Nov. 29, 1960 F. A. PRESTON ET AL 2,961,823

MULTI-POSITION PLYING AND TWISTING APPARATUS

Filed Feb. 14, 1957 3 Sheets-Sheet 1

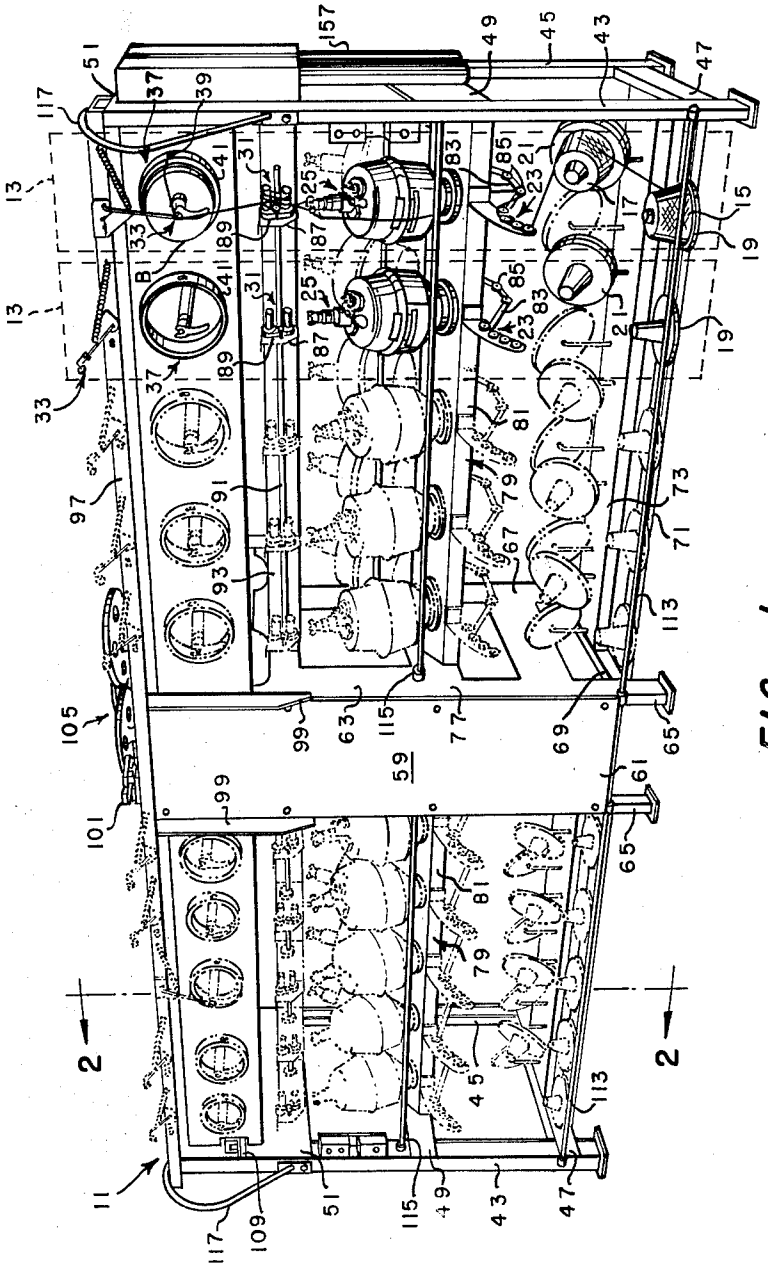


FIG. -1-

