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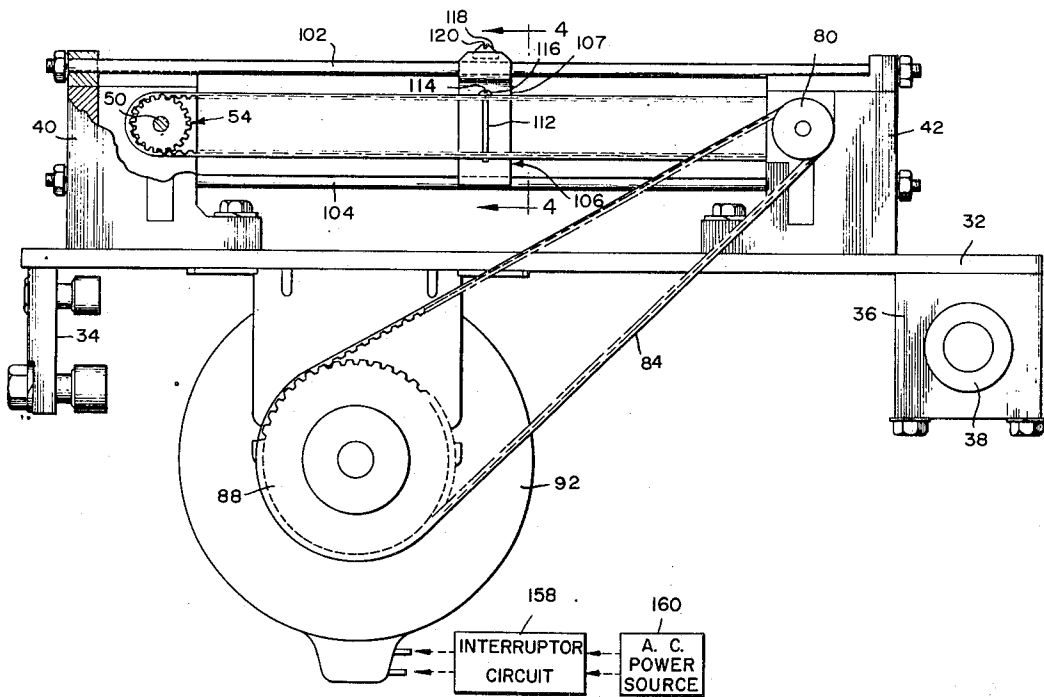
[54] **HIGH SPEED WINDER**
19 Claims, 6 Drawing Figs.

[52] U.S. Cl..... 242/43,
74/37
[51] Int. Cl..... B65h 54/28
[50] Field of Search..... 242/43,
158, 158(B); 74/37

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ABSTRACT: A high-speed filament winder having a frame, a bobbin drive roll, an arbor for supporting a cylindrical bobbin, the roll and arbor being movable with respect to one another so that the roll can contact-drive the yarn package on the arbor while the package grows in diameter, and a traversing mechanism for moving the yarn up and down the package. The traversing mechanism includes a pair of endless belts supported and driven by respective pairs of pulleys, a traverse guide mounted on guide rails and connected to the belts so as to provide a reciprocal motion.



