April 12, 1960 J. V. KEITH 2,932,150

TWISTER SPINDLE

Original Filed Sept. 30, 1953

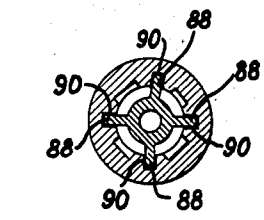


Fig. 4

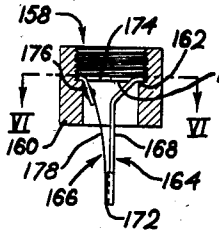


Fig. 5

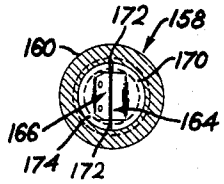


Fig. 6

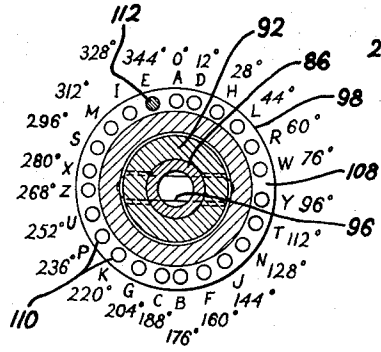


Fig. 3

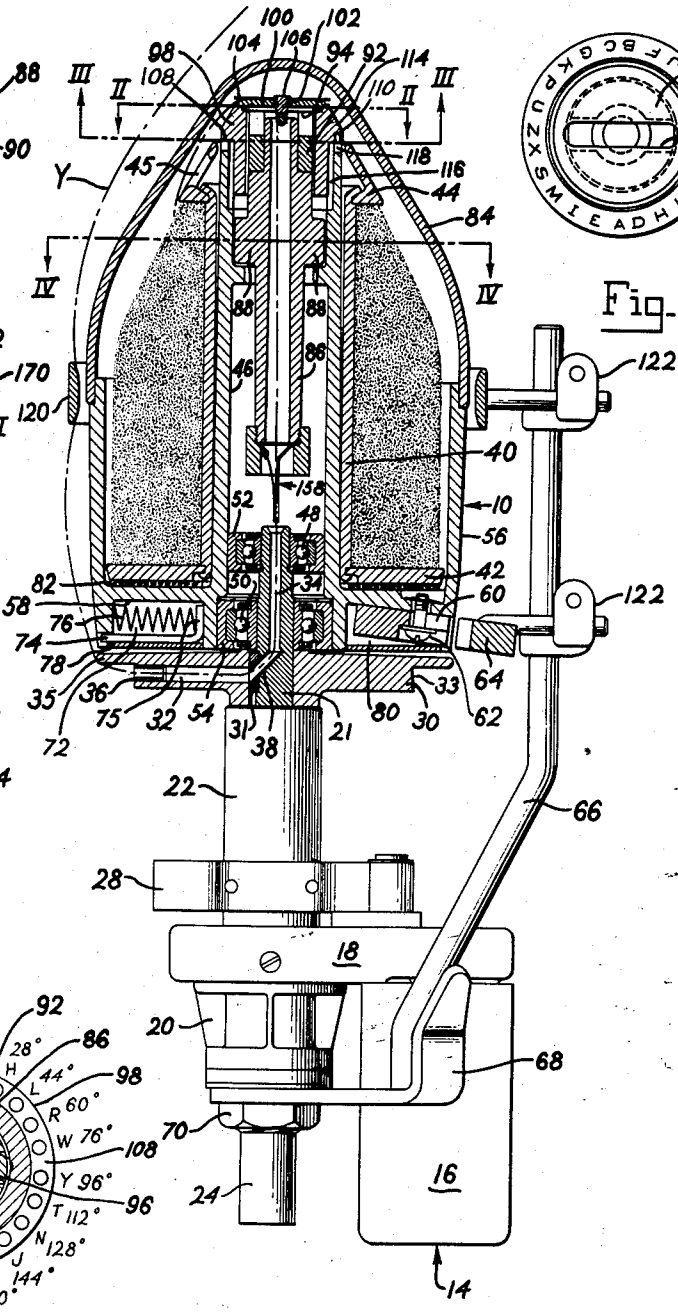


Fig. 1

Fig. 2

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TWISTER SPINDLE

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Original application September 30, 1953, Serial No. 383,263, now Patent No. 2,785,526, dated March 19, 1957. Divided and this application October 19, 1956, Serial No. 616,963

6 Claims. (Cl. 57—58.86)

The present invention relates to spindles for twisting yarn and more particularly relates to spindles of the multiple twist type and is a division of my copending application Serial No. 383,263 filed September 30, 1953, now U.S. Patent No. 2,785,526.

