

Dec. 10, 1940.

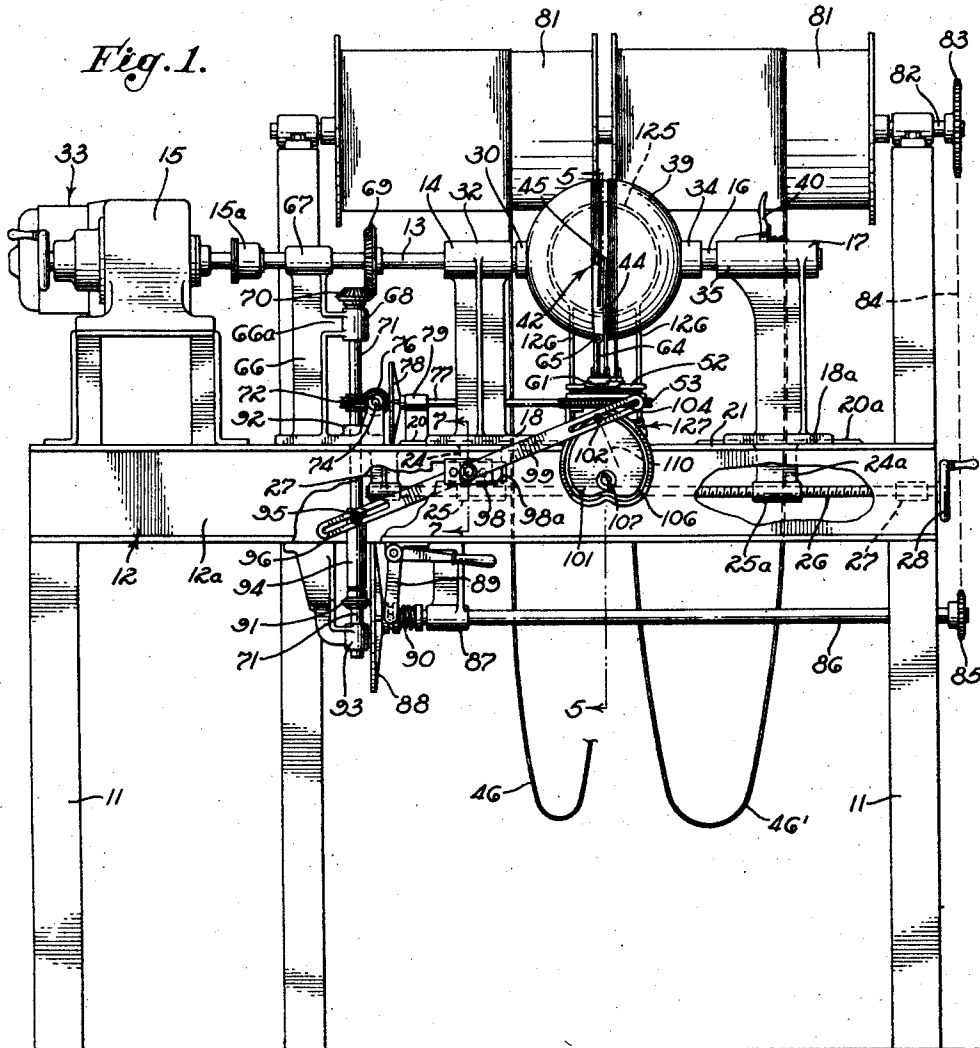
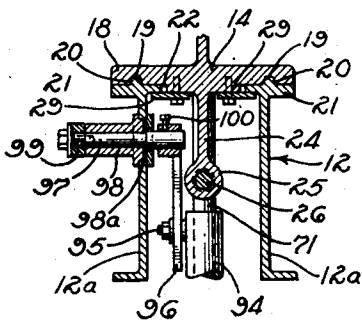
W. J. VOIT ET AL

2,224,416

WINDING MECHANISM

Filed Jan. 24, 1939

4 Sheets-Sheet 1



INVENTORS
WILLIAM J. VOIT
LEITH C. WEIMER
By HARRIS, KIECH, FOSTER & HARRIS
Ford W. Harris
FOR THE FIRM

ATTORNEYS.

