or lever 50 thereon

beneath each of the spindle rails 13. One end of each lifter arm 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, although a single lifter rod 52 is shown in FIGURE 1. Lifter rods 52 are guided for vertical movement in the corresponding spindle rails 13 and support, at their upper ends, the ring rails 24.

Each lifter arm 50 is provided with a weight 53 which normally urges the corresponding ring rail 24 upwardly, as is conventional, and thereby maintains the curved upper surface (FIGURE 4) of builder arm 40 in engagement with follower 36.

Since builder motion 30 and 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, 2 and 3. However, the electric motor 60 is mounted in the manner shown in the present drawings so as to be moved away from the main shaft 16 of the machine under fluid pressure and to be moved toward the main shaft 16 with respective decreases and increases in the effective diameter of a variable speed pulley assembly 61, the changes in effective diameter of the pulley assembly 61 being controlled by apparatus peculiar to the present invention.

Motor 60 is preferably of the constant speed type and the variable speed pulley assembly 61, mounted on the driven shaft 62 of motor 60, may be of a type such as is disclosed in either of my said United States Patents Nos. 2,810,296 and 2,877,528. Pulley assembly 61 may be mounted on either shaft 62 or 16 without departing from the spirit of the invention. The fluid-pressure-operated motor support may be of substantially the type disclosed in my copending United States application Serial No. 639,769, filed February 12, 1957, now Patent No. 2,927,471 and entitled Belt Tensioning Motor Support.

The pressure exerted upon the support for electric motor 60 and variable speed pulley assembly 61 is substantially inversely proportional to the fluid pressure applied to the variable speed pulley assembly 61. This is an important novel feature of the present invention, since it provides for smooth and efficient changes in the speed of the machine and insures proper tensioning of the belt engaging the cones of pulley assembly 61.

It will be observed in FIGURES 1, 2 and 3, that main shaft 16 has a V-pulley 63 fixed thereon, which may be termed as a fixed pulley. V-pulley 63 is engaged by at least one endless V-belt 64 which is also mounted on pulley assembly 61. Pulley assembly 61 (FIGURE 8) is a preferred embodiment of pneumatic or fluid pressure actuated means for regulating the speed of spindles 21, ring rails 24, rolls 10 and other moving parts of the machine.

Pulley assembly 61 comprises a pair of relatively movable cones or flanges 65, 66. Both cones 65, 66 may move relative to a sleeve 67 on which they are mounted, as disclosed in said United States Patent No. 2,810,296, or only one of the flanges, such as flange 66 in this instance, may move relative to said sleeve 67 as disclosed in said United States Patent No. 2,877,528. In this instance, sleeve 67 is keyed to motor shaft 62, as at 70, and is also secured against axial movement on shaft 62 as by means of a set screw 71.

Cone 66 has a tubular hub 72 keyed, as at 73, on sleeve 67. Stationary cone or flange 65 is keyed on hub 72, as at 74, so as to permit movable flange 66 and its hub 72 to move axially of stationary flange 65 while preventing relative rotational movement between flanges

65, 66. The outer end of hub 72 is secured to the inner wall of a hollow cylinder 75.

A piston 76 is disposed within cylinder 75 and a flexible diaphragm 77 is preferably secured between the outer wall and annular side wall of cylinder 75. Piston 76 is provided with a plurality of inwardly projecting pins 80 thereon which loosely penetrate said inner wall of cylinder 75 and bear against the outer surface of stationary flange 65. The outer end wall of cylinder 75 has a tube 82 journaled therein, as by means of anti-friction bearing 83. Tube 82 establishes communication between a pipe or conduit 84 and the interior of cylinder 75; between diaphragm 77 and the outer end wall of cylinder 75.

The variable speed pulley assembly 61 is shown in FIGURE 8 as though all fluid pressure had been released from the cylinder 75 thereof, in which instance, tensioned V-belt 64 will have moved movable flange 66 away from flange 65 so the pulley assembly 61 transmits relatively slow speed rotation to fixed pulley 63 and, consequently, to the machine. It will be noted that piston 76 has a hub 85 integral with or suitably secured thereto, which hub is secured in the outer end of inner sleeve 67 as by screws 86. Accordingly, when compressed air or fluid pressure is introduced into cylinder 75 through tube 82, diaphragm 77 presses against piston 76, and fluid pressure is likewise applied against the inner surface of outer wall of cylinder 75.

It is apparent that this moves cylinder 75 from left to right or outwardly in FIGURE 8. In so doing, piston 75 pulls hub 72 and movable flange 66 therewith, to move flange 66 toward flange 65 and thus increase the effective diameter of variable speed pulley assembly 61. It is apparent that the motor 60 must move toward fixed pulley 63 in order that the bight of belt 64 may move radially outwardly relative to flanges 65, 66.

