June 5, 1956 E. K. BAUER 2,749,055

PORTABLE CAP SPINNING UNIT WITH HYDRAULIC TRAVERSE

Filed Oct. 22, 1952 3 Sheets-Sheet 1

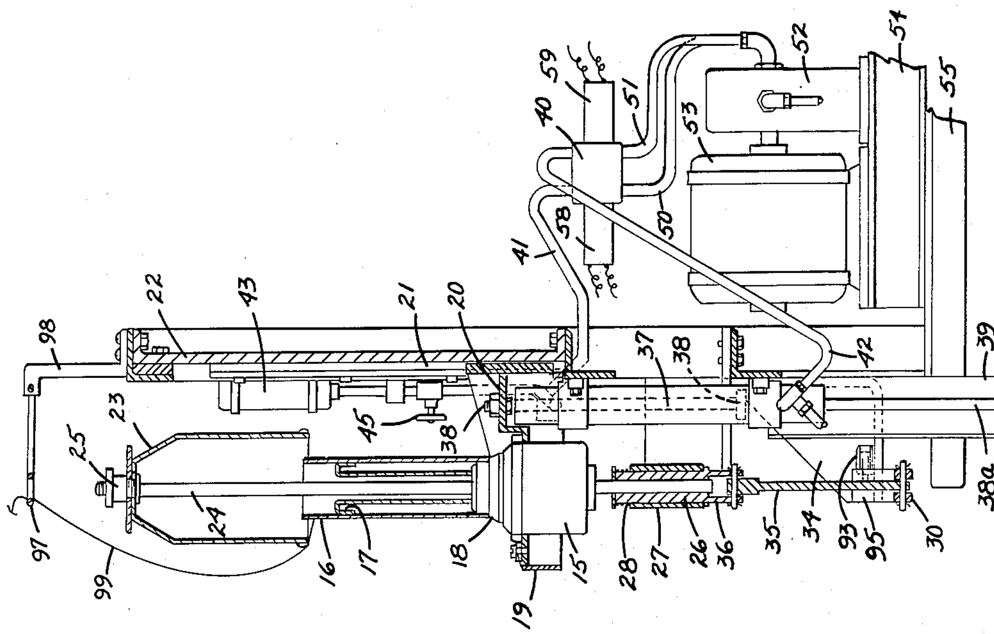

FIG-2

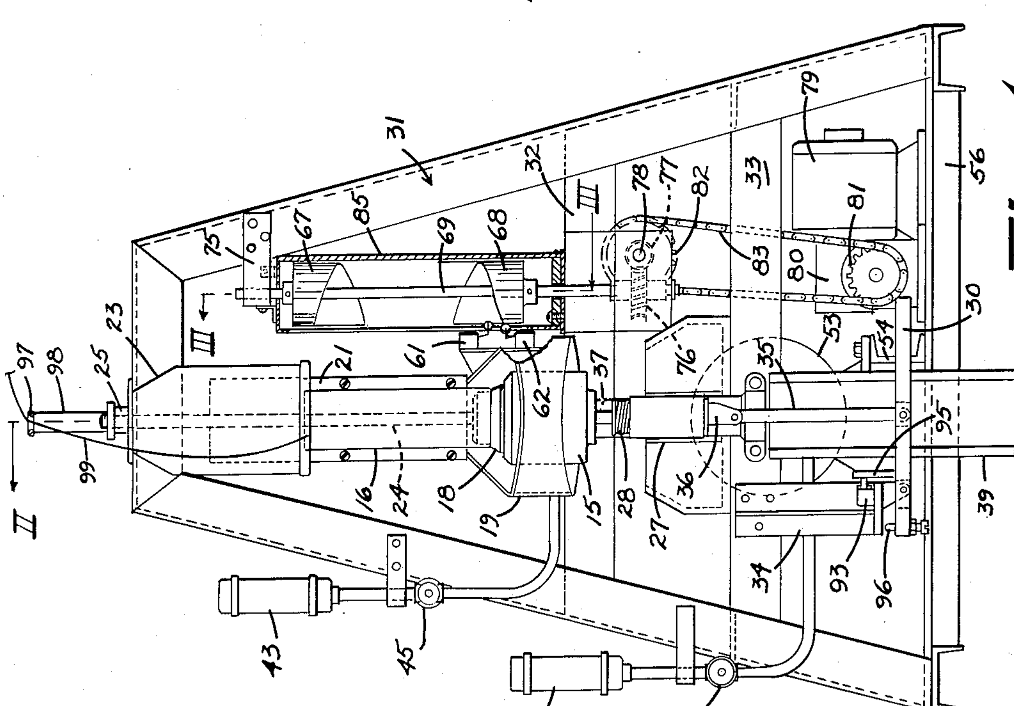

FIG-1

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PORTABLE CAP SPINNING UNIT WITH HYDRAULIC TRAVERSE

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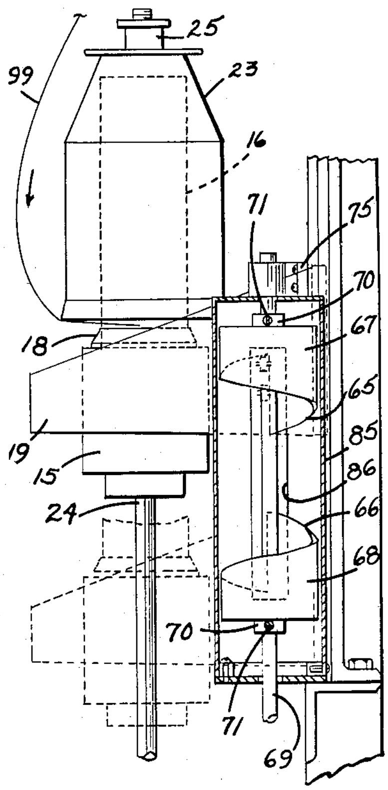

Fig. 3