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MULTI-POSITION PLYING AND TWISTING APPARATUS

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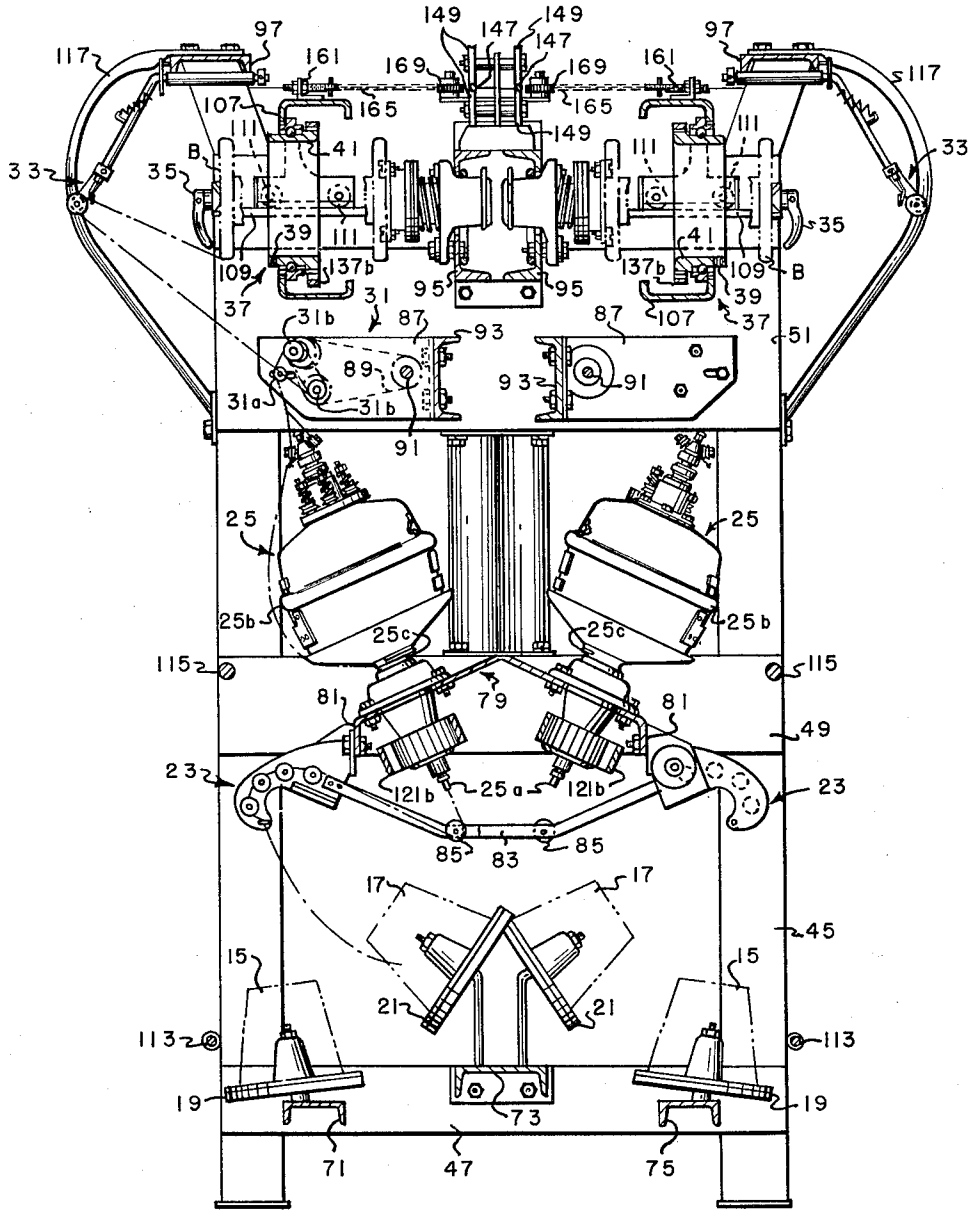