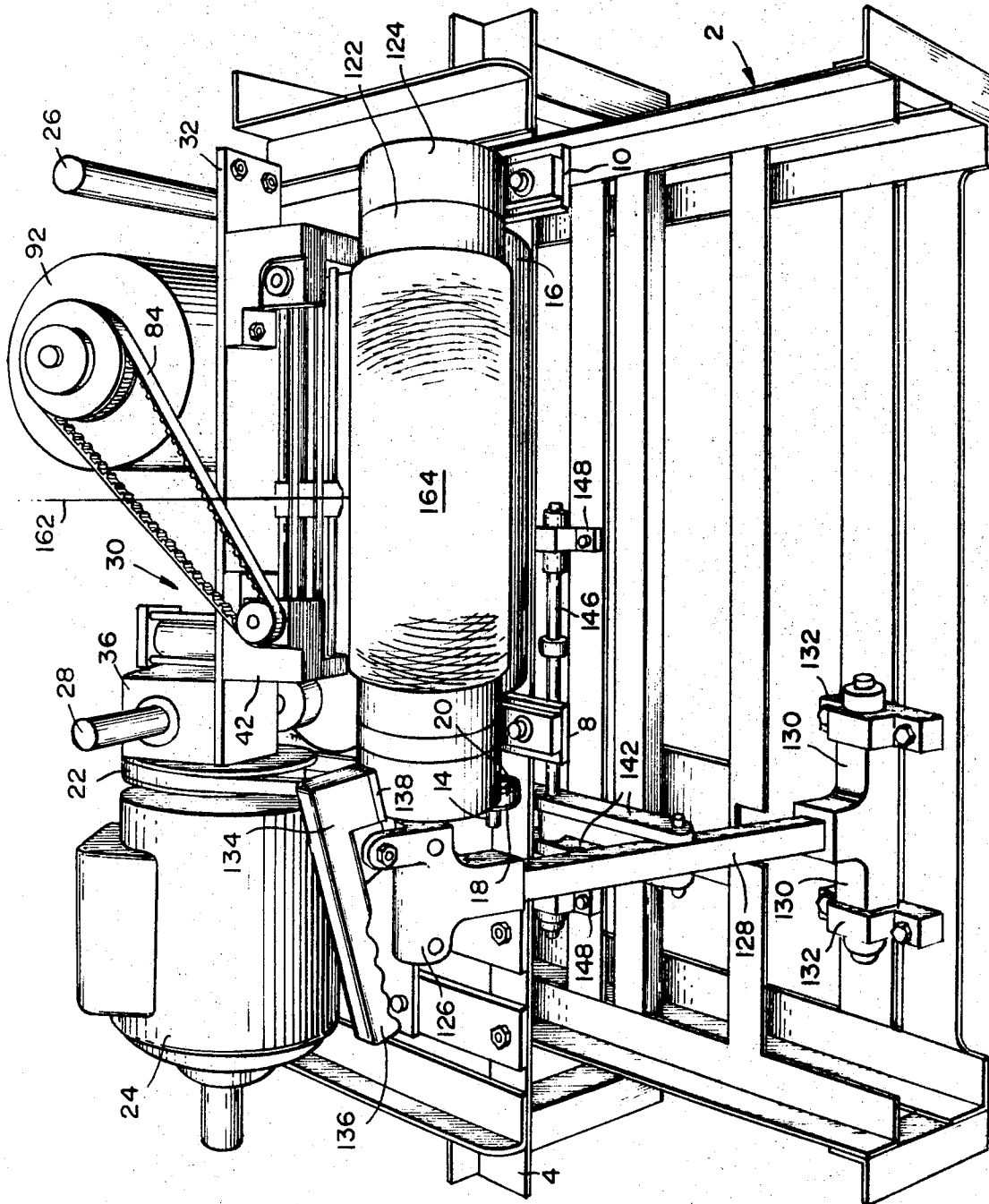
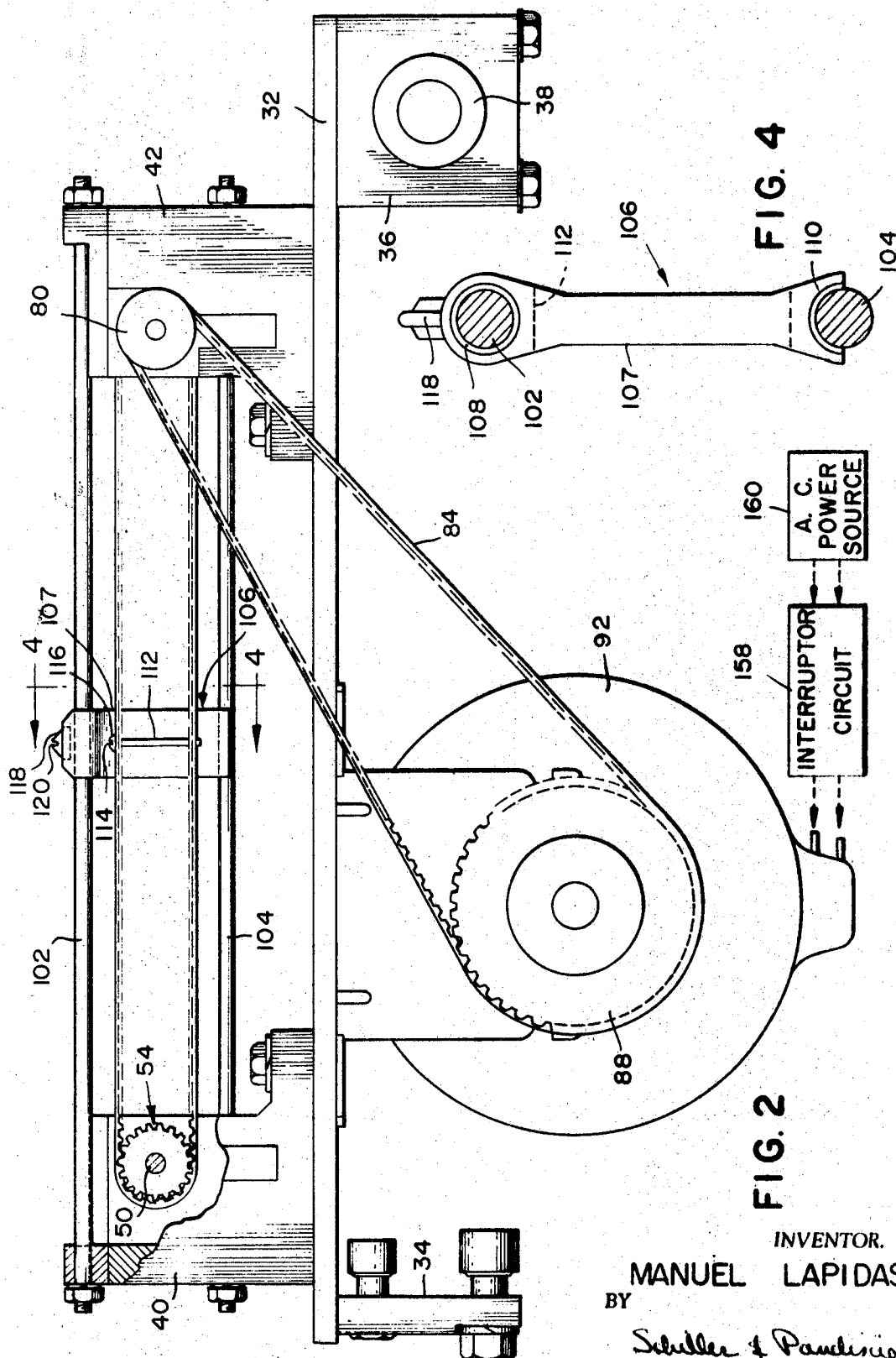