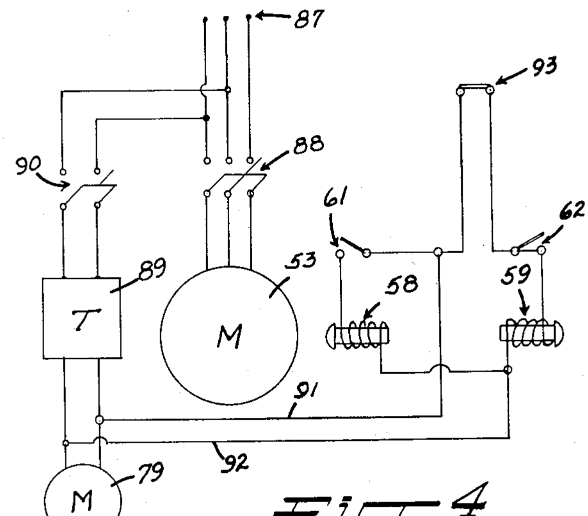

Fig. 4

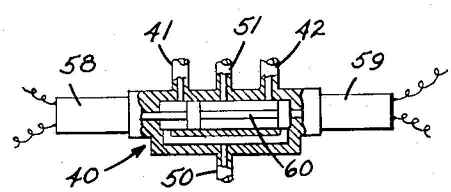

Fig. 5

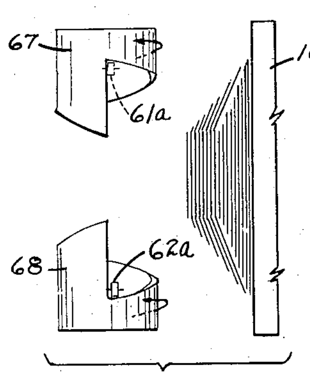

Fig. 6

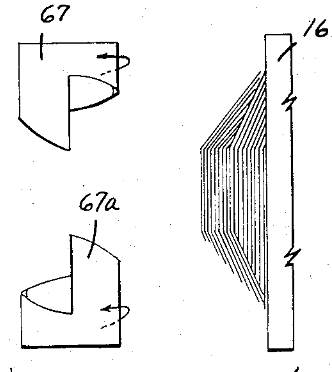

Fig. 7

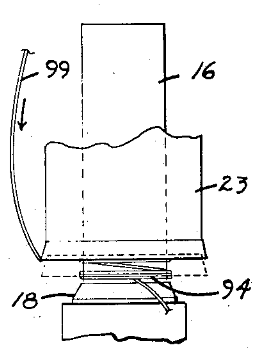

Fig. 8

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PORTABLE CAP SPINNING UNIT WITH HYDRAULIC TRAVERSE

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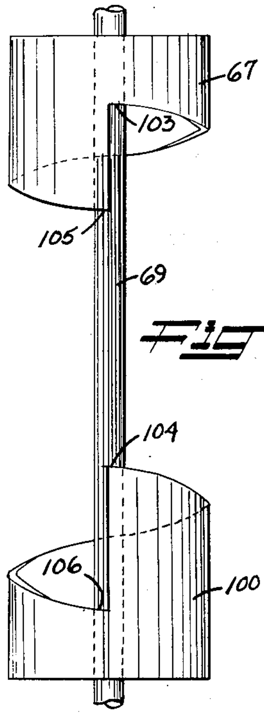