As heretofore stated, electric motor 60 is preferably of the constant speed type, and it will be noted that electric motor 60 may be energized by means of a pair of electrical conductors 90, 91 (FIGURE 1) having a plug or electrical connector 92 on the free ends thereof which may be connected to a suitable source of electrical energy, not shown. Conductor 91 may have a manually operable switch 93 interposed therein for controlling the flow of current to electric motor 60.

Electric motor 60 is fixed upon a movable support or slide 95 guided in a base 96 suitably secured to the floor F upon which the machine rests. One end of support 95 has the movable part 100 of a fluid motor or fluid-pressure-operated ram assembly 97 suitably connected thereto. In this instance, ram assembly 97 is shown in the form of a cylinder and piston arrangement, the movable part 100 thereof being shown in the form of a piston rod, and the stationary or fixed part being shown in the form of a cylinder 101.

Piston rod 100 slidably penetrates the head-end of cylinder 101 and has a suitable piston 102 fixed on the inner end thereof and which is mounted for axial sliding movement in cylinder 101.

The end of cylinder 101 opopsite from piston rod 100 is closed and has one end of a conduit 103 communicatively connected thereto. As best shown in FIGURES 6 and 9, the ends of conduits 84, 103 remote from variable speed pulley assembly 61 and ram 97 are connected to corresponding sides of respective pressure control valve means or regulator valves broadly designated at 105, 106, to the other side of which compressed air or fluid pressure may be introduced by respective conduits 107, 108 connected to a suitable source of pressure or compressed air 111, as by means of a branch conduit 112. Conduits 84, 103 are preferably provided with respective pressure indicating gauges G. Conduit 112 may also be provided with a suitable manual operable shut-off valve 113 interposed therein.

Pressure regulator valves 105, 106 may be identical and, therefore only regulator valve 105 will be described in detail and like parts of both valves 105, 106 shall bear the same reference numerals where applicable. Various types of regulator valves may be used for controlling the flow of fluid pressure to variable speed pulley assembly 61 and ram assembly 97, just so long as each valve is capable of gradually changing pressure between predetermined minimum and maximum pressures in the cylinder 75 of variable speed pulley assembly 61 and cylinder 101 of ram 97 with respective outward and inward movements of respective operating plungers thereof.

Pressure regulator valve 105 is shown, in FIGURE 7, in the form of a housing comprising an upper or primary part 115 and a lower or secondary part 116 having a flexible diaphragm 119 fixed therebetween. Axially opposed primary and secondary valve plungers 117, 118 are mounted for relative coaxial movement in the valve housing, both valve plungers 117, 118 being of hollow construction.

Valve plunger 118 is also of built-up construction and is fixed to the central portion of diaphragm 119. One end of a relatively heavy regulator spring 121 bears against the secondary valve plunger 118. The pressure of spring 121 against valve plunger 118 and diaphragm 119 is manually determined by means of an adjustment or regulator screw 122. The housing part 115 of regulator valve 105 has a sleeve or tubular guide 123 fixed therein in which the upper or primary valve plunger 117 is mounted for longitudinal sliding movement. Valve plunger 117 is reduced at its upper or outer end and loosely penetrates the restricted corresponding end of sleeve 123, thus forming a shoulder on the upper valve plunger 117 for limiting upward movement thereof.

A compression spring 124 normally urges the shoulder on upper plunger 117 against the restricted upper end of sleeve 123. The end of spring 124 opposite from upper plunger 117 is seated against the corresponding end of lower or inner plunger 118. The upper end of plunger 118 is loose in sleeve 123 so that air may pass therebetween.

Plungers 117, 118 are provided with respective valve seats *a*, *b* against which respective interconnected valve members *c*, *d* are adapted to be seated. A compression spring 125, within upper plunger 117, normally urges valve member *c* against its seat *a*. The housing part 115 of pressure regulator valve 105 has a pair of passageways *e*, *f* therein which communicate with the respective conduits 107, 84 and extend through sleeve 123 at opposite sides of an enlarged medial portion or piston *g* on upper valve plunger 117.

Upper valve plunger 117 has one or more passageways *h* for establishing communication between passageway *e* and valve seat *a*. The portion of valve plunger 117 below the piston *g* has one or more passageways *j* therein, establishing communication between passageway *f* and the interior or lower portion of upper valve plunger 117. The lower housing part 116 has an opening 126 therein which communicates with the atmosphere. The lower end of the inner or lower plunger 118 also has openings *k* therein which communicate with lower housing part 116.

In order that the manner in which variation of pressure in cylinder 75 of variable speed pulley assembly 61 is effected may be clearly understood, a description of the manner of operation of pressure regulator valve 105 will now be given.

The movable parts in both pressure regulator valves 105, 106 normally occupy the position in which the parts of pressure regulator valve 105 are shown in FIGURE 7 under minimum pressure conditions; that is, at times when a minimum amount of pressure is present in the respective cylinders 75, 101. It is apparent that regulator screw 122 (FIGURE 7) determines the amount of pressure exerted by spring 121 against diaphragm 119 and inner plunger 118. Thus, adjustment screw 22 de-

termines either the maximum or minimum pressure which may enter the cylinder 75 of pulley assembly 61 or the cylinder 101 of ram assembly 97, as the case may be.