In the following specification and claims the term "yarn" is employed in a general sense to apply to all kinds of strand materials, either textile or otherwise, and the designation "package" is intended to mean the product of a winding machine whatever its form.

Multiple twist spindles have been known to those skilled in the art for many years. Use of this type spindle, however, has not been wide-spread due to difficulties encountered in controlling the tension in the strand of yarn being twisted, in controlling the balloon formed by the rapidly rotating strand of yarn, and the fact that the yarn, carried by the spindle has a tendency to feed out of the twisting spindle when the running strand is broken. Accurate control of tension through a wide range of selection is necessary to accurately twist the great variety of yarns that a commercially successful spindle must be capable of twisting. The size and shape of the balloon formed by the twisting yarn affects the tension in the strand of yarn and also is the determining factor in the spacing of adjacent spindles. It is desirable to locate the spindles as close together as possible to obtain the greatest possible utilization of available space. When the supply of yarn continues to feed out of the spindle after it has broken, the end thereof is whipped around and becomes entangled in adjacent yarn balloons causing those strands to break and in addition the rapidly rotating end beats against adjacent parts of the twisting machine and is broken into small fragments which fill the air in the room and contaminate yarn being processed within a wide area. A further disadvantage in prior multiple twist spindles is the possibility that the bearings supporting the normally stationary supply of yarn being twisted may lock or seize with the result that said supply will be rotated at a very high speed to thereby cause the destruction of the spindle itself and the possibility of severe physical injury to the machine operator.

It is, therefore, one object of the present invention to provide a multiple twist spindle having tension controlling means that are readily adjustable.

Another object of the present invention is to provide a multiple twist spindle having a tension controlling means capable of accurately controlling the tension of a strand of yarn being twisted through a wide range of tensions.

Another object of the present invention is to provide a multiple twist spindle having a balloon restraining guard adapted to move with the spindle as it moves between its operative and inoperative positions.

Another object of the present invention is to provide a multiple twist spindle having means to arrest the rotation of the yarn supply package carried thereby in the event the bearings supporting said supply package lock or seize.

Another object of the present invention is to provide a

multiple twist spindle having means to catch the strand of yarn carried by the spindle in the event said strand breaks and to thereby prevent continued rotation of said spindle from feeding said yarn.

Another object of the present invention is to provide a multiple twist spindle with means to prevent the supply of yarn carried thereby from being discharged therefrom in the event the twisting operation is interrupted by breakage of the running strand.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the apparatus possessing the construction, combination of elements and arrangement of parts which are exemplified in the following detailed disclosure, and the scope of the application of which will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawings wherein;

Fig. 1 is an elevation partly in section showing the multiple twist spindle of the present invention;

Fig. 2 is a fragmentary sectional view taken on the line II—II of Fig. 1 and looking in the direction of the arrows;

Fig. 3 is a fragmentary sectional view taken on the line III—III of Fig. 1 and looking in the direction of the arrows;

Fig. 4 is a fragmentary sectional view taken on the line IV—IV of Fig. 1 and looking in the direction of the arrows;

Fig. 5 is an enlarged fragmentary view, partly in section, showing the yarn catching mechanism; and

Fig. 6 is a sectional view taken on the line VI—VI of Fig. 5 and looking in the direction of the arrows.

Figure 1 shows a multiple twist spindle **10** carried by a spindle swing **14** of the type disclosed in U.S. Patent 2,648,948, issued August 18, 1953, to D. G. Soussloff et al. Spindle swing **14** includes a bracket portion **16**, adapted to be secured to the bed of a twisting machine, having pivotally mounted thereon spindle carrying arm **18**. Spindle **10** is resiliently secured in arm **18** by means of a vibration isolating mounting member **20** of the type disclosed in application for U.S. Letters Patent Serial No. 222,836 for "Spindle Mounting" filed April 25, 1951 by D. G. Soussloff et al., now U.S. Patent No. 2,668,027.