Dec. 10, 1940.

W. J. VOIT ET AL

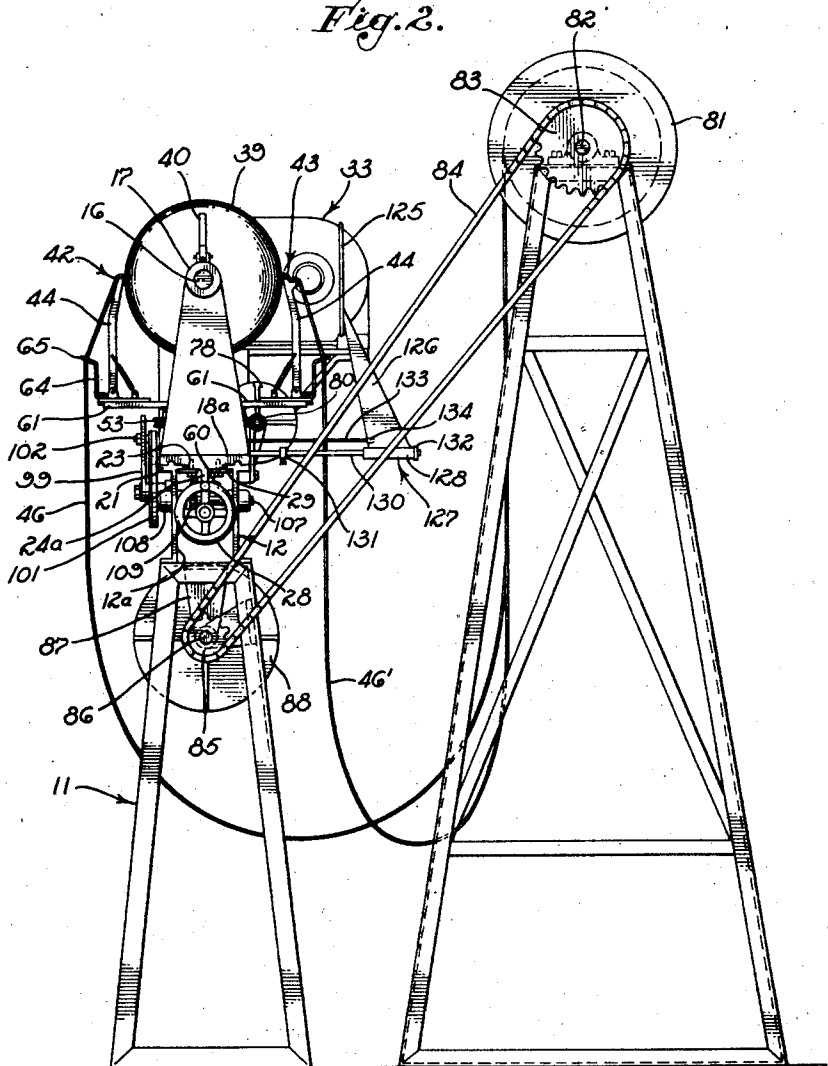
2,224,416

WINDING MECHANISM

Filed Jan. 24, 1939

4 Sheets-Sheet 2

Fig. 2.



INVENTORS
WILLIAM J. VOIT
LEITH C. WEIMER
BY HARRIS, KIECH, FOSTER & HARRIS
Ford W. Harris
FOR THE FIRM
ATTORNEYS.

Dec. 10, 1940.

W. J. VOIT ET AL

2,224,416

WINDING MECHANISM

Filed Jan. 24, 1939

4 Sheets-Sheet 3

Fig. 3.