FIG.-2-

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MULTI-POSITION PLYING AND TWISTING APPARATUS

Filed Feb. 14, 1957 3 Sheets-Sheet 3

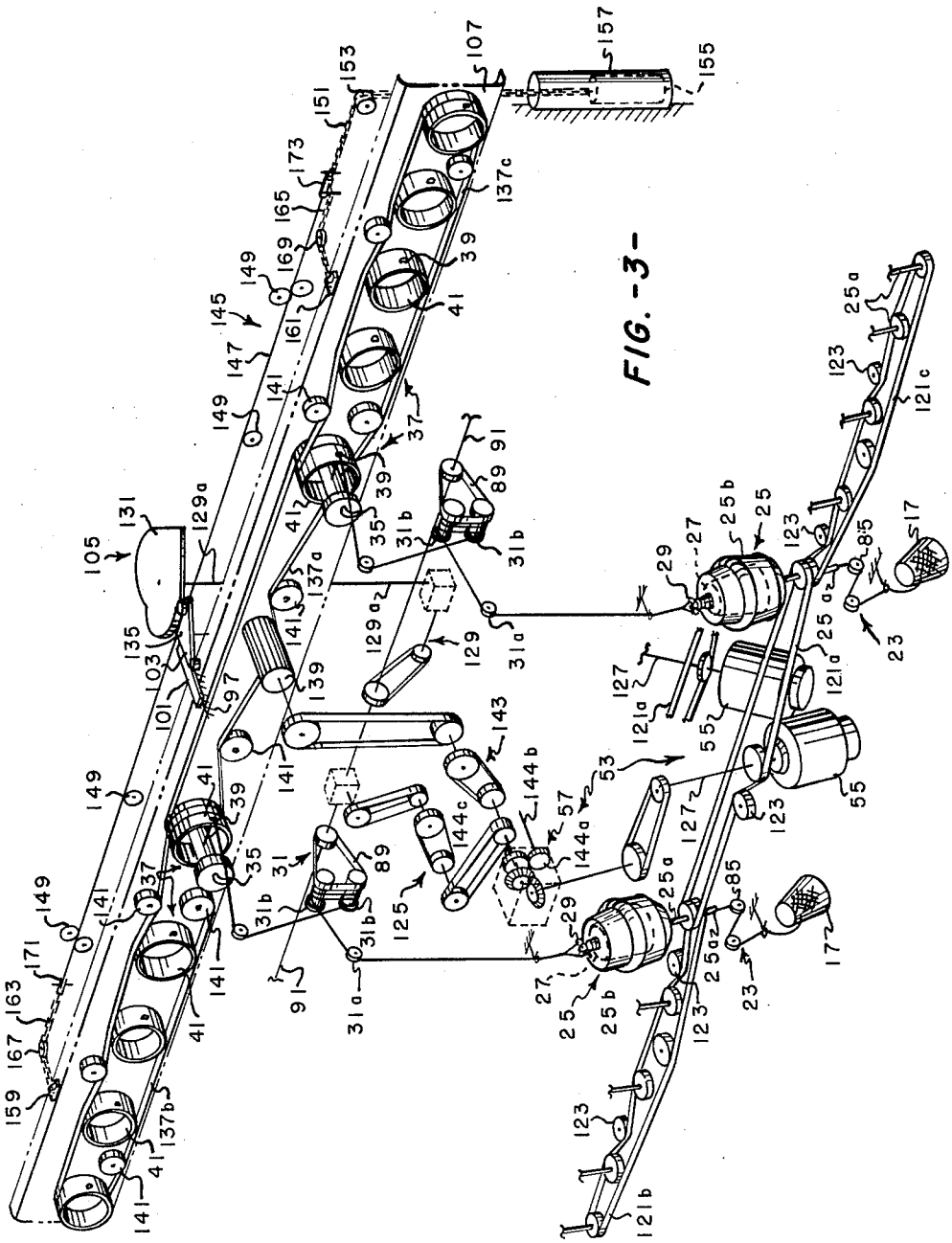


FIG. -3-

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MULTI-POSITION PLYING AND TWISTING APPARATUS

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21 Claims. (Cl. 57—58.3)

This invention relates to plying and twisting apparatus, and more particularly to an improved multiposition plying and twisting frame.

In recent years there has been developed yarn plying and twisting apparatus which features the continuous plying of two or more strands of yarn or the like and subsequent twisting of the plied strands on one unitary flow apparatus. While this general principle of continuous plying and subsequent twisting of the plied strand on a single continuous flow apparatus is quite good and most advantageous, a common practical problem arises in the arrangement of such apparatus to achieve the most economical utilization of floor space, particularly in a multiposition frame. A further problem lies in the arrangement of a suitable multiposition drive system which will be capable of the high speeds desirable in forming many plied constructions, and which will preferably also be suitable for a multiposition frame unit which is capable of being combined with other multiposition frame units to form a combined minimum floor space frame of any desired number of positions from individual multiposition frame units.

Accordingly, an important feature of this invention is the provision of a multiposition plying and twisting apparatus employing the principle of plying, twisting, and take-up in sequential continuous flow steps, which utilizes a minimum of horizontal floor space, and which is also particularly advantageous in presenting the working apparatus within easy working reach of an operator.

Another important feature lies in the provision of a symmetrical center drive for a multiposition plying and twisting frame of the type described above, which gives the advantage of permitting end to end assembly of any desired number of multiposition frame units, and also permits the utilization of short precision-speed drive belts to drive the various elements of the multiple positions at a high speed with a minimum of inertia and meshing of metal to metal gears.

Still another feature of the invention is the provision of a horizontally movable traverse rail arrangement on a multiposition twister take-up, in order to provide ready and facile operator handling and adjustment of the twister bobbin and twister apparatus as may be desired, the traverse arrangement employing a unique and advantageous parallelization and drive arrangement.

Particularly, the invention insofar as the conservation of floor space is concerned, is directed to the utilization at each position substantially vertically aligned strand supply sources, a rotatably driven plying spindle, an intermediate feeding means and a twister take-up device with the positions being arranged laterally side-by-side and also outwardly facing and back-to-back so that an operator will have an individual position wholly facing him without having to bend or lean himself over the position or go from one lateral side to the other of the frame in order to service a single position of the frame.

Still other objects and attendant advantage will become apparent to those skilled in the art, from a reading of the following detailed description of a preferred embodiment constructed according to the invention, taken in conjunction with the accompanying drawings, wherein:

Figure 1 is a side and end perspective view illustrating a preferred embodiment constructed according to the invention.

Figure 2 is a schematic cross sectional view taken along line 2—2 of Figure 1 illustrating the cross sectional arrangement of the various important structural and operating members of the apparatus of Figure 1, particularly showing the vertical flow relation and the back-to-back outwardly facing relation of the positions on opposite lateral sides of the frame unit.

Figure 3 is a schematic illustration of the center symmetrical drive for a single side of the multiposition frame unit of Figure 1, and also showing the relation of the drive units on both sides of the frame unit.