Fig. 9

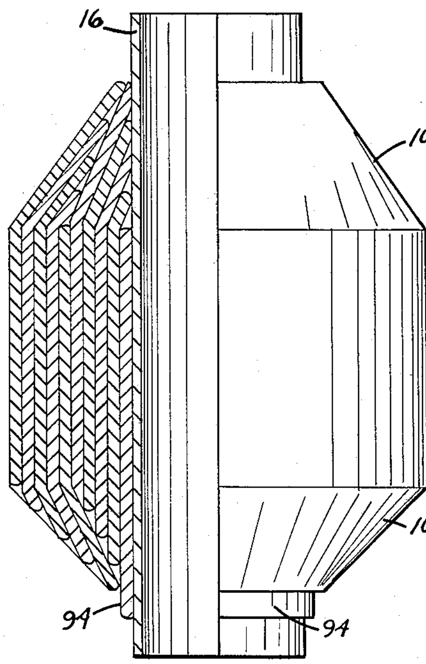

Fig. 10

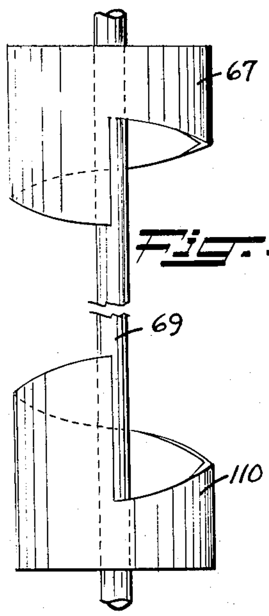

Fig. 11

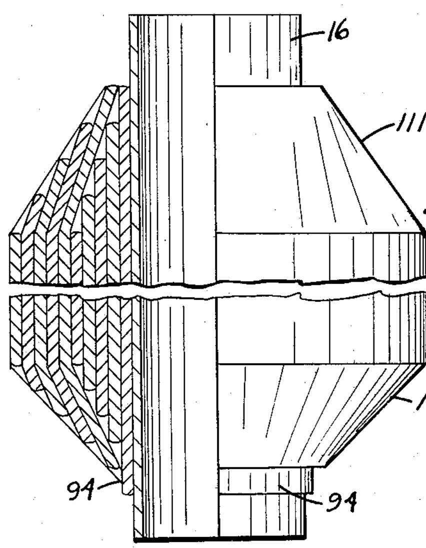

Fig. 12

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PORTABLE CAP SPINNING UNIT WITH HYDRAULIC TRAVERSE

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Application October 22, 1952, Serial No. 316,245

16 Claims. (Cl. 242—43.4)

This invention relates to winding machines and more particularly to an improved traverse for such a machine which enables the production of better and more desirable filament packages.

The present disclosure is directed to an improved winding machine as used in the textile industry for winding yarn packages from strands or filaments of a natural or synthetic fiber, but it will be understood that the nature of the filament used on the winding machine is immaterial.

I have found that the most advantageous type of yarn package such as customarily wound on tubes or cones should have the following characteristics. The tube should be substantially covered with yarn under uniform tension. Tendency for sloughing of the yarn when unwound should be eliminated or reduced to a minimum. The center of gravity of the yarn package should be below the transverse centerline of the tube. To enable cleaning of the package, it is important that the entire outer surface of the yarn be stripped by removing a minimum number of layers, thus reducing waste. In order to achieve the above desirable characteristics in a yarn package, it is necessary to provide a traverse mechanism for the winding machine that controls the layers of yarn wound on the tube to provide a special sequence, length, and relative location of the layers. Complicated and expensive traverse mechanisms have been heretofore designed for guiding the yarn onto the tube or cone. The present device is characterized by its simplicity and ability to modify completely the type of yarn package wound with relatively minor changes or adjustments.

A primary object of the invention therefore is to provide an improved traverse mechanism for filament winding machines.

A further object of the invention is to provide a double cam traverse mechanism for a yarn winding machine.

A further object of the invention is to provide a pair of cylindrical cams which, in conjunction with a pair of switches on the motor or flyer rail, control the points at which the rail reverses its traverse.

A further object of the invention is to provide means for temporarily by-passing one of the limit switches on the traverse mechanism of a yarn winding machine to permit limited over-travel of the motor rail thereby forming a tail.