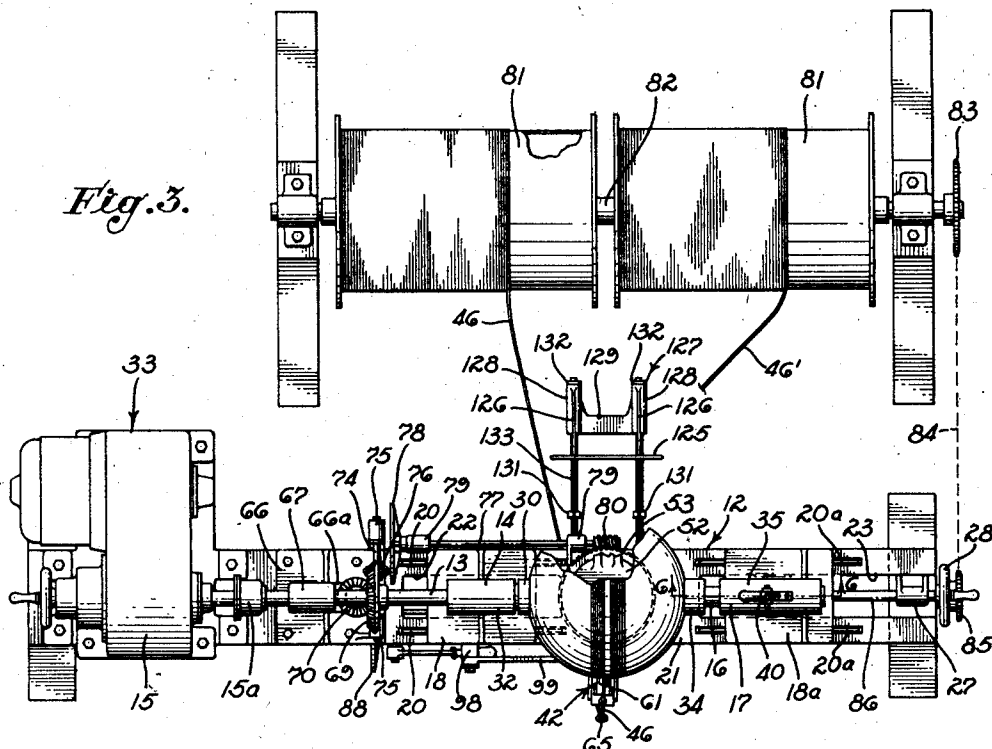


Fig. 4.