In this instance, the flanges 65, 66 of pulley assembly 61 are shown in maximum opened or separated position so the pulley formed therefrom is of a minimum effective diameter. Flanges 65, 66 are moved toward each other by moving the upper plunger 117 of regulator valve 105 downwardly relative to upper housing part to gradually open pressure regulator valve 115 in accordance with the rate at which plunger 117 thereof is moved downwardly.

As plunger 117 and its piston *g* move downwardly in FIGURE 7, lower valve *d* bears against seat *b* on lower valve plunger 118, so that valve seat *a* moves away from upper valve member *c* with further movement of the upper valve plunger 117. This movement of valve seat *a* away from upper valve member *c* permits compressed air to flow from the source 111, through conduits 112, 107 and passageway *e* into sleeve 123. Thus, fluid pressure or compressed air flows through passageway *h* in the reduced medial portion of upper plnuger 117, past valve seat *a*, through passageway *j*, through passageway *f*, through conduit 34 and tube 32 into cylinder 75. It is apparent that this causes flange 66 to move toward flange 65.

In the event that line pressure is greater than the amount of pressure desired to be admitted to cylinder 75 to obtain the desired maximum speed of the machine; that is, to obtain the desired maximum effective diameter of pulley assembly 61, regulator screw 122 of regulator valve 105 may be so adjusted that, upon a predetermined amount of pressure being present in the cylinder 75, and consequently, in the lower portion of sleeve 123, the pressure present in the lower portion of the sleeve 123 may then be such, relative to the pressure exerted by the regulator spring 121 as to move lower valve plunger 118 away from the lower valve member *d* and permit excess pressure to escape from the pressure regulator valve 105. The minimum pressure to be maintained in cylinder 75 is determined by the extent to which plunger 117 is permitted to move upwardly toward closed position.

From the foregoing, it is apparent that regulator valve 106 functions in the same manner as regulator valve 105 in determining the maximum and minimum range of pressure in cylinder 101 of ram assembly 97 when regulator valve 106 is closed and opened by lowering and raising plunger 117 of regulator valve 106.

Referring again to FIGURE 7, when pressure is to be released from cylinder 75 of pulley assembly 61, plunger 117 is permitted to move upwardly, under pressure of spring 124, to substantially close valve assembly 105. In so doing, seat *a* of upper plunger 117 engages upper valve member *c*, thus moving lower valve member *d* away from seat *b* on lower plunger 118. This permits air to escape from the lower portion of sleeve 123 in accordance with the rate at which plunger 117 is permitted to move upwardly. Of course, lower plunger 118 also moves upwardly as the pressure escapes past valve seat *b* to the extent effected by regulator spring 121. It follows that, if lower plunger 118 stops upward movement before valve *b* has reached its maximum upward movement, then there will be no positive pressure in the cylinder 75. However, if the regulator screw has been so adjusted that lower valve *d* ceases to move upwardly prior to lower plunger 118 having reached the limits of its upward stroke, a predetermined minimum pressure will remain in cylinder 75.

As heretofore stated, the pressure in cylinder 101 of ram assembly 97 is substantially inversely proportional to the pressure in cylinder 75 of variable speed pulley assembly 61. Thus, whenever the effective diameter of the pulley 65, 66 is increased by the admission of pressure into cylinder 75, belt 64 rides toward the outer peripheral surfaces of flanges 65, 66 and a proportional amount of pressure is released from cylinder 101 of ram 97 so that belt 64 need not overcome excess pressure in cylinder 101, in order to move motor 60 and support 95 toward fixed pulley 63 and main shaft 16, when the effective diameter of pulley 61 is increased.

Conversely, when pressure is released from cylinder 75, pressure is proportionally increased in cylinder 101 to move motor 60 and its support 95 away from fixed pulley 63 and main shaft 16 to produce an optimum amount of additional tension in belt 64 such as to move flanges 65, 66 apart from each other the desired distance to produce a predetermined minimum speed of the machine.

In order to produce the desired changes in the effective diameter of the pulley assembly 61, at predetermined ranges, relative to vertical reciprocation of ring rails 24, and to also produce the inversely proportional changes in pressure in cylinders 75, 101 of pulley assembly 61 and ram assembly 97, I have provided a novel apparatus for gradually closing regulator valve 105, as valve 106 is gradually opened, and vice-versa, and which means operates in timed relation to the operation of the spinning machine.

To this end, I have provided an operating lever 130 which is pivotally mounted intermediate its ends, as at 131, on foot-end frame member 15 in spaced relation above regulator valves 105, 106. Regulator valves 105, 106 are suitably secured to frame member 15 below operating lever 130 as best shown in FIGURE 6. Valves 105, 106 may be mounted for vertical adjustment on frame member 15 so they may be located in proper relation to operating lever 130.