Spindle **10** is provided with a spindle blade **21**, having a whorl **22** fixed thereon, rotatably journaled in spindle step **24** which in turn is secured in vibration isolating mounting **20**. A conventional spindle driving belt, not shown, is adapted to be engaged by whorl **22** upon rearward pivotal movement of arm **18** to thereby rotate said whorl and spindle blade **21** in an old and well known manner. Forward pivotal movement of arm **18** disengaged whorl **22** from the belt and brings said whorl into engagement with a fixed brake **28** to stop the rotation of the spindle and whorl. A disc like flyer **30** is fixedly secured to spindle **21** adjacent whorl **22** by means of key **31** and is provided with a radial passage **32**. The inner end of passage **32** connects with an axial passage **34** provided in the upper end of spindle blade **21** to thereby form a passageway for the yarn being twisted. Wear resisting members **36** and **38** are provided in passage **32** adjacent its outer end and at the juncture of said passage **32** with axial passage **34** to resist abrasion by the strand of yarn Y as it passes through said passages. The periphery of flyer **30** adjacent passage **34** comprises a yarn storage ring **33** adapted to receive a wrap or wraps of yarn when the spindle is in operation to assist in controlling the tension in yarn balloon, all in the manner familiar to those skilled in the art. Storage ring **33** is slightly tapered, being of smaller diameter at its upper

edge than at its lower edge, so that when the spindle is operated with more than one wrap of yarn therearound the wraps will be spaced longitudinally and will not fall one upon the other. Flyer 30 is provided with a flange 35 adjacent the upper edge of yarn storage ring 33 to guide the running strand of yarn around the upper portion of spindle 10 as it leaves said storage ring.

A support for holding a supply of yarn to be twisted is mounted on spindle blade 21. Said support comprises a cylindrical member 46 journaled on the upper portion of spindle blade 21 by means of anti-friction bearings 48 and 50 which have their inner races in engagement with said spindle blade and their outer races located within resilient annular vibration isolating members 52 and 54 which in turn contact the inner surface of the lower end of cylindrical member 46. An annular upstanding flange or rim 56 is carried by member 46 concentrically therewith by means of web portion 58 which connects the lower end of said member 46 and the lower end of flange 56. A permanent magnet 60 is fixedly secured in recess 80 in web 58, by any convenient means, as for example screw 62, and cooperates with a second permanent magnet 64 carried by upstanding arm 66 to prevent the rotation of said support member when spindle blade 21 is rotated. Magnet 64 is spaced from magnet 60 to provide a gap through which the yarn balloon can pass when the spindle is in operation. The lower end of arm 66 is secured, preferably by welding, to bracket member 68 which in turn is secured to spindle step 24 by having said step pass through a hole in one of its ends and being clamped between the lower end of vibration isolating mount 20 and the nut 70 which clamps said spindle step in said vibration isolating mount.

A second recess 72 is provided in the under side of web 58 diametrically opposite magnet 60. An L-shaped safety latch 74 is slidably journaled in said recess for radial movement in the same plane as magnet 64. Safety latch 74 is adapted to move, under the influence of magnet 64 from its normal inward position wherein its outer end is inside the circumference of web 58, to an outward position wherein its outer end will engage said magnet 64, in the event the yarn support starts to rotate with spindle blade 21 to prevent further rotation thereof. Latch 74 is normally held in its inward or withdrawn position by means of spring 76 having one of its ends in engagement with the upstanding portion 75 of said latch and its other end in engagement with the opposed wall of recess 72. Latch 74 is retained in recess 72 by means of an annular cover plate 78 which encloses recesses 72 and 80 to thereby present a smooth surface to the air currents set up by flyer 30 as it rotates. A yarn supply carrying bobbin, comprising a cylindrical barrel 40, a flat circular head 42 secured to its lower end and a frusto-conical shaped upper head 44, of smaller diameter than head 42, secured to its upper end, fits over cylindrical member 46 and has its lower head supported by felt pad 82 on web 58. A plurality of finger holes 45 are spaced around the tapering surface of frusto-conical head 44 to permit the bobbin and the supply of yarn carried thereby to be picked up by head 44 so that the lay of said yarn will not be disturbed. A dome 84, preferably made of transparent plastic material, engages in a rabbet formed in the upper edge of flange 56 to enclose the bobbin, the supply of yarn carried thereby, and the tension mechanism to be explained hereinafter.