FIG. 1

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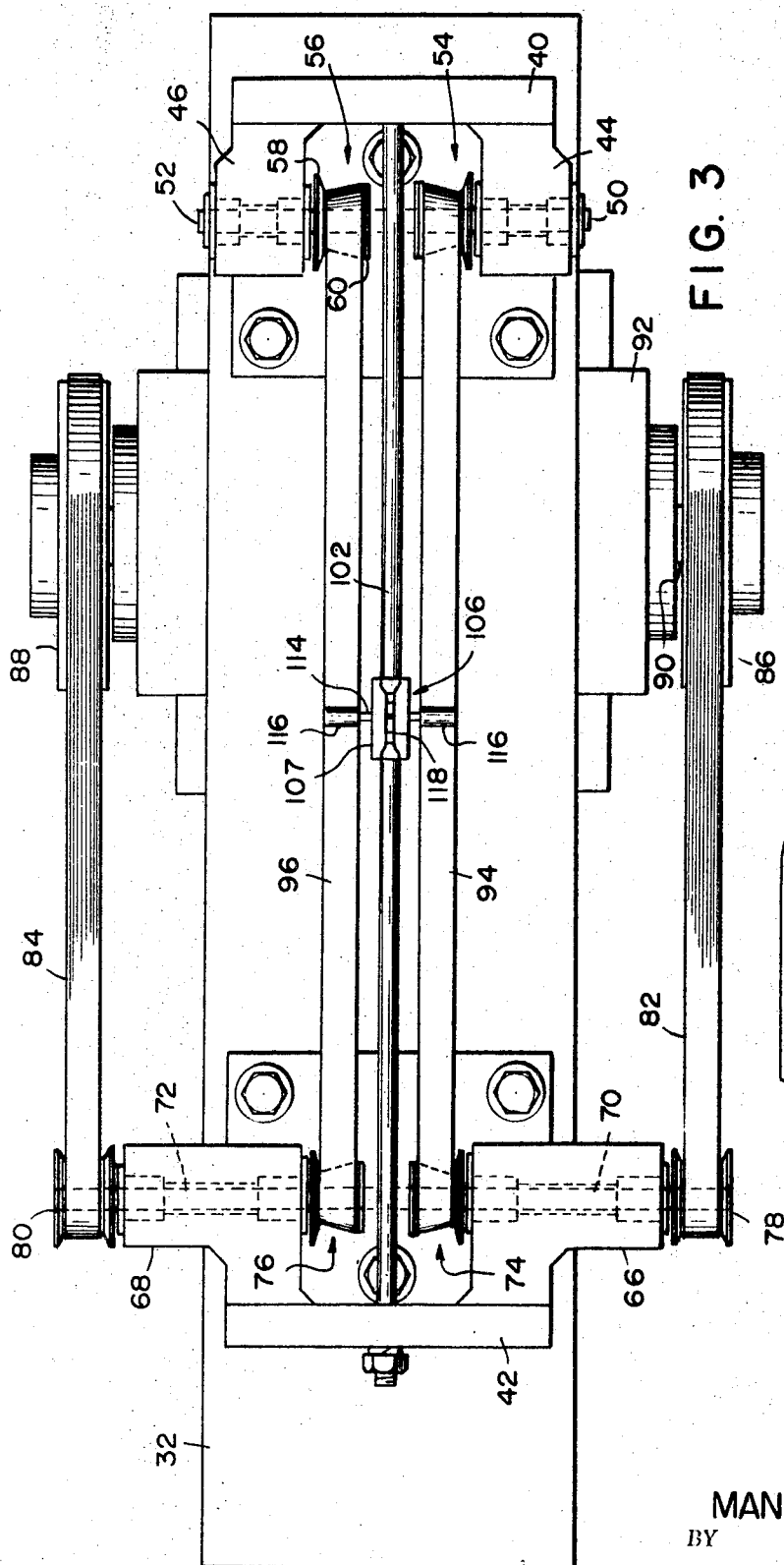