Referring now in detail to the figures of the drawings, a frame **11**, of generally box frame construction, has disposed thereon in both side-by-side and back-to-back relation a plurality of outwardly facing individual plying and twisting take-up positions, each generally indicated at **13**. Each of these plying and twisting take-up positions **13** is arranged with its components in substantially vertical flow relation from a supply source upwardly through a plying spindle and thence through a feeding arrangement to a twisting and take-up spindle arrangement, as disclosed and claimed in the copending application of Edward J. Wright, Serial No. 613,692, filed October 3, 1956. The individual positions do not form a part of this invention and it is not intended to claim any novelty in these individual positions other than their general relationship to each other in the overall combination of a multiple position frame unit particularly laid out and arranged for economical utilization of floor space and ease of arrangement of each of a multiplicity of units in end to end relation. For purposes of clarity and understanding of the instant invention, however, the component elements of an individual position **13** will be briefly described. As generally seen in each of the figures, yarn or other strandular material is fed from a first supply source **15** or **17** disposed on one of two creel supply holders **19** and **21** at the bottom of the frame **11**, thence upwardly through a pretensioning unit **23** and then through a rotatably driven hollow spindle **25** and radially outwardly through an opening **25c**, in said spindle **25**, then in a balloon about a second supply source **27** mounted in substantially non-rotatable position on said spindle **25** to a freely rotatable strand tension equalizing and/or metering control capstan **29** such as disclosed in copending application of Klein and Wright, Serial No. 512,552, filed June 1, 1955, now Patent No. 2,914,903, and then to a Y ply point where it is combined with a second strand from said second supply source **27**, the plied strands then being fed through a continuously synchronously driven feed roll or capstan arrangement **31** and then upwardly to an apex guide **33** which is aligned with an adjustably braked horizontal spindle **35** of a synchronously driven ring twister-winder generally indicated at **37** having a rotating guide eye **39** formed as in a positively driven ring **41** for the purpose of twisting the plied strand a desired amount and winding the twisted plied strand onto a bobbin B on said spindle **35**.

Each individual spindle position has two spaced apart supply package holders **19** and **21** at the base thereof, the rear one **21** of which is tilted outwardly toward the operator while the other front holder **19** is substantially vertical, and this arrangement particularly permits ease of creeling in of a reserve supply package **15** or **17** at

all times with the tail of the instant used supply package being secured to the outer end of the adjacent reserve supply package, each of the supply package positions alternating as the instant used and reserved holders.

The plying spindles **25** are rotatably driven through the medium of a belt drive as will later be described in conjunction with the Figure 3, as are the feed rolls **31** and the twister rings **37**.

Referring to the apex guide **33** for the take-up spindle **35** it will be noted that this guide is pivotally movable laterally out of the path of the bobbin during doffing and donning as indicated in the first two positions on the righthand end of the frame as viewed in Figure 1, the first position showing the apex guide **33** in operative position while the second plying and twisting position shows the apex guide in its upper inoperative position. This particular guide arrangement is illustrated in more detail in the copending application of Wright and Klein, Serial No. 645,379, filed March 11, 1957, now Patent No. 2,890,565, and as such does not individually form a part of this invention but only insofar as it forms a part of the overall combination, this arrangement will not be further described herein.

Referring now particularly to Figure 1, the multiposition frame unit **11** comprises at each end a pair of vertical end standards **43** and **45** which may suitably be formed of U-channel bars, and three cross brace members **47**, **49** and **51** secured between the spaced apart vertical end standards **43** and **45** as by welding or the like. Referring to Figure 3, at the center of the frame unit **11** there are mounted two motor and gear drive units generally indicated at **53**, each of which include a motor **55** and drive transmission system **57** for each side of the frame as will be more particularly described in conjunction with Figure 3. The two motor and drive transmission units are enclosed within a partially enclosed center housing **59** each side of which has a pivotally removable center cover plate **61** movably disposed between a pair of spaced apart transverse center standards **63** which extend across the width of the frame from one side to the other, as indicated in Figure 1. The vertical center standards **63** are open at the bottom, each thus forming two support legs **65**, **67** (which may suitably be formed as from L-channel stock) connected by a horizontal U-channel member **69**. Connected between the horizontal U-channel members **69** and the respective lower cross brace U-channel members **47** at each end of the frame are three longitudinal U-channel members **71**, **73** and **75** which serve to stabilize the frame and also to support the creel supply mounts **19** and **21** for the external supply packages of yarn or the like which are fed to the plying spindles **25**.

Secured between the intermediate cross brace members **49** at the ends of the frame and center cross plates **77** formed by the standards **63** on the respective sides of the motor and drive transmission housing **59** is a longitudinally extending inverted substantially V-shaped or arched support and brace member **79** on which the plying spindles **25** are mounted (see particularly Figure 2). As will be seen in both Figure 1 and Figure 2 this provides a back-to-back outwardly facing and vertically inclined position for the plying spindles on opposite sides of the frame.

The laterally outer longitudinal edge of the arched support member **79** is bent downwardly to form a substantially vertical mounting flange **81** on which the pretensioning array units **23**, which are preferably adjustable disc type tensioners, are fixedly mounted. Connecting between the two tension units and extending beneath the bottom of the arched support member **79** at each pair of back-to-back positions is a guide roller support **83** which also serves to stabilize or brace the tension unit arrays **23**, such tension units preferably having a shock absorbing cellular rubber mounting between themselves and the arch support **79**. As seen particularly in Figure 2, each plying spindle **25** includes a rotatably mounted hollow spindle shaft **25***a* which extends both above and below the respective inclined surface of the arched support member **79** on which it is rotatably mounted, and the strand aligning guide roller **85** at each position is disposed with its guide surface serving to guide the yarn from the tension array **23** and axially into the axial opening in the spindle shaft **25***a*.