An adjustable yarn tensioning mechanism, see Figures 1, 2, 3 and 4 is carried by cylindrical member 46. The tension device includes a magnet holding and yarn guiding tube 86 located within the bore of cylindrical member 46 and in alignment with axial passage 34 in spindle blade 21. Tube 86 is held against rotation in cylindrical member 46 by means of splines 88 formed on tube 86 slightly above its mid-point which fit into longitudinally extending grooves 90 formed in said cylindrical member 46. One of the splines 88, and the groove with which

it mates, are displaced circumferentially so that said splines and grooves are not symmetrically arranged, with the result that said tube 86 can be placed in said cylindrical member 46 in only one position. The outside diameter of tube 86 adjacent its upper end is reduced to receive therearound a circular permanent magnet 92 which is fixedly secured to said tube by any convenient means, as for example, cement. The length of circular magnet 92 is such that its upper end extends beyond the upper end of tube 86.

An adjustable shunt 94 is positioned above circular magnet 92 and comprises a circular disc of magnetic material, such as iron, provided with a diametrically extending slot 96. Shunt 94 is mounted adjacent the upper end of tension cap 98. Tension cap 98 has a generally cylindrical lower portion located in the upper end of cylindrical member 46 and having a bore that surrounds magnet 92. Its cylindrical portion joins a flange 108 thereon which rests upon the upper end of member 46 and its upper end 114 is frusto-conical in shape. A tension friction plate 100 is also carried by tension cap 98 immediately above shunt 94. Tension friction plate 100 is a disc provided with a central aperture 102 in alignment with the bore of tube 86 and is formed of a non-magnetic wear resistant material such as stainless steel, procelain, etc. A tension disc 104 formed of magnetic material rests on tension friction plate 100 and is provided with a depending stem 106 loosely fitting in aperture 102 to permit the yarn Y drawn from the supply to pass between friction plate 100 and tension disc 104 and to pass through aperture 102 between the wall of said aperture and depending stem 106 prior to travelling down tube 86, the axial passage 34 in spindle 21, and out radial passage 32 in flyer 30. Tension disc 104 is preferably formed from thin material and depending stem 106 is preferably formed from a light weight plastic to reduce to a minimum the weight of said tension disc. Tension disc 104 is drawn against friction plate 100 by the circular magnet 92 to thereby apply a restraining or tension creating force to the strand of yarn being drawn between said plate and said disc. The magnetic force exerted on tension disc 104 can be adjusted to increase or decrease the force applied to the running strand of yarn by rotating shunt 94 relative to magnet 92 to cut off greater or less numbers of magnetic lines of force depending upon the position of slot 96 with respect to the poles of said magnet. To facilitate this adjustment, and to insure the quick and accurate setting of the tension, tension cap 98 is rotatable within the upper end of cylindrical member 46 and is provided in the under side of its flange 108 with a plurality of holes 110 any one of which can fit over pin 112 upstanding from the upper end of said cylindrical member 46.

It will be understood that the maximum number of magnetic lines of force will pass through shunt 94 when the slot 96 formed therein is in alignment with the poles of magnet 92 and the minimum number of lines of force will pass through said shunt when said slot is at right angles to said magnetic poles. It will also be understood that there are two positions of said shunt when said slot therein is in alignment with said magnetic poles, i.e. a first position, and a second position wherein said shunt is rotated 180 degrees from the first position. In both of these positions of the shunt the maximum number of lines of force will pass therethrough. There are also two positions of said shunt, 180 degrees apart, when the slot 96 is at right angles to the poles of magnet 92 and the same minimum number of lines of force will pass therethrough regardless of which position is used. It is also true that when shunt 94 is in an intermediate position, for example with its slot 96 forming an angle of 45 degrees to the poles of magnet 92, the same number of magnetic lines of force will pass through said shunt regardless of whether that 45 degree angle is made by said slot being inclined from right to left or from left to right. In other