FIG. 3

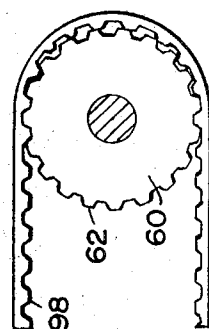


FIG. 5

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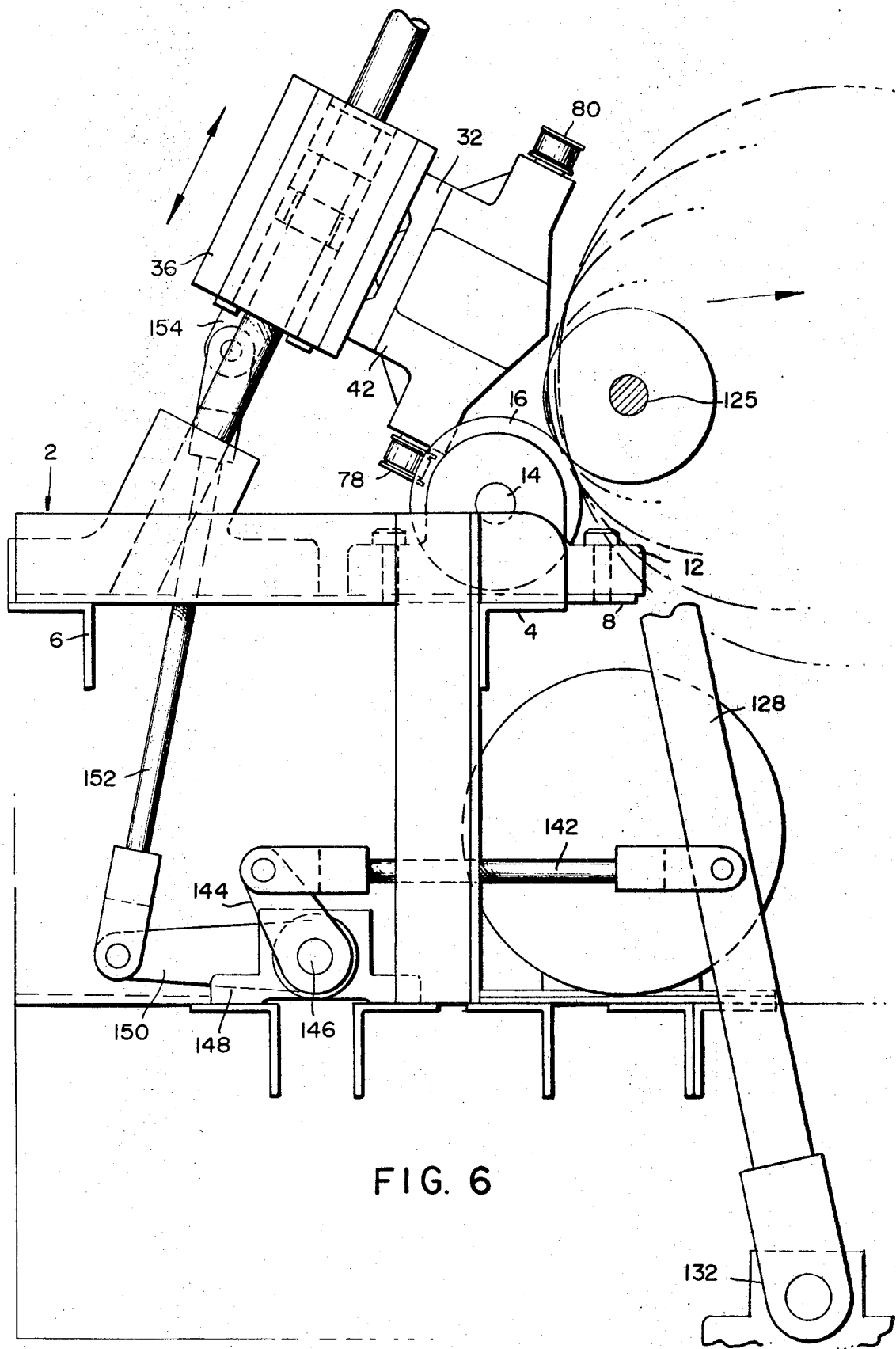


FIG. 6

HIGH SPEED WINDER

This invention relates to apparatus for winding continuous yarn filaments and in particular to an improved yarn winder having a low inertia traversing mechanism that permits winding continuous filament yarn bobbins at high speeds.

One conventional type of yarn winding equipment employs a traversing mechanism that includes a cylindrical cam with cross over grooves in which travels a boat-shaped dog that transmits reciprocating motion to a traverse guide through which travels a continuous yarn filament. This conventional type of traversing mechanism has high-power requirements because of the high-frictional forces generated by the high-pressure angle of the cam grooves against the traversing dog. To overcome wear it is necessary to lubricate the traversing dog and the grooves of the cam at frequent intervals. However, this leads to contamination of the yarn by oil splatters. Another conventional form of winding apparatus employs a chain driven traverse mechanism. This second form of traverse mechanism also requires continuous oiling to prevent wear and it is difficult to avoid yarn contamination by the oil that is thrown off of the chain by centrifugal force. Both types of traversing mechanism are restricted to low-speed operation in order to avoid abrasive wear of the cooperating mechanical elements and also to minimize yarn contamination from oil splatters.