Further objects will be apparent from the specification and drawings in which

Figure 1 is a front view of a unitary winding machine incorporating the present invention, certain parts being sectioned;

Fig. 2 is a vertical section as seen at II—II of Fig. 1;

Fig. 3 is an enlarged sectional detail as seen at III—III of Fig. 1 with the motor rail in a moved position;

Fig. 4 shows the wiring diagram of the present winding machine;

Fig. 5 is a schematic view showing partly in section the four-way solenoid valve used to control the movement of the motor rail;

Fig. 6 is a diagrammatic view showing schematically the type of package wound with allochiral cams of equal pitch;

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Fig. 7 is a view similar to Fig. 6 showing an entirely different package formation using two identical cams;

Fig. 8 is an enlarged detail of the cap and spindle in the position of Fig. 3 showing the manner of forming the tail;

Fig. 9 is an enlarged detail showing a pair of traverse cams of similar twist but of different pitch;

Fig. 10 is a diagrammatic representation of a yarn package partly sectioned as would be wound using the cams of Fig. 9.

Fig. 11 shows a pair of allochiral cams but of different pitch; and

Fig. 12 is a diagrammatic representation of a yarn package partly sectioned as would be found using the cams of Fig. 11.

The invention as applied to a cap yarn winding machine comprises essentially the provision of a camshaft which is driven in timed relation to the driving means for the spindle of the winding machine and which carries a pair of modified barrel cams. The motor rail has a pair of normally open limit switches which are closed at the end of each traverse in accordance with the angular position of the camshaft and cam surfaces. Generally, the cams are adjustable on the camshaft both rotationally and axially. The cam surfaces are smooth helical edges but, of course, may be varied in accordance with the type of yarn package that may be desired. While the pitch of the cams surfaces may be the same on each cam, I have found it desirable to use a higher pitch for the bottom cam thus making the top of the yarn package more tapered than the bottom, and thereby providing a package having a relatively low center of gravity.

When the cams are of the same right or left hand twist, the layers of yarn wound on the tube or cone are generally of equal length and will be exactly equal in length if the cams have the same pitch. Since the camshaft is timed to make approximately two complete revolutions for winding each package, the yarn layers will be formed to overlap each other at least twice at the points of maximum displacement, each layer in a cycle being substantially the same length as the preceding layer but displaced axially. See Fig. 7. If the cams are allochiral (of opposite twist), the layers are shortened at each end so that there is no overlapping until the camshaft makes one complete revolution. See Fig. 6.

The motor rail is reciprocated by means of a hydraulic plunger which is, in turn, controlled by a solenoid-actuated hydraulic valve. The solenoids are energized by switches mounted on the motor rail which contact the cam edges. The cap can be moved axially by means of suitable linkage, and when the cap is so displaced, an additional switch in series with the upper limit switch is held open by the linkage to prevent energization of one of the valve solenoids thus forming a "tail" for attachment to another package.

Referring to Figs. 1 and 2, I have shown my present improved traverse mechanism applied to a more or less conventional cap yarn winding machine. It will be understood however, that the improved traverse is useful in any type of yarn winding machine as well as coil winders where the shape of the coil or yarn package should be carefully controlled. The spindle motor 15 which drives a tube 16 through the conventional tube holder 17 and tube drive assembly 18 is mounted on the motor rail 19. Rail 19 is, in turn, carried by a bracket 20 slidable in ways 21 on vertical frame member 22.

In accordance with conventional construction of winding machines, a cap 23 is supported on a cap rod 24 by means of a suitable cap plug and lock nut assembly 25. Cap rod 24 is supported vertically in a bushing 26 which is axially slidable in bracket 27 and spring loaded therebetween by means of a helical compression spring

28. The rod **24** extends through the hollow shaft of motor **15** and does not rotate. It may be moved axially, however, by means of a treadle **30**. The frame member **22** is secured in the main frame assembly **31** at the top, and to cross member **32** at the bottom. A second cross member **33** mounts bracket **27** as well as bracket **34** on which the treadle **30** is pivoted. A link **35** pivotally connects treadle **30** and yoke **36** which is secured to the bushing **26** and to the cap rod **24** so that they move in unison when the treadle is pressed against the action of spring **28**.