Operating lever 130 is provided with a pair of adjustable abutments 132, 133 which may be spaced substantially equal distances from opposite sides of pivot point 131. Abutments 132, 133 are shown in the form of adjustment screws or set screws threaded through operating lever 130 and being locked in adjusted position by respective lock nuts 134. The lower ends of screws 132, 133 may be so arranged as to engage the plungers 117 of respective regulator valves 105, 106. However, since the plungers and the screws are relatively small, an intermediate transmission or equalizing lever 135 is positioned between abutments 132, 133 and the plungers 117 of regulator valves 105, 106. It will be noted that equalizer lever 135 is also pivotally mounted intermediate its ends, as at 136, on frame member 15, and diametrically opposed portions thereof bear against the upper ends of plungers 117.

Operating lever 130 has one end of a pliable element or sprocket chain 140 pivotally connected thereto, as at 141. Pliable element 140 extends upwardly from lever 130, passes over a sprocket wheel 142 journaled on one of the spindle rails 13 (FIGURE 4), then extends substantially parallel with the corresponding spindle rail 13, and then passes downwardly over another sprocket wheel 143 suitably journaled on the latter spindle rail 13.

The end of pliable element 140 opposite from lever 130 is pivotally connected, as at 144, to the outer end of a follower arm or control lever 145 which is oscillatably mounted intermediate its ends, as at 146, on the head-end frame member 14. Pivot point 146 is preferably closely adjacent the end of lever 145 to which pliable element 140 is connected. The end of follower arm 145 opposite from sprocket chain 140 has a cam follower or anticipator 147 mounted for longitudinal adjustment thereon, and being urged into engagement with the periphery of builder cam 31, as by means of a tension spring 150 (FIGURES 2, 6 and 9).

One end of tension spring 150 is connected to the end of actuating lever 130, to which pliable element 140 is connected, and the other end of tension spring 150 is connected to foot-end frame member 15. In order that follower 147 may be adjusted longitudinally of follower lever 145, it will be observed in FIGURES 4 and 5 that lever 145 is provided with a longitudinally extending ad-

justment slot 151 therein through which a reduced threaded portion of a shoulder bolt 152 extends. Follower 147 is in the form of a roller rotatably mounted upon the body of shoulder bolt 152.

The reduced portion of shoulder bolt 152 is provided with a nut 153 which may be loosened for adjusting bolt 152 and follower 147 longitudinally of slot 151, and which nut 153 may then be tightened to secure the follower 147 in the desired adjusted position. The position of the speed control or anticipator follower 147, relative to builder motion follower 32 and cam 31, determines the instant at which changes in speed commence relative to the position of ring rails 24.

It will be noted that builder cam 31 is substantially symmetrical and, since a short period of time is required for the effective transmission of pressure changes between the regulator valves 105, 106 and the respective cylinders 75, 101, it has been found desirable to reverse the direction of flow of fluid pressure or compressed air through regulator valves 105, 106 slightly in advance of the initiation of each reversal in direction of movement of the ring rail as it reaches respective uppermost and lowermost positions during the course of reciprocation thereof. The reversal of air flow in regulator valves 105, 106 in advance of the reversal in direction of movement of ring rails 24 is desirable in order that the changes from increasing to decreasing speed and decreasing to increasing speed of the machine are effective substantially simultaneously with the changes in direction of movement of the ring rails 24 to thereby prevent a sudden slackening or excessive tensioning of the yarn between the travelers 26 and the yarn carriers 22 or packages 23. Thus, it will be observed in FIGURES 4 and 9 that follower 147 is located in advance of follower 32 relative to the high and low surfaces of cam 31.

As shown in FIGURES 4 and 9, builder follower 32 is positioned at the highest point (the point of largest radius) of one of the lobes of builder cam 31, at which point the ring rails 24 would occupy their highest position in the winding of a particular layer of yarn onto the package. The ring rails 24 are shown in FIGURES 1 and 2 as being in a lowered position for purposes of clarity. The high point of the lobe of cam 31 opposite from follower 32 has moved beyond anticipator follower 147 so that the flow of compressed air into cylinder 75 of variable speed pulley assembly 61 has already been initiated, sufficiently in advance of the start of the next downward movement of ring rail 24, in order to insure that the pulley flange 66 starts to move toward pulley flange 65 by the time the ring rails 24 actually start their next downward movement.

Of course, as heretofore stated, as regulator valve 105 starts to close, for introducing pressure into cylinder 75 of variable speed pulley assembly 61, regulator valve 106 starts to open to exhaust fluid pressure or compressed air from cylinder 101, so that belt 64 may pull motor 60 and support 95 toward fixed pulley 63 as the effective diameter of the variable speed pulley assembly 61 is increased.

It will be noted that, as cam 31 rotates in the direction indicated (FIGURE 4), anticipator cam 147 moves downwardly toward the next succeeding lower surface of builder cam 31 and builder follower 32 approaches the next succeeding low surface of cam 31. Spring 150 lowers therewith the left-hand portion of actuating lever 130 and abutment 132 bears against and lowers the corresponding end of intermediate lever 135. In so doing, the left-hand portion of lever 135 moves downwardly thereby depressing plunger 117 of regulator valve 105 to gradually open regulator valve 105 and thereby gradually introduce compressed air or fluid pressure into cylinder 75 (FIGURES 8 and 9) of variable speed pulley assembly 61.