The primary object of the present invention is to provide a continuous yarn winder having a traversing mechanism that is capable of operating satisfactorily at speeds substantially higher than existing commercial traversing mechanism and does not require oil lubrication.

Still another object of the invention is to provide in a continuous yarn winder a low-inertia yarn guide and means for traversing the guide at a constant velocity except at stroke reversals where a simple smooth harmonic motion is produced with a relatively low-power input.

A more specific object of the invention is to provide a traverse mechanism in which the traverse stroke length can be readily and quickly adjusted.

A further specific object of the invention is to provide a traverse mechanism that has low inertia.

Still another specific object is to provide a yarn winding machine in which the bobbin support and the yarn traversing mechanism are connected by a linkage that maintains a predetermined clearance between the traversing yarn guide and the surface of the yarn bobbin as the bobbin increases in diameter.

Another specific object is to provide apparatus that will wind ribbonless yarn bobbins at yarn speeds in excess of 3,000 yards per minute.

Other objects and many of the attendant advantages of the present invention will become more readily apparent from the following detailed specification when considered together with the accompanying drawings, wherein:

FIG. 1 is a perspective view looking down at the front of the winding machine;

FIG. 2 is a plan view, partly in section, of the traversing mechanism and its motor drive;

FIG. 3 is a front elevational view of the traversing mechanism as shown in FIG. 2;

FIG. 4 is a sectional view taken along line 4-4 of FIG. 2;

FIG. 5 is an enlarged fragmentary view in elevation of one of the belts used to transport the traversing yarn guide and one of the sprockets on which the belt is mounted; and

FIG. 6 is a fragmentary side view in elevation looking from left to right in FIG. 1.

Referring now to FIGS. 1 and 6, the illustrated apparatus comprises a frame identified generally by the numeral 2 having a pair of transversely extending frame members 4 and 6 connected by a pair of longitudinally extending frame members 8 and 10. Mounted on frame members 8 and 10 are two bearing blocks, one of which is shown at 12 in FIG. 6, in which are journaled the cylindrical extensions 14 of a bobbin drive roll 16. Mounted on one of these extensions 14 is a small pulley 18 that carries an endless belt 20. The latter also is

mounted on a large drive pulley 22 that is affixed to the output shaft of a constant speed a.c. motor 24 attached to the rear end of the machine frame. When motor 24 is energized it acts through pulleys 18 and 22 and belt 20 to rotate drive roll 16 at a constant speed.

Also secured to the frame at its rear end are two inclined guide rods 26 and 28. These guide rods slidably support a traversing mechanism indicated generally by numeral 30. The traversing mechanism comprises a carriage in the form of an elongate plate 32 having a dual roller assembly 34 (FIG. 2) attached to one end and a slide block 36 attached on its opposite end. The two rollers of assembly 34 engage and ride along opposite sides of guide rod 26. Slide block 36 has a hole fitted with a bushing 38 sized to accommodate guide rod 28 in a snug sliding fit.

Mounted on the opposite side of plate 32 are two spaced pulley stands 40 and 42 (See FIGS. 2 and 3). The former, hereinafter identified as the "idler pulley stand" comprises two spaced portions 44 and 46 that rotatably support two idler pulley shafts 50 and 52 respectively. The adjacent ends of shafts 50 and 52 are fitted with like idler pulleys identified generally by numerals 54 and 56 respectively. Each of these pulleys has a single sidewall 58 and a frustoconically shaped belt-supporting hub 60 that is formed with a series of evenly spaced teeth 62 on its periphery (See FIG. 5). The second pulley stand 42, described hereafter as the "drive pulley stand", also comprises two spaced portions 66 and 68 that rotatably support two drive pulley shafts 70 and 72 respectively. The adjacent ends of these shafts are fitted with drive pulleys 74 and 76 that are identical in construction to idler pulleys 54 and 56. The opposite ends of shaft 70 and 72 are fitted with conventional toothed timing belt pulleys 78 and 80 which carry timing belts 82 and 84 respectively. The latter ride over and are driven by large timing belt pulleys 86 and 88 that are mounted on the opposite ends of the output shaft 90 of a split phase a.c. motor 92. This motor is attached to plate 32 so as to move therewith.

The idler timing pulley 54 and the timing drive pulley 74 carry a traverse belt 94. A second like traversing belt 96 is carried by idler timing pulley 56 and timing drive pulley 76. These belts which extend parallel to each other are lightweight polyester-reinforced polyurethane timing belts having a series of lugs 98 that engage the teeth 62 of the pulleys on which they are mounted. Lugs 98 have a finer pitch than the teeth 62. In the preferred embodiment of the invention, lugs 98 have a pitch of 0.0816 inch while teeth 62 have a pitch of 0.200 inch. This combination of fine-pitch lugs on the belts and coarse pitch teeth on the drive pulleys 74 and 76 allows one or the other of the traverse belts to shift on its drive pulley to the extent necessary to maintain perpendicularity of the traverse guide pin (described below) to the two traverse belts, thereby assuring low-friction alignment of the bushings of the traversing guide and the guide rails on which they travel. The yarn guide and its guide rails are described below.