The motor rail **19** together with tube **16** are moved vertically up and down through the action of a hydraulic cylinder **37** secured to cross members **32** and **33** and carrying a piston and rod assembly **38** bolted to bracket **20**. A shield or guard **39** is provided over the bottom of cylinder **37** to enclose the tail rod **38**a when in its bottom position. Fluid for activating the piston in the cylinder is controlled and regulated by means of a fluid valve **40** (Fig. 5) having an upper fluid connection or conduit **41** between the valve and cylinder **37**, and a lower similar conduit **42**. Air chambers **43** and **44** are connected to conduits **41** and **42** respectively to provide smooth action of the piston **38** in cylinder **37**. Air chambers **43** and **44** are desirably provided with valves **45** and **46** respectively connected to lines **41** and **42**.

Fluid for actuating the motor rail assembly is delivered to valve **40** through conduit **50** from pump **52** which is, in turn, driven by motor **53**. The pump and motor are mounted on the subframe assembly **54** which is carried by frame members **55** and **56**.

Activation of valve assembly **40** is achieved through solenoids **58** and **59** which reciprocate a piston valve element **60** to alternately connect the discharge conduit **50** from pump **52** to conduits **41** and **42**. The position of the valve **60** shown in Fig. 5 introduces fluid under pressure through conduit **41** to the top of cylinder **37**. Fluid that had been in the cylinder is vented through conduits **42** and **51**. When solenoid **58** is energized and solenoid **59** de-energized, the valve element **60** shifts in the valve housing to connect pressure conduit **50** and cylinder conduit **42** and simultaneously permitting fluid from the cylinder to discharge through conduit **41** into conduit **51**.

The solenoids **58** and **59** are selectively energized to operate the valve **40** by means of switches **61** and **62** mounted on the motor rail **19**. The switches have rollers **61**a and **62**a respectively which contact the cam surfaces **65** and **66** on cylindrical cams **67** and **68** respectively. These cams are adjustably secured to a camshaft **69** by means of collars **70, 70** and set screws **71, 71**. Camshaft **69** is journaled at its upper end in a bracket **75** and at its lower end carries a worm wheel **76** driven by a meshing worm gear **77** carried on shaft **78**. Motor **79** drives camshaft **69** through reduction gear box **80**, sprockets **81, 82**, and chain **83**. The speed of shaft **69** is such that it turns approximately two revolutions during the complete winding of a package. A guard **85** encloses cams **67** and **68**, and is slotted at **86** to permit access of rollers **61**a and **62**a to the cam surfaces **65** and **66**.

Fig. 4 shows the wiring diagram in which motor **53** is connected to a source of electrical current **87** through a suitable switch **88**, and the motor **79** is connected to two sides of the same source of current through a transformer **89** and switch **90**. Solenoids **58** and **59** are likewise connected to the low tension side of transformer **89** through leads **91** and **92**.

In operation, switches **88** and **90** are closed thus starting both motors **53** and **79**. The motor rail **19** then moves either up or down depending upon the position of valve element **60** in valve assembly **40**. However, the reciprocation of the motor rail will be stopped at the position shown in Fig. 3 when the operator depresses treadle **30**. This not only lowers cap **23** to the dotted line position shown in Fig. 8 but also opens a switch **93** in the circuit to solenoid **59** so that this solenoid will not be energized to lower the motor rail until the operator releases treadle **30**. In winding tubes with yarn, it is desirable to provide a tail **94** for each yarn package so that the tail can be tied to the leading end of the next yarn package thus avoiding any interruption in the unwinding of a plurality of packages. A bracket **95** secured to treadle **30** operates switch **93** in accordance with the position of the treadle, and the axial displacement or lowering of cap **23** may be regulated by means of a set screw **96** at the end of the treadle.

In the customary manner, yarn feeds through an eye or pig tail **97** mounted on top of the frame by means of a bracket **98** so that a balloon is formed by the yarn strand **99** as it revolves around the cap **23** at high speed. After the tail **94** has been sufficiently wound, the operator releases treadle **30** which, in turn, closes switch **93** and permits the traverse mechanism to commence normal operation. The motor rail reciprocates up and down to wind layers of yarn or filament on tube **16** and the reversing of the motor rail travel is controlled by limit switches **61** and **62** and cam surfaces **65** and **66**. The upper limit of each yarn layer is determined by bottom switch **62** and bottom cam **66**, whereas the lower limit of each yarn layer is determined by upper switch **61** and upper cam surface **65**. The switches **61** and **62** are normally open so that when they are closed respectively, solenoids **58** and **59** are energized to move valve **60** as explained above. It will therefore be understood that the length of each yarn layer as well as its axial position on tube **16** is controlled by the axial position of cam surfaces **65** and **66** which are contacted by the switches **61** and **62**.