At the same time, abutment 133 moves upwardly or away from the right-hand portion of intermediate lever 135, which, in turn, is moved upwardly by plunger 117 of regulator valve 106, thus gradually closing regulator valve 106 so that pressure is gradually released from cylinder 101. Prior to the succeeding low surface of cam 31 approaching builder follower 32, which is immediately prior to ring rails 24 reaching lowermost position, anticipator follower 147 is engaged by the next succeeding lowermost surface of builder cam 31 so that the left-hand end of actuating lever 130 then starts to move upwardly immediately preceding initiation of the next succeeding upward stroke of ring rails 24.

It follows that upward movement of the left-hand portion of actuating lever 130 (FIGURE 9) moves abutment 132 away from, and abutment 133 toward, respective portions of intermediate lever 135 which portions, in turn, to permit plunger 117 of regulator valve 105 to gradually move upwardly as plunger 117 of regulator valve 106 gradually moves downwardly. Accordingly, regulator valve 105 is gradually opened as regulator valve 106 is gradually closed. Thus, pressure is gradually released from cylinder 75 of variable speed pulley assembly 61 as it is gradually increased in cylinder 101 of ram assembly 97.

Thus, pulley assembly 61 is gradually moved away from fixed pulley 63 under predetermined and sufficient pressure to cause belt 64 to gradually increase the distance between cones or flanges 65, 66, thus gradually decreasing the effective diameter of pulley assembly 61 and gradually decreasing the speed of the machine.

As heretofore stated, the adjustment screw 122 on each regulator valve 105, 106 may be adjusted downwardly relative to lower housing part 116 so as to permit a predetermined maximum pressure to flow through the valve to the respective cylinders when plungers 117 are fully depressed or opened, or screws 122 may be adjusted upwardly relative to lower housing part 116 to permit a predetermined minimum pressure to continue to flow through the respective valves to the respective cylinders when the plungers 117 are in fully raised or closed position.

During operation of the machine as thus far described, the screws 122 are preferably adjusted for the minimum pressure desired to be maintained in the cylinders 75, 101. Obviously, the minimum and maximum pressures which should be introduced into the cylinders 75, 101 depends upon many variables including the sizes of the cylinders, the desired speeds of the machine and the chartacter of the yarns being wound on packages 23. In one application of this apparatus, in running one-thirties' to one-nineties' cotton strands, it was found desirable to vary the pressure in the ram assembly cylinder 101 from a minimum of ten pounds per square inch to a maximum of twenty pounds per square inch, while maintaining the pressure in the cylinder 75 of the variable speed pulley assembly 61 from a minimum of twenty pounds per square inch to a maximum of forty pounds per square inch.

If it is desired to increase or decrease the amount of minimum pressure which may be present in cylinders 75, 101 when the plungers 117 of the respective regulator valves 105, 106 are in raised or substantially closed position, the adjustment screws 132, 133 are adjusted downwardly toward bar 135 relative to actuating lever 130. Conversely, if it is desired that the minimum pressure present in the cylinders 75, 101 is decreased when the plungers 117 are in fully raised position, the screws 132, 133 are adjusted upwardly relative to bar 135 in the actuating lever 130. Of course, the maximum pressure which may be introduced into cylinders 75, 101 when the respective plungers 117 are moved downwardly is determined by adjustment of the lower regulator screws 122 on respective valves 105, 106.

In the event that regulator screws 122 cannot be adjusted to produce the desired range of variation in pressure, the valves 105, 106 may be vertically adjusted, since their housings are preferably provided with slots S

through which their holding screws H extend (FIGURES 6 and 7).

If it is desired that the machine is operated at a constant predetermined speed, screws 132, 133 may be adjusted upwardly relative to or removed from actuating bar 130, thus rendering the gradual speed mechanism inoperative, and the regulator screws 122 may be adjusted upwardly to move each respective valve member *c* (FIGURE 7) off of its seat *a* so that a predetermined constant pressure will enter and pass through each valve 105, 106. Of course, when said predetermined pressure is present in the sleeve 123 of each regulator valve, with an excess pressure therein, the diaphragm 119 and lower plunger 118 move downwardly slightly to permit excess pressure to escape between the valve *d* and valve seat *b*.

Referring to FIGURE 9, it will be noted that adjustment of anticipator follower 147 on follower lever 145 determines the instant each inverse change in machine speed is effected, without necessarily changing the rate, range or extent of speed variation effected by the cam 31, by the screws 132, 133 (or location of valves 105, 106), and by the regulator screws 122, respectively. The "rate" of speed variation is the frequency at which relative changes in machine speed occur. The "range" of speed variation is the distance the ring rail may move during each gradual increase and each gradual decrease in machine speed. The "extent" of speed variation is the difference between (1) the speed of the machine at the start of each inverse change in machine speed and (2) the speed of the machine at the end of each such change in machine speed.