words the effect of shunt **94** depends upon the angle its slot makes with the poles of magnet **92** and the effect is always the same regardless of whether the angle formed is right hand or left hand or is 180 degrees displaced. That being the case it is possible to calibrate tension cap **98** by using the entire 360 degrees of the surface of its flange **108** to give the effect of extremely small increments taken through 90 degrees of its circumference, and thus permit the holes **110** to be spaced four times as far apart as would be possible if the calibration were done in 90 degrees. Indicia consisting of letters of the alphabet are stamped in the conical surface **114** of tension cap **98** with each letter corresponding to a hole **110**. The hole **110** which, when engaged by pin **112**, positions the slot in the shunt at 90 degrees to the magnet poles is given the letter A. Therefore when tension cap **98** is positioned so that pin **112** engages the hole marked A the minimum number of magnetic lines of force will pass through shunt **94** to draw tension disk **104** against tension friction plate **100**, with the result that the minimum amount of tension will be applied to a strand of yarn drawn therebetween. The hole marked with the letter B is located in a clockwise direction, as viewed in Fig. 3, substantially 176 degrees from the hole A so that when tension cap **98** is rotated to the position wherein pin **112** engages hole B slot **96** will form an angle of 86 degrees with the poles of magnet **92**. The hole marked with the letter C is located 12 degrees in a clockwise direction from the hole marked B and 188 degrees from the hole marked A. As a result when pin **112** is engaged in hole C slot **96** will form an angle of 82 degrees with the poles of magnet **92**, but will be inclined in the opposite direction from its inclination when the hole B is engaged. The hole marked with the letter D is located 184 degrees in a clockwise direction, as viewed in Fig. 3, from the hole marked C and 12 degrees from the hole marked A. Therefore, when pin **112** is engaged in hole C slot **96** will form an angle of 78 degrees with the poles of magnet **92**. The remaining holes **110** are located in the manner illustrated in Fig. 3 with the result that moving tension cap **98** so that pin **112** engages holes **110** in alphabetical order, starting with the hole marked A, will vary the angle slot **96** makes with the poles of magnet **92** in increments of substantially 4 degrees.

Longitudinal grooves **116** are formed in the bore of cylindrical member **46** adjacent its upper end and cooperate with notches **118** in the upper edge of member **46** to provide a plurality of air passageways leading from the space surrounding the yarn supply package and the tension mechanism into the interior of cylindrical member **46**. When flyer **30** is rotated at its high operational speed the radial passage **32** formed therein acts in the manner of a centrifugal pump and evacuates most of the air from the interior of cylindrical member **46**. Notches **118** and longitudinal grooves **116** provide an air passage around tension disc **104** to permit the air enclosed by dome **84** to be drawn into the bore of cylindrical member **46** at the same rate said cylindrical member is evacuated, to maintain the pressure on both sides of tension disc **104** substantially equal. Failure to so vent the spindle would result in pressure outside cylindrical member **46** pressing tension disc **104** against friction plate **100** and result in excessive tension being applied to the strand of yarn being twisted.