Thus the supply yarn proceeds from one of the supply packages **15** or **17** thence through the pretensioning unit **23** and downwardly and under the guide roller **85**, then upwardly through the center of the spindle shaft **25***a* and outwardly through a radial aperture in the spindle shaft whereupon it proceeds in a driven balloon about the housing **25***b* of the plying spindle **25** which houses the second supply package **27**, from whence it approaches the ply point where it is combmined with the yarn strand from this second supply package and then proceeds through the feed roll arrangement **31** which is formed by an axially aligned guide roller **31***a* and a pair of driven feed capstans **31***b* over which the yarn is passed a number of times. The feed capstans **31***b* are preferably canted with respect to each other in order to provide lateral spacing between the wraps of the yarn thereon and thus prevent entrapment of the yarn in its multiple passages thereover. The feed capstan arrangement at each position is mounted on an L-shaped support member **87** which extends substantially horizontally outwardly and each of these capstans are driven by a common precision cog belt **89**, such as a precision drive belt commercially sold under the name of "Timing" belt, which is in turn driven from a common longitudinally extending drive shaft **91** which is journaled in bearings in each of the L-shaped feed capstan support members **87**. The capstan support members **87** are supported in spaced apart relation on a longitudinally extending U-channel brace **93** which, in the illustrated embodiment, extends for a length corresponding to five positions of the frame and thus extends between the end cross brace **51** and the transverse center standards **63** of the drive unit housing **59**. Each lateral side of the frame unit thus has two of the longitudinally extending support members **93** for the feed roll capstan arrangements **31**.

Disposed in back-to-back longitudinally extending relation extending along the entire frame unit length above the longitudinal support members **93** are corresponding two spindle support members which may suitably be U-shaped channel bars **95** cross braced together in rigid box-like form as by welding on which the individual take-up spindles are mounted in outwardly extending horizontal position. These support members are also suitably secured as by welding, or bolts, or the like to the end frame members **51** and thus extend through the center housing **59** as one continuous structural member to which the center frame members **63** are secured. Longitudinally extending along the top of each lateral side of the frame are a pair of U-channel support members **97** upon which are appropriately mounted the apex guide assemblies **33**, these support members extending longitudinally from one end frame member to the other and being suitably secured thereto as by bolts, or welding, or the like, as desired. These apex guide support members **97** are supported at their intermediate ends through the means of two vertical angle bars **99** which extend upwardly from the center drive housing **59**. Each of these guide unit support members **97** also serve to support adjacent their center section an adjustably guide member **101** for the cam follower **103** of the traversing mechanism **105** for the traverse rail **107**.

Two traverse ring rails **107** are provided in the illustrated embodiment, one on each lateral side of the frame **11** and extending longitudinally of the frame for lateral movement horizontally in and out thus giving axial movement of the twister and winding rings **37** along the take-up spindles **35**. The ring rails are suitably mounted for reciprocable movement as through the medium of a pair of horizontally disposed angle supports **109** secured to

the end frame members 43, 45, 51 at each longitudinal end of the frame, and which serve as a guide support for traverse rail guide rollers 111 mounted at each end of the ring traverse rail 107.

Disposed along the lateral side of each group of five spindles are guard rails 113 and 115. The lower rail 113 of these two guard rails may extend along one or more entire frame units 11 and thereby serve to secure two or more frame units 11 together, if so desired. Additionally, or alternatively, two or more frame units 11 may be bolted together at their abutting ends, or a common end frame standard and cross brace arrangement 43, 45, 47, 49, 51 may be employed for adjacent frame units, if desired. The rail 115 serves the dual purpose of a guard rail and as a support for the opened cap section of the housing 25*b* of the plying spindle 25 during replacement of the supply package 27. Disposed at each end of the frame unit 11 on each lateral side is an apex guide safety guard 117 which protects the operator from injury, due to possible inadvertent head contact with the outwardly extending apex guide unit when coming around the corner of the frame.

The motor and drive assembly 55, 57 disposed within the central housing 59 is schematically shown in Figure 3, the particular mounting support for each of the elements thereof constituting no part of this invention and therefore not being shown in detail. Referring now to Figure 3 for the drive arrangement for each of the various parts of the frame, disposed in canted outwardly extending relation at the bottom of each lateral side of the central drive housing 59 is a drive motor 55 which serves to drive the entire group of plying and twisting take-up positions on its respective lateral side of the frame unit 11. To this end each drive motor 55 is connected to each of the rotatably mounted plying spindle shafts 25*a* through the medium of three cog type precision drive belts 121. To the end that conveniently short belts are utilized, and easy end-to-end frame unit assembly is permitted, the drive motor 55 is disposed in the longitudinal center of the frame 11 and is operatively connected directly to the two directly adjacent spindles by the drive belts 121*a*, with each of the reamining four spindles on each side of these two spindles being driven from these two spindles by respective cog drive belts 121*b* and 121*c*, each of the cog drive belts being held in tight engaging position through the medium of idler pulleys 123.