It is thus seen that I have provided a novel apparatus for controlling the speed of a spinning or similar machine in which the changes in the speed from decreasing to increasing, or vice-versa, may be effected at any time independently of vertical reciprocation of the ring rail 24, and wherein the range and extent of the gradually increasing and gradually decreasing speeds may be accurately predetermined independently of the instants (or locations of the ring rail) at which inverse changes in speed are initiated. It is seen further that I have provided means whereby increased pressure is applied to the motor 60 and its variable speed pulley assembly 61, away from the fixed pulley 63, whenever the effective diameter of the variable speed pulley assembly is decreased and, conversely, wherein the pressure is proportionally released from the motor 60 and variable speed pulley assembly 61 in accordance with increases in the effective diameter of the variable speed pulley assembly 61.

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 textile machine having spindles and at least one ring rail, means for driving said spindles and continuously reciprocating said rail, fluid-pressure-operated means for regulating the speed of the spindles and the ring rail, a valve adapted to produce variation of pressure in said fluid-pressure-operated means, means controlling the rate, range and extent of pressure variation produced by said valve, means automatically operable at a predetermined interval relative to initiation of each movement of said rail in one direction for opening said valve and being automatically operable at a predetermined interval relative to initiation of movement of said rail in the opposite direction to close said valve, and means for adjusting said automatically operable means independently of said controlling means whereby the intervals at which the opening and closing of said valve occur may be determined independently of the rate, range and extent of speed variation effected by said valve and independently of the location of the ring rail.

2. A textile machine having spindles and at least one ring rail, means for driving said spindles and for continuously reciprocating said 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, means controlling the rate, range and extent of pressure variation produced by said valve, means automatically operable a relatively short interval before initiation of each movement of said rail in one direction for opening said valve and being automatically operable a relatively short interval before initiation of movement of said rail in the opposite direction to close said valve, and means for adjusting said automatically operable means independently of said controlling means whereby the intervals at which the opening and closing of said valve occur may be determined independently of the rate, range and extent of speed variation effected by said valve and independently of the location of the ring rail.

3. A textile machine having spindles and at least one ring rail, means for driving said spindles and reciprocating said rail, pneumatically actuated means for regulating the speed of the spindles and the rail, valve means adapted to produce variation of pressure in said pneumatically actuated means, means automatically operable prior to termination of movement of said ring rail in one direction for initiating the opening of said valve means and for gradually opening said valve means during subsequent movement of said rail in the opposite direction, and said automatically operable means being operable to initiate closing of said valve means immediately prior to termination of movement of said rail in said opposite direction and to gradually close said valve means during subsequent movement of said rail in said one direction.

4. A textile machine having spindles, at least one ring rail, a builder motion having a reciprocatory arm coupled to said rail for reciprocating said 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 operatively associated with said reciprocatory arm for producing an increase in pressure in said pressure-responsive means with movement of said reciprocatory arm in one direction and for effecting reduction in pressure in said pressure-responsive means with movement of said reciprocatory arm in the opposite direction, and said operatively associated means being operable to initiate each increase and each reduction in pressure, in each instance, immediately prior to said reciprocatory arm reaching the terminus of each movement of said arm in said opposite direction and in said one direction respectively.

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

6. 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 pressure variation in said fluid-pressure-operated means, means controlling the rate, range and extent of pressure variation produced by said valve means, means automatically operable at a predetermined relatively short interval preceding initiation of movement of said traversing means in one direction for opening said valve means, said automatically operable means being operable a predetermined interval preceding initiation of movement of said traversing means in the opposite direction to close said valve means, and means for adjusting said automatically operable means independently of said control-

ling means whereby the intervals at which the opening and closing of said valve occur may be determined independently of the rate, range and extent of speed variation effected by said valve and independently of the location of said traversing means.

7. 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 operable automatically a predetermined interval preceding each movement of said ring rail in one direction for initiating the opening of said valve and for gradually opening said valve during the subsequent movement of said ring rail in said one direction, said automatically operable means also being operable to initiate the closing of said valve a predetermined interval preceding movement of said ring rail in the opposite direction and to gradually close the valve during said movement of the rail in said opposite direction, and means for adjusting said automatically operable means for determining the intervals in which the opening and closing of said valve is initiated relative to said movements of said ring rail in one direction and in the opposite direction, respectively.

8. In a machine having means for traversing yarn onto a rotating yarn carrier in a reciprocatory manner while maintaining the strokes of the transversing 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 a variation of pressure in said fluid-pressure-operated means, means automatically operable a predetermined interval preceding each movement of said traversing means in one direction for initiating opening of said valve means and for gradually opening said valve means during subsequent movement of said traversing means in said one direction, and said automatically operable means being operable to initiate the closing of said valve means a predetermined interval preceding initiation of movement of said traversing means in the opposite direction and for gradually closing said valve means during subsequent movement of said traversing means in said opposite direction.