Referring to Figs. 6 and 7, the various shapes of yarn package that can be achieved with the same or slightly modified cams will be explained. Fig. 6 shows cams **67** and **68** diagrammatically and these two cams are of equal pitch and allochiral with the high parts of each cam in axial alignment. These cams provide an initial maximum traverse which is gradually shortened equally at each end by each cam as the camshaft **69** turns. The shape of a yarn package formed with such cams is also shown diagrammatically in Fig. 6 in which the first yarn layer covers the maximum length of the tube **16**. The second layer is shortened both at the top and the bottom until the shortest layer is wound. This builds a symmetrical wrapping which is tapered both at the top and the bottom. When the camshaft **69** makes one complete turn, the above wrapping is repeated so that the first layer after the cams have made one turn extends substantially to the first layer on the tube. This is due to the fact that this first maximum repeat layer is wound directly over the preceding shortest layer due to the abrupt slope of the cam surface. As the package continues to build, the layers are similarly shortened at each end so that a yarn package having a short outer layer and symmetrical tapering conical ends is provided. Such a yarn package gives good tube coverage, fair tension and minimum sloughing tendency. The package cannot be completely cleaned, however, except by removing nearly half of the yarn wound thereon. Since cams **67** and **68** are exactly allochiral, the yarn package is symmetrical with respect to the transverse centerline of the tube.

Fig. 7 illustrates a variation in the yarn package form which may be achieved by using a second cam **67**a in place of cam **68**. In this case, cams **67** and **67**a are identical to each other. The high point of each cam is axially aligned on camshaft **69** with the result that the travel of the motor rail is always the same but it gradually shifts or progresses from one end of the tube to the other. A yarn package wound with cams **67** and **67**a is shown diagrammatically in Fig. 7 and it will be noted that each layer is intermediate in length to the maximum and minimum layers shown in Fig. 6. However, the first layer starts at the bottom of tube **16** and is carried upwardly to a point substantially above the centerline of the tube. The second layer is of the same length as the first layer but is displaced upwardly therefrom a slight amount in accordance with the pitch of the cams. In this way the layers are progressively wound on top of each other until the last layer of the first revolution of the camshaft. This layer extends from the maximum top position on tube **16** to a point somewhat below the transverse centerline of the tube and symmetrically opposite with respect thereto as compared to the first layer. When camshaft **69** has gone just beyond one turn, the winding shifts axially and abruptly to form a downward layer extending from the maximum bottom position to the same point where the first layer ended. The cycle is thus repeated during the second revolution of the camshaft and the resulting package is almost identical in outer appearance to the package wound in Fig. 6. However, it will have several noticeably better features. In the package of Fig. 7 the tube is covered, the tension is fairly uniform, and the sloughing tendency is reduced to a minimum. Furthermore, it is possible to clean approximately 70% of the package surface by removing only the outer yarn layer. This, of course, is a decided advantage over the package shown in Fig. 6.

Further improvements in the package that can be wound with the present invention are shown in Figs. 10 and 12 and these advantages can be achieved by using cams similar to those shown in Figs. 6 and 7 but with slightly different pitch. The upper cam **67** has been retained throughout the various modifications as a basis of comparison. However, in Fig. 9 the lower cam **100** is of the same slope or twist as cam **67** but it has a greater pitch. Since cam **100** controls the shape of the upper part of the yarn package, the greater pitch provides more slope in the top conical portion **101** than is formed in the lower conical portion **102**. This lower center of gravity of the package insures smooth running at higher unwinding speeds, and it reduces sloughing tendency because the yarn strand when unwound is drawn from or over the more gradually tapering end of the package.

In Fig. 10 the layers are wound on the tube **16** in a manner generally similar to that shown in Fig. 7. Due to the fact that the pitch of the cams is not equal, there will be a gradual increase or decrease in the length of each layer. This increment or decrement as the case may be is, however, far less than in the package of Fig. 6. With cams **67** and **100**, it will be seen that the minimum layer length occurs when the switch rollers **61***a* and **62***a* contact points **103** and **104** on the cams. The width of the layers then gradualy increases to a maximum until the rollers contact points **105** and **106** on the cams. This difference in the length of each layer may, of course, be controlled as desired by the relative shape or pitch that is used.