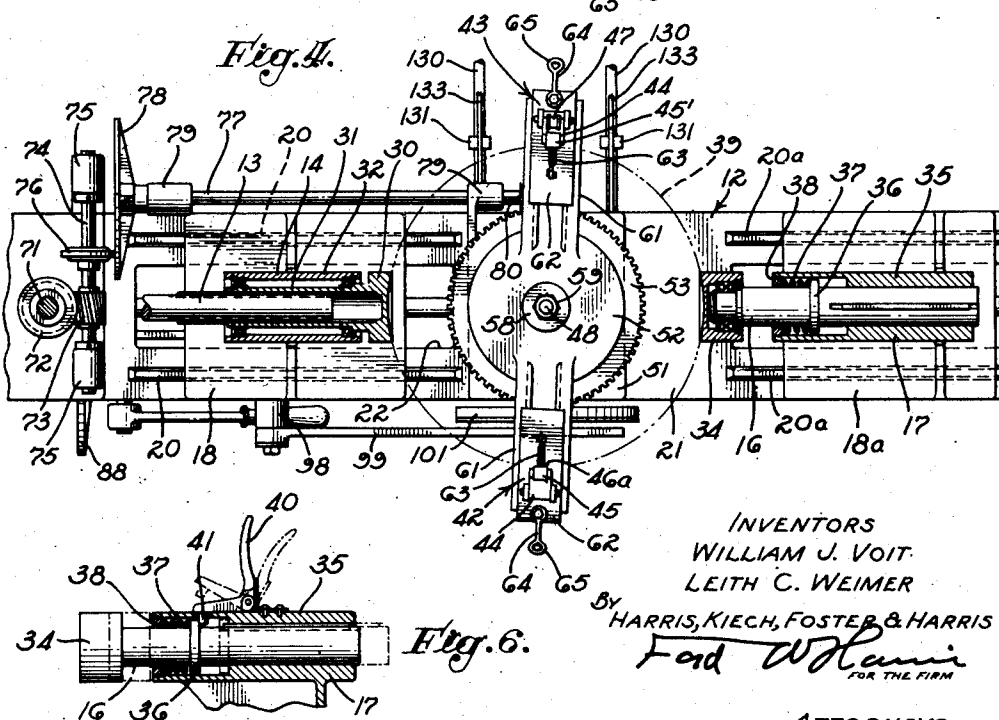


Fig. 6.

INVENTORS
WILLIAM J. VOIT
LEITH C. WEIMER
HARRIS, KIECH, FOSTER & HARRIS
Ford W. Harris
FOR THE FIRM
ATTORNEYS.

Dec. 10, 1940.

W. J. VOIT ET AL

2,224,416

WINDING MECHANISM

Filed Jan. 24, 1939

4 Sheets-Sheet 4

Fig. 8.

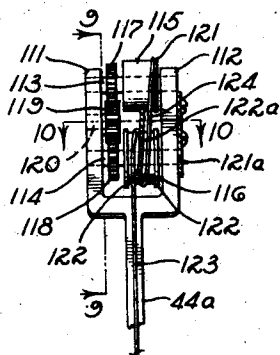


Fig. 9.

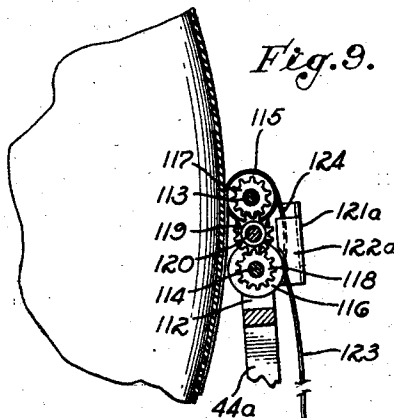


Fig. 5.

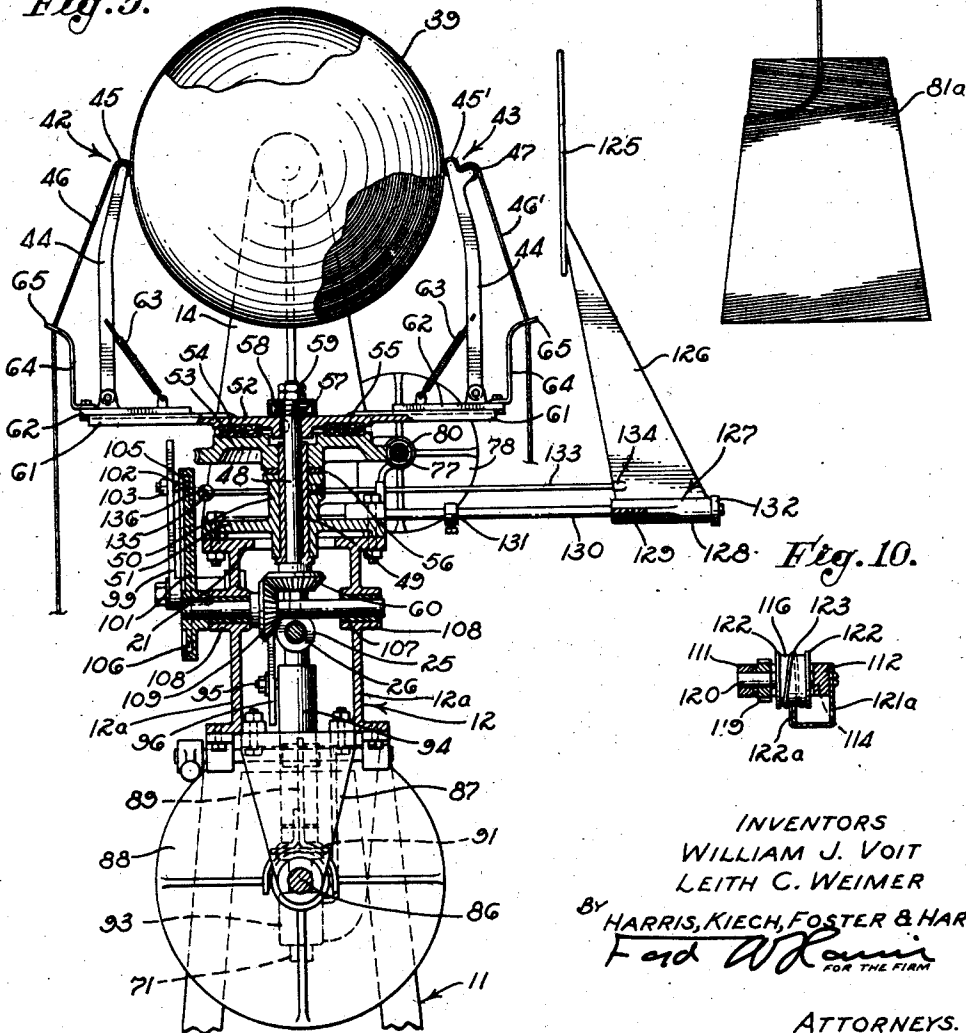
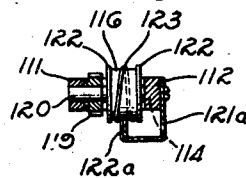