The feed capstan units 31 are driven from common drive shaft 91, which in turn is driven through a precision speed reducing belt and gear train generally indicated at 125 in turn operatively connected to the motor drive shaft 127. A speed reducing belt and gear drive unit 129 is connected from the common drive shaft 91 for the feed capstan units and includes a vertical drive shaft 129*a* which imparts slow rotation, or otherwise as may be desired, to a traverse cam, such as a heart cam 131. Heart cam 131 serves in conjunction with a bell crank cam follower 103 pivotally mounted on ring rail 107 as indicated at 135 to reciprocate at a slow or other desired traverse rate the ring rail 107 on its respective lateral side of the frame. Angular and lateral adjustment of cam follower guide 101 against which the one arm of the ball crank follower 103 rides during reciprocating traverse motion of the ring rail 107 may be employed to adjust the path of the traverse rail axially of the take-up spindles 35. Disposed in spaced apart relation on the ring rail 107 are twister-winding rings 37 which serve to twist the plied cord or yarn and wind it onto the bobbins B which are supported on the adjustably braked rotatable take-up spindles 35. Each of these rings 37 is preferably the inner race of a ball or roller bearing, which is of special construction in that the inner race has a sprocket type pulley formed thereon in order to provide for positive drive of the ring and has a guide eye formed therein for purpose of positively guiding the yarn as it is driven about the bobbins B, as shown and described in detail in the copending application of Edward J. Wright, Serial No. 613,692, filed October 3, 1956. Each of these twister-winding rings 37 is driven through a precision drive cog belt drive arrangement including three cog belts 137*a*, 137*b* and 137*c* arranged similarly to the cog belts 121*a*, 121*b* and 121*c* which drive the plying spindle shafts 25*a*, as previously described. Thus a center cog belt 137*a* is driven from toothed drum pully 139 and in turn directly drives each of the two laterally adjacent twister rings 37, the remaining twister rings being driven from the two directly driven twister rings through the medium of the other two interconnecting cog belts 137*b* and 137*c*. The drum pulley 139 permits movement of the cog belts along its length as the ring rail is traversed along the axes of the spindles 35, the drum pulley remaining axially stationary while the flanged cog belt idler pulleys or sprockets 141 on the ring rail maintain the cog belts 137 in direct engagement with the sprocket pulleys on rings 37. The drum pulley 139 is driven as through the medium of a speed reduction or speed step up belt arrangement 143, as may be desired, in order to have the twister rings 37 add or subtract the desired twist to the plied cord or the like as the cord is wound onto the bobbin B. To obtain necessary reversal of direction of rotation of rings 41 and achieve either addition or subtraction of twist, reversing gears 144*a* are provided to obtain counter-rotation of shaft 144*b* from shaft 144*c*. Thus, the belt arrangement 143 may be connected to either shaft 144*c* or 144*b* depending on the direction of ring rotation, and consequent twist addition or subtraction desired, as is pointed out in the above mentioned copending application of Edward J. Wright, Serial No. 613,692, wherein a single position similar to the multiple positions 13 is disclosed and claimed and direction of twist for the plied strands.

In order to provide complete parallelization of the ring traverse rail during its reciprocating traverse movement along the axes of the horizontal take-up spindles 35, there is provided a parallelizing arrangement generally indicated at 145 which serves in conjunction with the traverse rail drive cam arrangement 131, 103, 101 to form a unique drive and parallelizing arrangement for traverse rails. The parallelizing arrangement includes a longitudinally extending rod member mounted on a plurality of sheaves 149. Rod member 147 has secured at one end a chain or other flexible member 151 which extends over a sprocket wheel or pulley 153 and is connected at its free end to a weight 155 which may suitably be vertically slidably movable in a weight housing 157 fixedly secured on the end of the frame 11. The rod 147 is adjustably connected to two longitudinally spaced apart positions 159 and 161 on the ring rail 107 through the medium of two flexible members 163, 165, which may preferably be chains and which pass around sprocket wheels or pulleys 167, 169. The chains 163, 165 may suitably be connected to the rod 147 as by clamps 171 and 173, or otherwise as desired, the opposite ends of the chains 163 and 165, respectively, being connected to the rail 107 as through the medium of the threadedly adjustable clamps 159 and 161. It will thus be seen that the weight 155 imparts a lateral force on the ring rail which is substantially equal at both connecting points 159 and 161 on the ring rail and causes the ring rail to have its cam follower 103 which is secured thereto held in engagement with the cam 131 and cam follower guide 101. The provision of the two spaced apart connecting points on the intermediate rod 147 and the rail 107 thus provides substantially equal biasing force at all points on the traverse rail and thereby maintains the traverse rail in parallel position even though the traverse rail is driven only by a single traverse cam in the center thereof. This eliminates any necessity for extensive parallelizing guides which might otherwise be necessary in a traverse rail of this length and which are commonly employed in the art.

It will be apparent that many modifications and alternative embodiments may be made by one skilled in the art

without departing from the scope and spirit of the invention, and it is accordingly to be understood that the invention is not to be limited by the particular illustrated embodiment but only by the scope of the appended claims.