Fig. 11 shows upper cam **67** used in conjunction with cam **110** which is allochiral to cam **67** and has a greater pitch similar to cam **100**. This combination of cams winds a yarn package shown diagrammatically in Fig. 12 which is similar to the package of Fig. 6 in that the first layer of yarn wound on the tube is of maximum length and subsequent layers gradually decrease in length. The decrement, however at each end of the layer is unequal. Since the pitch of cam **110** is greater than the pitch of cam **67**, the shortening of the layers takes place more rapidly at the top **111** of the package than at the bottom **112**. Therefore, a package of the same general shape as that shown in Fig. 10 will be wound after two revolutions of camshaft **69**. The characteristics of the package of Fig. 12 with regard to cleaning approximate those of the Fig. 6 package. However, sloughing is reduced and higher speeds are possible because of the more gradual taper at the top of the package.

In addition to the unexpected differences in package construction that can be achieved by using two cams of the type disclosed herein which have helical surfaces controlling the length of each yarn layer as it is progressively wound, further variations are possible by changing the axial and rotational relationship of the cam surfaces simply by loosening either or both set screws **71, 71** and positioning the cams on shaft **69** as may be desired. The examples given above are illustrative of only a few of the wide variations possible. However, it has been found that the construction shown in Fig. 9 which winds the yarn package of Fig. 10 gives what is considered to be the best all around yarn package. This package has low center of gravity and more gradual tapering at the top which reduces or eliminates sloughing and the package can be cleaned in a maximum area by removing and therefore wasting the minimum amount of yarn. The relative importance of one or more of these advantages will depend upon circumstances, but with the present invention, it is readily possible to provide the exact type of package giving the particular advantage that is desired with a minimum expense and alteration of the traverse mechanism.

The yarn packages described herein have all been formed with two complete revolutions of the camshaft **69**. It will be understood, however, that one or more than two revolutions can be used. Nevertheless, in all traverses in which the rail reverses more yarn is wound at the point of reversal because there is never instantaneous change of direction. If the reversals are on top of each other or too close together, a lump of yarn will be formed thereby inducing sloughing. By repeating the cycle at least twice per package, the consecutive reversals causing lumping are sufficiently far apart that there is no appreciable build up.

It will be appreciated that the illustrations of the yarn packages are diagrammatic only and the thickness of each layer has been greatly enlarged in order to bring out the nature of the winding. Furthermore, the provision of the tail shown in Fig. 8 which is readily provided with the present invention has been omitted from the showings of Figs. 6 and 7 in the interest of clarity.

It must be understood that I have provided a simple and inexpensive traverse mechanism that is capable of producing a coil or yarn package selectively having the best combination of all features desired and which can be applied to any type of filament winding machine.

I claim:

1. A traverse assembly for winding machines comprising a filament guiding member, a filament receiving member said members being mounted reciprocably and rotatably with respect to each other, a shaft mounted in spaced relation to the axis of rotation of one of said members and fixed against axial movement in a direction parallel thereto, means for turning said shaft at a predetermined relative constant speed with respect to the rotation and reciprocation of said members, a pair of oppositely facing cam surfaces carried by said shaft, electrical contact responsive means on the reciprocable member for contacting each of said cam surfaces during reciprocation, and means responsive to activation of said electrical contact means for reversing the direction of travel of the reciprocable member.

2. A traverse assembly for winding machines comprising a filament guiding member, a filament receiving member said members being mounted reciprocably and rotatably with respect to each other, a shaft mounted in spaced relation to the axis of rotation of one of said members and fixed against axial movement in a direction parallel thereto, means for turning said shaft at a predetermined relative speed with respect to the rotation and reciprocation of said members, a pair of barrel cams each having an oppositely facing cam surface carried by said shaft, means on the reciprocal member for contacting the cam surface on each of said cams during reciprocation, and hydraulic means responsive to activation of said contacting means for reversing the direction of travel of the reciprocable member.

3. A traverse assembly for winding machines comprising a filament guiding member, a filament receiving member said members being mounted reciprocably and rotatably with respect to each other, a shaft mounted in spaced relation to the axis of rotation of one of said members and fixed against axial movement in a direction parallel thereto, means for turning said shaft at a predetermined relative speed with respect to the rotation and reciprocation of said members, a pair of identical barrel cams each having an oppositely facing cam surface carried by said shaft, means on the reciprocable member for contacting the cam surface on each of said cams during reciprocation, and means responsive to activation of said contacting means for reversing the direction of travel of the reciprocable member.

4. A traverse assembly for winding machines comprising a filament guiding member, a filament receiving member said members being mounted reciprocably and rotatably with respect to each other, a shaft mounted in spaced relation to the axis of rotation of one of said members and fixed against axial movement in a direction parallel thereto, means for turning said shaft at a predetermined relative speed with respect to the rotation and reciprocation of said members, a pair of allochiral barrel cams each having an oppositely facing cam surface, means on the reciprocable member for contacting the cam surface on each of said cams during reciprocation, and means responsive to activation of said contacting means for reversing the direction of travel of the reciprocable member.