Fig. 10.



INVENTORS
WILLIAM J. VOIT
LEITH C. WEIMER
BY HARRIS, KIECH, FOSTER & HARRIS
Ford W. Harris
FOR THE FIRM
ATTORNEYS.

UNITED STATES PATENT OFFICE

2,224,416

WINDING MECHANISM

William J. Volt, Los Angeles, and Leith C. Weimer,
Southgate, Calif.; said Weimer assignor to said
Volt

Application January 24, 1939, Serial No. 252,601

17 Claims. (Cl. 242-3)

This invention relates to winding machines for laying elongated material, such as threads, strings, cords, and yarn upon balls or other bodies having a spherical or other curvilinear surface, and particularly to machines for winding thread upon ball centers or cores in contiguous spiral convolutions about a common axis to produce a reinforced ball such as is described in our applications, Serial No. 178,748, filed December 8, 1937, now Patent 2,194,132, and Serial No. 183,898, filed January 7, 1938, now Patent 2,157,580, in accordance with the method described in those applications.

In following the inventions disclosed in these applications, the string, thread, cord, yarn, strips of fabric or other elongated material is wound without tension, beginning at or near one polar point on the ball in contiguous coils or convolutions of gradually increasing diameter to the median equatorial great circle and then of gradually decreasing diameter until the opposite polar point is reached. This winding produces a layer of an even thickness, which is equal to the diameter of the strand material. Other similar windings are made upon the first winding, with the axis of each winding preferably perpendicular to the axis of the next preceding winding, to any desired number to build up a reinforcing layer on a hollow elastic or solid core, the layer being in turn covered with some type of wear-resisting material.

One of the objects of this invention is to provide a winding machine which will feed the thread perpendicularly to the surface of the ball, as it lays it thereupon, at all points of the spiral winding between the polar areas of that winding.

Another object is to provide a feed head which will move in a path lying in a great circle plane of the ball and concentric with that great circle.

Another object is to provide means for moving the feed head in timed relationship with the speed of rotation of the ball, and means for varying this timed relationship to correspond to different diameters of thread, to the end that the convolutions of the thread upon the ball will be evenly spaced thereon, either contiguously or at a constant interval.