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 operatively associated with said ring rail for at least initiating an increase in the amount of pressure directed into the fluid-pressure-operated expansible pulley at a predetermined interval preceding the initiation of movement of said ring rail in one direction, said operatively associated means being operable to at least initiate a decrease in the amount of pressure directed to the fluid-pressure-operated expansible pulley immediately preceding the initiation of movement of said ring rail in the opposite direction, 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.

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 pulley, conduit means extending from a source of fluid pressure to said expansible pulley, a pressure regulator valve interposed in said conduit means, means for at least partially opening said pressure regulator valve to correspondingly increase the amount of pressure directed into the expansible pulley immediately prior to each movement of said ring rail in one direction with reciprocation thereof, said last-named means also being operable for at least partially closing said pressure regulator valve to correspondingly decrease the amount of pressure directed into the expansible pulley immediately prior to 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 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 automatically operable at a predetermined instant prior to each movement of said ring rail in one direction for initiating an increase in the amount of pressure directed into the fluid-pressure-operated expansible pulley and for gradually increasing the amount of pressure directed into the fluid-pressure-operated expansible pulley during the subsequent movement of said ring rail in said one direction, said automatically operable means also being operable to initiate a decrease in the amount of pressure directed into the fluid-pressure-operated expansible pulley at a predetermined instant preceding each movement of said ring rail in the opposite direction and for gradually decreasing the amount of pressure directed to the fluid-pressure-operated expansible pulley during subsequent movement of said ring rail in said opposite direction, 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.

12. 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 pulley mounted on each of said shafts, one of said pulleys being a fluid-pressure-operated expansible pulley, at least one V-belt entrained over said pulleys, a movable support for said driven shaft, means for increasing the amount of pressure directed into the expansible pulley with movement of said ring rail in one direction, said means being operable for decreasing the amount of pressure directed into the expansible pulley with movement of said ring rail in the opposite direction, said expansible pulley being so arranged that increased pressure correspondingly changes the effective diameter of the expansible pulley and the decreased pressure inversely changes the effective diameter of the expansible pulley to thereby effect the corresponding changes in the speed of the machine, and means automatically operable for yieldably moving said support and its corresponding pulley in a direction away from the other pulley when the effective diameter of the expansible pulley is decreased, and means for releasing said last-named means so the V-belt pulls said support and its corresponding pulley toward the other pulley when the diameter of the expansible pulley is relatively increased.

13. 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 pulley mounted on each of said shafts, one of said pulleys being a fluid-pressure-operated expansible pulley, at least one V-belt entrained over said pulleys, a movable support for said driven shaft, means for gradually increasing the amount of pressure directed into the expansible pulley with movement of said ring rail in one direction, said means being operable for gradually decreasing the amount of pressure directed into the expansible pulley with movement of said ring rail in the opposite direction, said expansible pulley being so arranged that increased pressure correspondingly changes the effective diameter of the expansible pulley and the decreased pressure inversely changes the effective diameter of the expansible pulley to thereby effect the corresponding changes in the speed of the machine, means automatically operable for moving said support and its corresponding pulley in a direction away from the other pulley under gradually increasing yieldable pressure when the effective diameter of the expansible pulley is decreased, and means for gradually releasing the pressure applied by said last-named means so the V-belt pulls said support and its corresponding pulley toward the other pulley when the diameter of the expansible pulley is relatively increased.

14. In a variable speed drive for a spinning machine and the like having a pair of spaced substantially parallel shafts, one shaft being driven, a pulley on each shaft, an endless belt entrained over said pulleys, one pulley being an expansible pulley comprising a pair of cones, and releasable first fluid-pressure-operated means for moving said cones toward each other to increase the effective diameter of the expansible pulley; the combination therewith of a movable support carrying one of said shafts, second fluid-pressure-operated means for applying pressure to said support in a direction away from the other shaft, means to increase the pressure in said second fluid-pressure-operated means when pressure is released from said first fluid-pressure-operated means so the belt is maintained taut as the effective diameter of the expansible pulley is decreased, and said last-named means being operable to decrease the pressure in said second fluid-pressure-operated means when the effective diameter of said expansible pulley is increased to permit the belt to pull the support toward said other shaft without the belt having to overcome the full force of the previously increased pressure in said second fluid-pressure-operated means.

15. In a variable speed drive for a spinning machine and the like having a pair of spaced substantially parallel shafts, one shaft being driven, a pulley on each shaft, an endless belt entrained over said pulleys, one pulley being an expansible pulley comprising a pair of cones, first fluid-pressure-operated means for moving said cones toward each other to increase the effective diameter of the expansible pulley, and means to increase and decrease the pressure in said first fluid-pressure-operated means; the combination therewith of a movable support carrying one of said shafts, second fluid-pressure-operated means for applying pressure to said support in a direction away from the other shaft, means to proportionally increase the pressure in said second fluid-pressure-operated means when pressure is decreased in said first fluid-pressure-operated means so the belt is maintained taut as the effective diameter of the expansible pulley is decreased, and said last-named means being operable to proportionally decrease the pressure in said second fluid-pressure-operated means when the pressure is increased in said first fluid-pressure-operated means and the effective diameter of said expansible pulley is increased so the belt pulls the support toward said other shaft without the belt being encumbered by excessive pressure in said second fluid-pressure-operated means.