5. A traverse assembly for winding machines comprising a filament guiding member, a filament receiving member said members being mounted reciprocably and rotatably with respect to each other, a shaft mounted in spaced relation to the axis of rotation of one of said members and fixed against axial movement in a direction parallel thereto, means for turning said shaft at a predetermined relative speed with respect to the rotation and reciprocation of said members, a pair of barrel cams having the same twist and unequal pitch on oppositely facing cam surfaces of each cam, means on the reciprocable member for contacting the cam surface on each of said cams during reciprocation, and means responsive to activation of said contacting means for reversing the direction of travel of the reciprocable member.

6. A traverse assembly for winding machines comprising a filament guiding member, a filament receiving member said members being mounted reciprocably and rotatably with respect to each other, a shaft mounted in spaced relation to the axis of rotation of one of said members and fixed against axial movement in a direction parallel thereto, means for turning said shaft at a predetermined relative speed with respect to the rotation and reciprocation of said members, a pair of barrel cams having opposite twist and unequal pitch, means on the reciprocable member for contacting the cam surface on each of said cams during reciprocation, and means responsive to activation of said contacting means for reversing the direction of travel of the reciprocable member.

7. A traverse assembly for winding machines comprising a filament guiding member, a filament receiving member said members being mounted reciprocably and rotatably with respect to each other, a shaft mounted in spaced relation to the axis of rotation of one of said members, means for turning said shaft at a predetermined relative speed with respect to the rotation and reciprocation of said members, a pair of oppositely facing cam surfaces carried by said shaft, means on the reciprocable member for contacting the cam surface on each of said cams during reciprocation, means responsive to activation of said contacting means for reversing the direction of travel of the reciprocable member, and means for axially displacing the filament receiving member with respect to the filament guiding member beyond the normal cam controlled limit to form a tail.

8. A traverse assembly for winding machines comprising a filament guiding member, a filament receiving member said members being mounted reciprocably and rotatably with respect to each other, a shaft mounted in spaced relation to the axis of rotation of one of said members, means for turning said shaft at a predetermined relative speed with respect to the rotation and reciprocation of said members, a pair of oppositely facing cam surfaces carried by said shaft, means on the reciprocable member for contacting the cam surface on each of said cams during reciprocation, means responsive to activation of said contacting means for reversing the direction of travel of the reciprocable member, and means for rendering the reversing means inoperative to provide a tail.

9. A traverse assembly for winding machines comprising a filament guiding member, a filament receiving member, said members being mounted reciprocably and rotatably with respect to each other, a camshaft mounted in spaced relation to the axis of rotation of one of said members and fixed against axial movement in a direction parallel to the axis thereof, means for turning said camshaft at a predetermined relative speed with respect to the rotation and reciprocation of said members, a first barrel shaped cam having a spiral cam surface mounted on said camshaft, a second barrel shaped cam having an oppositely facing spiral cam surface mounted on said camshaft, a pair of limit switches mounted on the reciprocable member and positioned to engage the cam surfaces, means for reciprocating the reciprocable member, means for reversing the direction of travel of said last named means, and means for energizing said reversing means upon respective closing of the limit switches by the cam surfaces.

10. Apparatus as defined in claim 9 in which the cams are identical.

11. Apparatus as defined in claim 9 in which the cams are allochiral.

12. Apparatus as defined in claim 9 in which the cams have the same twist and are of unequal pitch.

13. Apparatus as defined in claim 9 in which the cams are of opposite twist and have unequal pitch.

14. Apparatus as defined in claim 9 having a manually operable switch in series with one of the limit switches for selectively rendering the reversing means inoperative to provide limited over-travel of the reciprocable member.

15. Apparatus as defined in claim 14 having means for simultaneously opening the switch and moving the reciprocable member with respect to the rotatable member.

16. A traverse assembly for winding machines comprising a shaft, means for rotating said shaft, a pair of spiral cam surfaces connected to and rotatable with said shaft, a reciprocable filament layer forming member associated with said shaft, means for reciprocating said layer forming member, and means carried by the reciprocable member for reversing said reciprocating means upon contact with said cam surfaces, said last-mentioned means comprising a pair of limit switches positioned to contact the cam surfaces and means for rendering one of said limit switches inoperative to permit limited over-travel of the layer forming member beyond its normal reversing position.

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