Still referring to FIGS. 2 and 3, the traversing mechanism also includes two parallel vertically spaced traverse guide rails 102 and 104 of circular cross section that are attached to and extend between the two pulley stands 40 and 42. These rails slidably support a lightweight yarn traverse guide assembly identified generally by numeral 106. This traverse guide assembly comprises a lightweight plastic body 106 that preferably is formed of nylon or DuPont's resin sold under the trademark Zytel, but it may be made of other strong lightweight resins. As shown best in FIG. 4, the upper end of body 106 has a hole fitted with a cylindrical bushing 108 that makes a sliding fit with guide rail 102. The bottom end of body 107 has a semicircular groove fitted with a semicylindrical bushing 110 that fits around guide rail 104. These bushings are made of a plastic material impregnated with a tetrafluorethylene compound. Tetrafluorethylene compounds, e.g., Teflon brand polymer sold by DuPont, are slippery materials and maintain their low-friction characteristic without need for lubrication. Typical plastics that are im-

pregnated with a polyfluorethylene material are Glacier DU brand material sold by Garlock Mfg. Co., and Delrin AF brand material sold by DuPont.

The yarn traverse guide body 107 also is formed with a vertical slot 112 in which is slidably positioned a pin 114. The opposite ends of this pin project beyond the sides of the guide body 107 and are secured to the traverse belts 94 and 96. The latter are each formed with a single raised portion 116 having a hole for pin 114. Secured in the upper end of body 107 is a yarn guide in the form of an alumina insert 118. This insert has a V-shaped groove 120 that receives and guides a continuous strand of yarn.

The guide assembly 106 serves to direct yarn onto a cylinder 122 that is removably mounted on an arbor or bobbin chuck 124 (See FIG. 1). The arbor is supported cantilever fashion, one of its ends 125 (FIG. 6) being rotatably secured in a bearing unit 126 that is attached to the upper end of a swing arm 128. The bottom end of arm 128 has a pair of lateral extensions 130 that are journaled in two bearing blocks 132 attached to the machine frame. In addition to supporting arbor 124, the upper end of swing arm 128 carries a brake member 134 having a handle portion 136 and a brake surface 138. The brake member is pivotally secured to bearing unit 126 with its center of gravity located so that its handle portion hangs down in the manner shown in FIG. 1. The brake surface 138 is made of a suitable material, e.g., an impregnated asbestos laminate and is located so that it will engage arbor 124 when the brake member is pivoted by pulling up on its handle portion 136.

The swing arm also serves to control movement of the traversing mechanism along the inclined guide rods 26 and 28. This is achieved by a mechanism comprising two lever arms 142 that are pivotally connected at one end to swing arm 128 and at the opposite end to a rocker arm 144 that is affixed to a shaft 146 rotatably supported by a pair of bearing blocks 148 attached to the machine frame. Shaft 146 carries a second rocker arm 150 that is pivotally connected to two elongate lever arms 152 (only one is visible in FIG. 6). These lever arms 152 are pivotally attached to a lug 154 on slide block 36. The foregoing linkage couples the traversing mechanism and the arbor 124 so that the position of the former on guide rods 26 and 28 is a function of the distance between the arbor and drive roll 116. As the yarn bobbin on arbor 124 increases in diameter and forces the arbor away from drive roll 16, the traversing mechanism will move up on guide rods 26 and 28. The aforementioned linkage also causes the traversing mechanism to drop down on guide rods 26 and 28 when the arbor moves back toward drive roll 16.

As an optional feature the invention also includes an interrupter circuit 158 coupled between motor 92 and the a.c. power supply 160 to which it is connected. Preferably this interrupter circuit consists of a transistor switch that periodically interrupts the flow of current to the motor for a brief interval. This switching occurs about once for each complete traversing cycle of the yarn traverse guide assembly 106 and can be as frequent as several times for each half cycle or as infrequent as once every several cycles. The yarn guide assembly traversing cycle includes two strokes, one in each direction. While the interrupter circuit may be designed to operate aperiodically, it is preferred that it will operate approximately periodically so as to impress a cyclic velocity pattern on the yarn traverse guide.

Operation of the foregoing apparatus will now be described. With the machine at rest and cylinder 122 removed, the arbor 124 will rest against the driving roll 16 and the traversing mechanism will be in its lowermost position on guide rods 26 and 28. To perform a winding operation, a cylinder 122 is slipped onto the arbor and a strand of yarn 162 is positioned in groove 120 and then wrapped around the cylinder by manually rotating the arbor. Then the two motors 24 and 92 are started. Motor 24 will cause roll 16 to rotate (clockwise as seen in FIG. 6). Roll 16 in turn will drive arbor 124 and cylinder 122 by virtue of frictional engagement with the yarn