In the event strand of yarn Y breaks after it has emerged from radial passage **32** in flyer **30**, the centrifugal force exerted on the strand due to its rapid rotation by said flyer tends to draw yarn from the supply carried by the spindle. The rapid rotation of a free feeding strand of yarn causes the strand to strike adjacent parts of the twisting machine and break into small fragments that fill the air over a wide area to contaminate yarn being processed by other spindles and to clog bearings and gearing in all exposed mechanisms. The spindle of the present invention is provided with a device which permits the free passage of the strand of yarn while the strand remains unbroken but which will catch and hold it in the event it breaks. The yarn catching device **158** is disclosed in Figs. 1, 5 and 6 and includes a ring **160** threadedly secured to the lower end of yarn guiding tube **86**. The bore of ring **160** is restricted to form a shoulder **162** which cooperates with the lower end of tube **86** to clamp yarn catching elements **164** and **166** to the end of said tube. Element **164** comprises a relatively rigid depending flat finger **168** secured at its upper end to horizontal semi-circular member **170**. The lower end of finger **168** is provided at each side thereof with a shallow flange or boss **172**. Element **166** comprises a horizontal semi-circular member **174** having a downwardly inclined detent **176** formed thereon. A flat spring **178** has its upper end secured to detent **176** and forms a continuation thereof. The two semi-circular members **170** and **174** when fitted together form a circle that will fit inside of ring **160** against the shoulder **162**. Thus when said member **170** and **174** are fitted in ring **160** and said ring screwed on the lower end of tube **86** said members **170** and **174** are clamped between said tube and flange to thereby hold the lower end of flat spring **178** against flanges **172**. Flanges **172** hold spring **178** spaced from finger **168** a distance slightly greater than the diameter of the strand of yarn Y to normally permit the free passage of said strand therebetween. When strand Y breaks the centrifugal force on said strand does not feed the strand as fast as it is normally drawn in the twisting process. As a result the length of yarn between flyer **30** and tension disc **104** is, in a very short time, twisted to such an extent that kinks are formed therein which can not pass through the space between finger **168** and spring **178** and the feeding of the strand is thus stopped. Continued rotation of flyer **30** after the strand Y has stopped will twist the strand to such an extent that it will be twisted apart, usually just below the yarn catching device **158**. After the strand has been twisted off on the axis of spindle blade **21** the flyer obviously can no longer exert any effect on the strand and any tendency for the strand to feed out of the spindle ceases. Spring **178** is flexible and is pushed aside by the threading needle employed to thread multiple twist spindles when said needle is passed down through tube **86**. In the event it is desired to twist a yarn of different diameter on spindle **10** it is only necessary to replace finger **168** with another similar finger having flanges **172** thereon slightly higher than the diameter of the new strand of yarn.

A smooth ring **120** formed from a wear resistant material is concentrically spaced around spindle **10** at approximately the point that would normally yield the maximum balloon diameter. Ring **120** is carried by upstanding arm **66** by means of mounting bracket **122** adjustably secured to said arm. Ring **120** functions to restrain the balloon formed by the rapidly rotating strand of yarn from being of excessive diameter thereby reducing the tension imposed on the strand of yarn due to centrifugal force and wind resistance and also permitting spindles **10** to be spaced closer together. Inasmuch as ring **120** is carried by upstanding arm **66** which in turn is carried by spindle carrying arm **18** it will be seen that said ring will move with spindle **10** to and from its operative position and will always remain concentric therewith.

The above described apparatus operates in the following manner: After a bobbin of yarn has been placed over cylindrical member **46**, tension disc **104** is removed and the strand of yarn Y from the supply is passed, by means of a conventional threading needle, through aperture **102** in friction plate **100**, slot **96** in magnetic shunt **94**, yarn guiding tube **86**, between finger **168** and spring **178** and through axial passage **34** of spindle blade **21**, and out radial passage **32** in flyer **30**. As the yarn emerges from radial passage **32** it is passed upwardly inside of balloon restraining ring **120**, through yarn guide, not shown, concentric with spindle blade **21**, and onto any convenient

take-up. Tension disc 104 is then replaced on friction plate 100 with its depending stem 106 extending into aperture 102. Tension cap 98 is then lifted to free it from pin 112 and it is then rotated until the indicia marked thereon indicates that the desired setting of shunt 94 has been obtained, whereupon pin 112 is engaged in the appropriate hole 110 to insure that the setting will not change during the twisting operation. Following this, dome 84 is placed on annular flange 56 to enclose the yarn supply and tension mechanism, and arm 18 is pivoted rearwardly to engage whorl 22 with the driving belt to place the spindle in operation. The yarn supply and tension mechanism is held against rotation by the magnets 60 and 64 so that rotation of flyer 30 swings a loop of yarn about the supply, in the manner old and well known to those skilled in the art, to thereby insert two turns of twist into strand Y for every single rotation of said flyer.

In the event bearings 48 and 50 seize so that the yarn supply and its support start to rotate, L-shaped safety latch 74 will be drawn out of its recess 72 by magnet 64 as said latch approaches said magnet, whereupon the end portion of the latch will strike against side of the magnet and thereby prevent damage to the spindle which might take place if said yarn supply and its support were permitted to rotate at high speed.