What is claimed is:

1. Multiposition plying and twisting apparatus comprising a plurality of laterally side-by-side plying and twisting positions, each of said positions comprising in substantially vertical sequential ascending order alignment one above the other, a first supply package, a yarn tension device for tensioning strands proceeding from said first supply package, a plying spindle having a second supply package associated therewith, at least one plied strand feed roll, and a twister take-up spindle, said twister take-up spindle axis at each position being substantially horizontal, the axis of said first supply package and the axis of said plying spindle being inclined from the vertical, said second supply package being supported by said plying spindle.

2. Multiposition plying and twisting apparatus comprising a plurality of laterally side-by-side plying and twisting positions, each of said positions comprising in substantially vertical sequential ascending order alignment one above the other, a first supply package, a yarn tension device for tensioning strands proceeding from said first supply package, a plying spindle having a second supply package associated therewith, at least one plied strand feed roll, a twister take-up spindle, an inverted-V-shaped longitudinally extending support member having outwardly and downwardly inclined side sections, each substantially equally inclined to the horizontal and with the major longitudinal axis thereof substantially horizontal, two rows of said side-by-side plying and twisting positions, one of said rows having its respective plying spindles supported on one of said downwardly inclined sections with the axis of said spindles being substantially perpendicular to the upper lateral surface of the respective inclined section, the spindles of the other said row of positions being similarly arranged in side-by-side spaced apart relation on the other of said downwardly extending legs of said inverted-V-shaped support member, whereby each of said rows of plying spindles are disposed with the axes of their respective spindles inclined to the horizontal and to an imaginary vertical plane extending longitudinally between said rows of positions.

3. Apparatus according to claim 2 wherein each of said twister take-up spindles has its axis disposed substantially horizontally, said twister take-up spindles each comprising a take-up spindle and a strand twisting and winding device adapted to twist the strand product of said plying spindle and wind said strand product on a carrier which may be disposed on said spindle, and a drive operatively connected to said strand twisting and winding device and adapted to traverse said twisting and winding device along a selected portion of the length of said take-up spindle, the traverse path of said twisting and winding device being substantially parallel with the axis of said horizontally disposed take-up spindle, and an apex guide disposed in axial spaced apart relation from the outer end of said take-up spindle and adapted to guide said plied strand product of said plying spindle from said feed rolls symmetrically to said twisting and winding device.

4. A multiple position plying and twisting apparatus comprising first and second plying spindles, a support for said spindles, said spindles being rotatably mounted on said support, each with its respective axis inclined substantially symmetrically upwardly and outwardly with respect to an imaginary vertical plane passing substantially centrally between said spindles, at least one feed roll disposed above each of said spindles and having a peripheral tractive surface in substantially vertical alignment with its respective plying spindle, first and second take-up spindles mounted with their axis substantially horizontal and being disposed respectively above and in substantially vertical alignment with a respective one of said plying spindles and feed rolls, said take-up spindles being each adapted to support a strand carrier for winding of plied strands thereon, a twisting and winding device for each of said take-up spindles and mounted for reciprocable traversing movement along a portion of the length of said take-up spindle, a reciprocating-motion-imparting drive operatively connected to said twisting and winding device and adapted to traverse said two devices along a selected build path, and first and second apex guides spaced apart respectively from said first and second take-up spindles and each being disposed in substantially horizontal alignment with the axis of its respective take-up spindle, said apex guide being laterally movable upwardly and away from the axis of said take-up spindle.

5. Apparatus according to claim 4 further comprising two strand supply packages for each of said plying spindles, one of said supply packages for each of said spindles being disposed beneath the respective spindle and having its axis inclined upwardly and outwardly in the same general direction as its respective plying spindle, said second supply package for each of said plying spindles being supported on its respective plying spindle, and a pretensioning tension device for each of said plying spindles and disposed in vertical flow relation between the respective first supply package support and the input end of said respective plying spindle, each of the respectively associated first supply packages, plying spindle, feed rolls, and take-up spindles being disposed in substantially vertical alignment.

6. Apparatus according to claim 5 comprising a first linear row of said laterally side-by-side first plying spindles and associated strand plying, feeding, twisting and take-up means, each of said plying spindles and said associated means comprising an individual plying, twisting and take-up position, and a second row of laterally side-by-side plying, twisting, and take-up positions corresponding to said second spindle and associated supply, feeding, twisting and take-up means, said first row of said first positions being disposed in substantially back-to-back relation with said second row of positions.

7. Apparatus according to claim 6 further comprising an inverted generally V-shaped, support arch extending longitudinally along the length of said rows of positions, said first row of plying spindles being mounted on one inclined section of said inverted-V-shaped support arch, the plying spindles of said second row of positions being mounted on the oppositely inclined section of said support arch.

8. Apparatus according to claim 7 comprising synchronous drive means adapted to drive each of said rows of plying spindles, feed rolls and take-up spindle arrangements, said synchronous drive means for each of said rows comprising a respective single motor disposed substantially centrally along the longitudinal length of its respective said row, and motion transmitting means operatively connecting each of said motors with its respective row of plying spindles, feed rolls, and take-up spindle arrangements.