wrapped about the cylinder. Simultaneously motor 92 will drive pulleys 74 and 76 and the latter in turn will drive the two traverse belts 94 and 96. The belts are driven unidirectionally, passing in turn around drive pulleys 74 and 76 and idler pulleys 54 and 56. The direction of taper of the frustoconical hubs of the traverse belt pulleys constantly urges the belts towards the pulley walls 58 so that they will track evenly, yet the contact pressure of the belts on the pulley walls is quite small so as to minimize belt wear and the input power required to move the belts. As the belts 94 and 96 continue to move they will transport the yarn traversing guide along its guide rails. It is to be noted that the guide rails extend beyond the traverse belt pulleys so that the pin 114 can follow the belts as they move around the pulleys. In moving around the pulleys pin 114 will move in one vertical direction in slot 112 as its connections with the traverse belts move around the drive pulleys 74 and 76, and in the opposite vertical direction as these same connections move around the idler pulleys 54 and 56. This action causes the yarn traversing guide assembly to reverse its direction of movement each time the aforesaid pin connections move around the traverse belt drive and idler pulleys, with its velocity during each such reversal changing according to a simple harmonic motion. The traverse speed is governed by the speed of motor 92 and the ratio of the driving motor pulleys 86 and 88 and the driven traverse pulleys 74 and 76. In the absence of the interrupter circuit 158, the yarn traverse guide travels at a constant velocity except when it reverses its stroke. As the traversing proceeds the yarn 162 is wound around the cylinder in a helix to form a bobbin or yarn package 164. In the preferred embodiment the traverse speed is set relative to the peripheral speed of the bobbin being wound to produce a yarn helix angle of from about 6°, for example, for 30—40 denier yarn wound at low tension, to about 16° for heavy yarns such as carpet yarns. This angle provides handling and shipping stability to the finished yarn package and assures acceptable yarn delivery when unwound at high speeds. When a yarn package has been fully wound the motors are shut off and the arbor brought to a halt by pulling on the brake handle. Operating the brake handle results in the bobbin moving out of engagement with driving roll 16 whereupon it is brought to a halt by the restraining force exerted on the arbor by brake surface 138.

It is to be noted that winding yarn at a constant helix angle has a tendency to produce "ribbons" when the diameter of the bobbin reaches a certain size relative to the traverse speed. This tendency is eliminated by changing the traverse speed periodically. This is accomplished by the interrupter circuit 158 which, by intermittently interrupting the input power to motor 92, impresses a varying velocity pattern on the traverse guide assembly. This cyclic change in velocity is attained smoothly and without subjecting the traversing mechanism to disturbing forces. The overall power input required to drive the traversing mechanism is quite small due to its low inertia and its self-lubricating characteristics.

It is to be noted that in order to achieve high traversing speed at low-power input it is essential that the bushings 108 and 110 of the traverse guide assembly be in near perfect alignment with the guide rails 102 and 104 at all times. This in turn requires that the traverse guide driving pin 114 be maintained perpendicular to the two traverse belts. This is achieved by the combination of fine pitch lugs 98 on the traverse belts and the coarse pitch teeth 62 on the traverse belt pulleys. As shown in FIG. 5 this combination provides imperfect meshing of lugs and teeth, with the result that if the driving pin tends to shift out of true perpendicularity, one or the other of the traverse belts will shift on its pulleys to the extent necessary to rapidly restore perpendicularity.

The foregoing construction provides many advantages in addition to those mentioned above. For one thing the traversing mechanism is highly reliable and long wearing and, because of its low inertia and self-lubricating characteristics, it is possible to wind yarn bobbins at yarn speeds in excess of 3,000 yards per minute. Another advantage is that the

elimination of the need for lubrication of the traversing mechanism eliminates oil contamination of the yarn. The linkage between the bobbin arbor and the traversing mechanism makes it possible to maintain a constant or programed clearance between the traverse guide assembly and the bobbin surface, so that there is a substantially constant angle between the filament and the bobbin surface. The programed clearance also governs formation of the sides of the bobbin. A further advantage is that the traverse stroke length can be readily changed by changing the location of the pulley stands on plate 32 and using different length traverse belts.

It is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts specifically described or illustrated, and that within the scope of the appended claims, it may be practiced otherwise than as specifically described or illustrated.

I Claim:

1. Apparatus for winding a yarn bobbin comprising a frame, a bobbin drive roll rotatably supported by said frame, means for driving said bobbin drive roll, a swing arm pivotally attached to said frame, an arbor adapted to receive a cylinder on which said bobbin is to be formed, means on said swing arm rotatably supporting said arbor in parallel relation to said bobbin drive roll, said swing arm normally positioning said arbor so that a cylinder mounted thereon bears against and is driven by said bobbin drive roll, a yarn filament traversing mechanism, and means attached to said frame supporting said traversing mechanism for rectilinear movement along a predetermined path proximate to said arbor, said traversing mechanism including:

- a. first and second belts;
- b. first and second pairs of pulleys supporting said first and second belts, respectively in parallel spaced relation to each other;
- c. a motor;
- d. means coupled between said motor and said first and second pairs of pulleys for driving said belts in the same direction and at the same speed;
- e. guide rail means located between and extending parallel to said belts;
- f. a yarn filament traverse guide mounted for movement along said guide rail means, said traverse guide including means for guiding a continuous strand of yarn to a cylinder as it is rotated by said bobbin drive roll; and
- g. means connecting said traverse guide to said belts so that as said belts move in an endless path about said first and second pairs of pulleys said yarn traverse guide will traverse said guide rail means in a back-and-forth mode of movement characterized by a simple harmonic motion at the end of one stroke and the beginning of the next stroke, whereby a filament of yarn fed via said traverse guide to a cylinder mounted on said arbor will be wound in helical layers on said cylinder to form a yarn bobbin.