16. A structure according to claim 15, in which said means to increase and decrease pressure in said first fluid-pressure-operated means comprises a first pressure regulator valve and said means to increase and decrease pressure in said second fluid-pressure-operated means comprises a second pressure regulator valve, and means to open and close either valve in unison with the respective closing and opening of the other valve.

17. In a structure according to claim 16, said machine having a vertically reciprocating ring rail, and said last-named means being automatically operable to open one valve and close the other valve at a predetermined instant before initiation of each movement of said rail in one direction, and to close said one valve and open the other valve at a predetermined instant before initiation of each movement of said ring rail in the opposite direction.

18. A structure according to claim 16 wherein said machine includes a vertically reciprocating ring rail, said means to open and close either valve being automatically operable to initiate the opening of one valve and the closing of the other valve at a predetermined instant preceding initiation of movement of said ring rail in one direction and to continue gradual opening of said one valve and gradual closing of the other valve during subsequent movement of said ring rail in said one direction, and said means to open and close either valve also being automatically operable to initiate the closing of said one valve and the opening of said other valve at a predetermined instant preceding movement of said rail in the other direction and to continue gradual closing of said one valve and gradual opening of said other valve during subsequent movement of said rail in said other direction.

19. In a variable speed drive for a spinning machine and the like having a rotating builder motion cam, a pair of spaced substantially parallel shafts, one shaft being driven, a pulley on each shaft, an endless belt entrained over said pulleys, one pulley being an expansible pulley comprising a pair of cones, first fluid-pressure-operated means for moving said cones toward each other to increase the effective diameter of the expansible pulley, and means under control of said cam for gradually increasing and decreasing the pressure in said first fluid-pressure-operated means in alternation; the combination therewith of a movable support carrying one of said shafts, second fluid-pressure-operated means for applying pressure to said support in a direction away from the other shaft, means to gradually increase the pressure in said second fluid-pressure-operated means in inverse relation to the gradual decrease in pressure in said first fluid-pressure-operated means so the belt is maintained taut and spreads apart said cones and the effective diameter of the expansible pulley is thereby decreased, and said last-named means being operable to gradually decrease the pressure in said second fluid-pressure-operated means in inverse relation to the gradual increase in pressure in said first fluid-pressure-operated means and when the effective diameter of said expansible pulley is increased so the belt pulls the support toward said other shaft without the belt being encumbered by excessive pressure in said second fluid-pressure-operated means.

20. A structure according to claim 19 wherein said machine is provided with a vertically reciprocable ring rail operatively connected with said builder motion cam; said means under control of said cam for gradually increasing and decreasing the pressure in said first fluid-pressure-operated means comprising a pivoted follower arm, a cam follower longitudinally adjustable on said arm and engaging said cam, a first pressure regulator valve interposed in a fluid pressure system to said first fluid-pressure-operated means, said means to gradually increase and decrease the pressure in said second fluid-pressure-operated means comprising a second pressure regulator valve interposed in a fluid pressure system to said second fluid-pressure-operated means, each valve having a plunger normally biased to closed position, a pivoted actuating lever adapted to open one of said valves while substantially releasing the plunger on the other of said valves with movement thereof in one direction and being adapted

to substantially release the plunger of said one of said valves and to open the other of said valves with movement thereof in the other direction, and means operatively connecting said follower arm with said lever whereby movement of said follower arm in opposite directions imparts respective movements to said lever.

21. A structure according to claim 20 including an intermediate pivoted lever having opposed portions engaging said valve plungers, and adjustable means spaced from opposite sides of the pivot point of said actuating lever and being engageable with said intermediate lever for imparting movement thereto and to the respective plungers.

22. In a machine having spindles and at least one ring rail, said machine also having means for rotating said spindles and continuously reciprocating said rail; the combination therewith of regulating means for producing a gradual increase in the speed of the spindles and the ring rail during movement of the ring rail in one direction and for producing a gradual decrease in the speed thereof with movement of the ring rail in the opposite direction, controlling means operatively associated with said regulating means for controlling the rate, range and extent of the variation in speed of the spindles and rail, means automatically operable for initiating said gradual increase in speed at a predetermined relatively short interval preceding initiation of movement of said ring rail in said one direction, said automatically operable means also being operable a predetermined interval preceding initiation of movement of said rail in said opposite direction to initiate said gradual decrease in speed, and means for adjusting said automatically operable means independently of said controlling means whereby the instants at which the gradual changes in speed are reversed may be determined independently of the rate, range and extent of speed variation effected by said regulating means and independently of the location of the ring rail.

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