9. Apparatus according to claim 8 wherein said motion transmitting means comprises three belts operatively connecting each of said motors with its respective plying spindle, one of said belts for each of said motors being directly connected between said motor and two of its directly adjacent respective plying spindles, the other two of each of said three belts being directly connected between a respective one of said two directly adjacent plying spindles and a plurality of plying spindles adjacent to said respective one of said two plying spindles.

10. Apparatus according to claim 9, further comprising twisting and winding arrangement for said take-up spindles of each of said rows of spindles, said twisting and winding arrangement for each of said rows comprising a respective common traverse rail, said rail having a plurality of apertures therein corresponding to the respective positions of said take-up spindles, said traverse

rail being movable in a substantially horizontal plane in a direction at right angles to its length, a single cam for each of said traverse rails, motion transmitting means operatively connecting each of said motors with a respective one of said cams, a cam follower on each of said traverse rails, said cam having a substantial vertical axis of rotation, and biasing means adapted to bias each of said followers into contact with its respective cam.

11. Apparatus according to claim 10 wherein said biasing means comprises a movable weight for each of said traverse rails and a laterally flexible linearly extending member operatively connecting said weight to said traverse rail.

12. Apparatus according to claim 11 wherein said means for traversing each of said traversing rail further comprises a substantially rigid rod extending parallel along a portion of the length of its respective rail, said first mentioned flexible member being operatively connected to said rod adjacent one end of said rod, friction reducing guide means for linear movement of each of said first mentioned flexible members and the respective said rod in response to vertical movement of said weight and horizontal movement of said traverse rail, and a pair of spaced apart flexible members for each of said traverse rails, each said pair of flexible members being directly connected to spaced apart points on its respective one of said traverse rails and its respective associated rod, and guide means for guiding said pairs of flexible members during movement of said traverse rail, pair of flexible members, rod, and weight.

13. Multiposition plying and twisting apparatus comprising two longitudinal back-to-back rows of plying and twister-takeup positions, each of said rows each comprising a plurality of plying spindles, the plying spindles in one of said rows being oppositely vertically inclined to the plying spindles of the other said row, and a corresponding plurality of plied yarn feed roll device and twister take-up spindles, one feed roll device and one take-up spindle for each of said plying spindles, each corresponding take-up spindle having its axis substantially horizontal and disposed substantially vertically above its corresponding plying spindle, each of the respective said plying spindles, feed roll devices, and take-up spindles, being arranged in vertically ascending relation one above the other.

14. Apparatus according to claim 13 wherein the axis of each said take-up spindle is in substantially vertical alignment with its corresponding plying spindle, the take-up spindles of each of said rows being cantilever mounted, the free ends of the take-up spindles in one row extending in a direction opposite to the free ends of the take-up spindles in the other said row.

15. Apparatus according to claim 13, further comprising prime motion means disposed substantially longitudinally symmetrically of said rows of spindles, and motion imparting drive means operatively connecting said prime motion means in driving relation to said plying spindle and twister-take-up spindle positions.

16. Apparatus according to claim 15 wherein said prime motion means comprises two separate drive motors each inclined outwardly at substantially the same angle as and operatively connected in driving relation to a respective one of said rows of plying spindles.

17. Apparatus according to claim 13, further comprising a horizontal longitudinally extending arch support member having two oppositely inclined longitudinal sections, said plying spindles in said two rows being rotatably mounted on a respective inclined section of said arched support member in back-to-back row relation.

18. Apparatus according to claim 18 wherein said motion imparting drive means comprises endless belts operatively connected between said longitudinally symmetrically disposed drive motors and their respective rows of plying spindles.

19. Multi-position plying and twisting apparatus comprising two longitudinal rows of laterally side-by-side plying and twisting positions, each of said positions comprising in substantially vertical sequential ascending alignment one above the other, a plying spindle, at least one plied strand feed roll, and a twister take-up spindle, an inverted-V-shaped longitudinally extending support member having outwardly and downwardly inclined side sections, each substantially equally inclined to the horizontal and with the major longitudinal axis thereof substantially horizontal, one of said rows having its respective plying spindles supported on one of said downwardly inclined sections with the axis of each of its said spindles being substantially perpendicular to the upper lateral surface of the respective inclined section, the spindles of the other said row of positions being similarly arranged in side-by-side spaced apart relation on the other of said downwardly and outwardly inclined sections of said inverted-V-shaped support member, whereby each of said rows of plying spindles are disposed with the axes of their respective spindles inclined to the horizontal and to an imaginary vertical plane extending longitudinally between said rows of positions.

20. Multi-position plying and take-up apparatus comprising a plurality of side-by-side plying and take-up positions, each of said positions comprising in substantially vertical sequential ascending alignment one upon the other, a plying spindle, at least one plied strand feed roll, and a take-up spindle, and a common support member for said plying spindles, said support member being arched along its length to form two oppositely extending downwardly and outwardly inclined support surfaces, said plying spindles being mounted on said support surfaces in both side-by-side relation to form two rows in back-to-back row relation, said spindles in each of said rows extending in upwardly and outwardly inclined relation with respect to an imaginary vertical plane passing through the longitudinal center of said arched support member.

21. Apparatus according to claim 20 wherein the axis of said take-up spindle at each position is substantially horizontal.

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