2. Apparatus as defined by claim 1 further including means for interrupting operation of said motor periodically so to impress on said yarn guide a changing velocity pattern that varies the helix angle of the yarn as it is wound onto said cylinder.

3. The apparatus of claim 1 wherein said guide rail means comprises two parallel spaced rails and said yarn traverse guide comprises a body with bushings adapted to ride along said rails, and further wherein said body has a slot therein and said means connecting said traverse guide to said belts comprises a pin positioned in said slot and connected to said belts.

4. Apparatus as defined by claim 1 wherein said guide rail means comprises two parallel spaced rails, and further wherein said first and second pairs of pulley means each includes a driving pulley having a series of uniformly spaced teeth and further wherein said belts are timing belts provided with a series of evenly spaced lugs that engage the teeth of said driving pulleys, the pitch of said lugs being finer than the pitch of said teeth so that one of said belts can slip relative to the other belt to maintain low-friction alinement of said yarn guide on said guide rail rods.

5. Apparatus as defined by claim 1 further including means for moving said traversing mechanism in a given direction along said predetermined path as the bobbin being wound increases in diameter.

6. Apparatus as defined by claim 5 wherein said means for moving said traversing mechanism in said given direction comprises a mechanical linkage between said traversing mechanism and said swing arm.

7. Apparatus as defined by claim 6 wherein said linkage moves said traversing mechanism at a rate sufficient to maintain a programed clearance between said yarn traverse guide and the surface of the bobbin being wound.

8. Apparatus as defined by claim 1 wherein said belts are constructed of a lightweight synthetic material.

9. Apparatus as defined by claim 8 wherein said belts are constructed of polyurethane reinforced with a polyester.

10. Apparatus as defined by claim 1 wherein said yarn traverse guide is made of plastic and includes self-lubricating bushing means in sliding engagement with said guide rail means.

11. Apparatus as defined by claim 1 wherein said swing arm includes a handle whereby said swing arm may be pulled in a direction to move said arbor away from said bobbin drive roll.

12. Apparatus as defined by claim 11 wherein said handle is pivotally connected to said swing arm, and further including braking means attached to said handle, said braking means positioned so as to engage and brake said arbor when said handle is pivoted relative to said swing arm.

13. Apparatus as defined by claim 12 wherein the pivot axis of said handle extends at right angles to the pivot axis of said swing arm.

14. Apparatus as defined by claim 1 wherein said drive roll and arbor extend horizontally and further wherein the said means supporting said traversing mechanism comprises two parallel spaced guide rods located in a common inclined plane extending parallel to said drive roll and said arbor.

15. Apparatus as defined by claim 14 wherein said traverse mechanism is adapted to be lifted off of said two guide rods.

16. Apparatus as defined by claim 1 wherein said means for driving said bobbin drive roll comprises a second motor and torque transmitting means coupling the output shaft of said motor to said bobbin drive roll.

17. Apparatus as defined by claim 16 including means for momentarily and periodically interrupting the operation of said second motor.

18. A traversing mechanism for yarn winding apparatus comprising first and second traverse belts provided with a series of identical lugs, first and second pairs of pulleys having a series of identical teeth that are engaged by said lugs, said pulleys supporting said first and second belts respectively in parallel spaced relation to each other, a motor, means coupled between said motor and corresponding pulleys of each of said pairs for driving said traverse belts in the same direction and at the same speed, a pair of spaced guide rails located between and extending parallel to said traverse belts, a yarn traverse guide comprising a body with an elongated slot therein and being mounted for movement along said rails, and means comprising a pin that is slidably positioned in said slot and has its opposite ends connected to said traverse belts move in endless paths about said pulleys said yarn traverse guide will move back and forth on said guide rails with its movement characterized by a simple harmonic motion each time it reverses direction, the pitch of said lugs being different than the pitch of said teeth so that one of said belts can slip relative to the other of said belts to maintain low-friction alinement of said yarn traverse guide on said guide rails.

19. A traversing mechanism for yarn winding apparatus comprising first and second endless, fiber reinforced, synthetic polymeric traverse belts, first and second pairs of pulleys, each pulley comprising a frustoconical hub and a single sidewall, said first and second pairs of pulleys supporting said first and second belts respectively having only two runs, said runs being substantially parallel, a motor, means coupled

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between said motor and corresponding pulleys of each of said pairs for driving said traverse belts in the same direction and at the same speed, a pair of spaced guide rails parallel to one another and located between said traverse belts and extending parallel to the runs of said traverse belts, a yarn traverse guide 5 mounted for movement along said rails, said yarn traverse

guide being connected to said traverse belts and movable therewith so that as said traverse belts move in endless paths about said pulleys said yarn traverse guide will move back and forth on said guide rails with its movement characterized by a simple harmonic motion each time it reverses direction.

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