In the event the strand of yarn being twisted breaks, rotation of flyer 30 will impart such a high degree of twist to the length of yarn between said flyer and tension disc 104 that kinks or snarls will be formed therein that can not pass between finger 168 and spring 178. Continued rotation of flyer 30 will twist the strand off on the axis of the spindle whereupon any tendency for the yarn to feed from the spindle will be ended.

Since certain changes may be made in the above apparatus without departing from the scope of the invention herein involved, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. In a multiple twist spindle having a rotatable spindle provided with an axial bore and a radial passage connecting therewith, the combination comprising a stationary yarn support carried by said spindle, yarn tensioning means carried by said support, and yarn catching means carried by said support and interposed between said tensioning means and said spindle bore, said yarn catching means comprising a pair of elements spaced a predetermined distance apart to form an opening through which a strand of yarn must pass as it travels from said tensioning means to said axial bore.

2. A multiple twist spindle comprising a rotatable spindle having an axial bore and a radial passage connecting therewith, a stationary yarn support carried by said spindle, yarn tensioning means carried by said support, a tubular member carried by said support in axial alignment with said bore for guiding a strand of yarn from said tension to said bore, and yarn catching means carried by said tubular member, said yarn catching means comprising a pair of elements spaced a predetermined distance apart to form an opening through which a strand of yarn must pass as it travels from said tensioning means to said axial bore.

3. A multiple twist spindle comprising a rotatable spindle having an axial bore and a radial passage connecting therewith, a stationary yarn support carried by said spindle, yarn tensioning means carried by said support, a tubular member carried by said support in axial alignment with said bore for guiding a strand of yarn from said tension to said bore, and yarn catching means carried by said tubular member, said yarn catching means comprising a substantially rigid member, a second member resiliently urged toward said rigid member, and means interposed between said members to space said second member a predetermined distance from said rigid member to form a yarn passage therebetween.

4. In a multiple twist spindle including a rotatable spindle having an axial bore formed therein and a radial passage connecting therewith, the combination comprising a stationary yarn support carried by said spindle, a tubular member carried by said support in axial alignment with said bore, yarn tensioning means adjacent the end of said tubular member remote from said spindle, and yarn catching means carried by said tubular member, said yarn catching means comprising a substantially rigid member, a second member resiliently urged toward said rigid member, and means interposed between said members to space said second member a predetermined distance from said rigid member to form a yarn passage therebetween.

5. A multiple twist spindle comprising a rotatable spindle having an axial bore and a radial passage connecting therewith, a stationary yarn support carried by said spindle, yarn tensioning means carried by said support, a tubular member carried by said support in axial alignment with said bore for guiding a strand of yarn from said tension to said bore, and yarn catching means carried by said tubular member, said yarn catching means comprising a pair of elements spaced a predetermined distance apart to form an opening through which a strand of yarn must pass as it travels from said tensioning means to said axial bore, said elements comprising a substantially rigid member, and a resilient member, and abutment means carried by one of said members to space said members a predetermined distance apart to thereby form a yarn passage therebetween.

6. A multiple twist spindle comprising a rotatable spindle having an axial bore and a radial passage connecting therewith, a stationary yarn support carried by said spindle, yarn tensioning means carried by said support, a tubular member carried by said support in axial alignment with said bore for guiding a strand of yarn from said tension to said bore, and yarn catching means carried by said tubular member, said yarn catching means comprising a pair of complementary semi-circular segments, means for detachably securing said segments to one end of said tubular member, a stationary rigid finger carried by one of said segments and extending therefrom axially of said tubular member, a resilient finger carried by the other of said segments and urged in the direction of said rigid finger, and abutment means carried by one of said fingers to space said fingers a predetermined distance apart to thereby form a yarn passage therebetween.

References Cited in the file of this patent

UNITED STATES PATENTS

2,445,721	Bartholomew	July 20, 1948
2,478,927	Carter	Aug. 16, 1949
2,684,566	Roberts	July 27, 1954
2,725,711	Vibber	Dec. 6, 1955
2,729,932	Vibber	Jan. 10, 1956
2,731,786	Klein	Jan. 24, 1956
2,732,610	Perry	Jan. 31, 1956

FOREIGN PATENTS

250,053	Switzerland	May 18, 1948