Another object is to provide means for feeding the thread from a reel or other supply device at a variable linear speed which shall at any moment be the same, or substantially the same, linear speed as that at which the ball receives the thread. This feature of the invention makes it possible to feed the thread to the ball without tension or at a constant tension of any desired

amount. When winding inflated rubber bladders, it is of advantage that the thread be applied without tension to avoid deformation of the bladder by the thread. When winding solid or thick-walled ball centers or bladders disposed on rigid or semi-rigid forms, it may be of advantage to apply the thread under some degree of tension of constant magnitude.

Whether the thread be applied with our without tension, it is desirable to have the linear speed of the thread, as it leaves the reel or other supply device, equal to the linear speed of the thread as it is applied to the ball. When a reel is used, we accomplish this object by a time correlation of the rotational speed of the supply reel with the angular position of the feed head with respect to the surface of the ball.

A further object of our invention is to provide adjusting means for varying the ratio between the rotational speed of the reel and the rotational speed of the ball existing at any given point in the winding cycle to compensate for variations in the ratio of the diameters of balls and reels of different sizes.

Another object is to provide a winding machine that will, by its duplex construction, shorten the time required for completing the winding operation.

Another object is to provide manual devices for controlling the operation of the machine and to provide means for attaining other desirable results, which will be apparent from the following description and from the drawings.

In the drawings:

Fig. 1 is a view in side elevation of one form of machine embodying our invention.

Fig. 2 is a view in end elevation of the machine.

Fig. 3 is a plan view of the machine.

Fig. 4 is an enlarged plan view, partly in section, of the central portion of the winding mechanism.

Fig. 5 is an enlarged vertical transverse sectional view taken along the line 5-5 of Fig. 1.

Fig. 6 is an enlarged vertical section taken along the line 6-6 of Fig. 3.

Fig. 7 is an enlarged vertical section taken along the line 7-7 of Fig. 1.

Fig. 8 is a view in elevation of an alternative form of feed head.

Fig. 9 shows a vertical sectional view taken along the line 9-9 of Fig. 8.

Fig. 10 shows a horizontal sectional view taken along the line 10-10 of Fig. 8.

We have shown and described our invention as applied to the winding of thread upon a hollow

inflated rubber center to form a reinforcing layer for a hollow athletic ball of the basket ball or soccer ball type. It can also be used wherever it is desired to apply any type of elongated material, whether fibrous or elastic, to any ball-like object either solid or hollow, irrespective of the material of the ball center or of the material of the cover, when such is used, and whether the ball be spherical or of some other shape.

- 10 It is therefore to be understood that when, for instance, we use the word "thread" in the following description and claims, it is to be considered as exemplary of any other form of elongated strand-like material, and when we use the word "ball,"
- 15 it is to be given as broad a meaning as the context and the description of associated objects and of the functional or cooperative relationship of the ball thereto will permit.

The main frame of the machine which we have shown and described as embodying our invention comprises a supporting structure 11 and a horizontal cast beam 12 mounted thereon at a convenient elevation above the ground. Upon this beam is mounted mechanism of the character of a lathe for supporting the ball and rotating it upon a horizontal axis during the winding operation.

This mechanism consists of a drive or headstock spindle 13 revolvably mounted in a headstock body 14, a variable-speed drive box 15, and a tailstock spindle 16 longitudinally slidably mounted in a tailstock body 17. The headstock body and the tailstock body are longitudinally slidably mounted upon the beam 12. The character of the headstock mounting is shown in Fig. 7. The tailstock body is similarly mounted.

Referring to Fig. 7, a base 18 of the headstock body 14 and a base 18a of the tailstock body 17 are longitudinally grooved on their under surfaces, as at 19. These grooves fit over upwardly-projecting ways 20, 20a formed in the upper face of the beam 12. The upper horizontal plate element 21 of the beam 12 is centrally cut away to form apertures 22, 23 (see Figs. 2 and 3). The headstock body and tailstock body are each formed with depending webs 24, 24a respectively, which project downwardly from the base plate 18 through the apertures 22 and 23, respectively. At the lower edges of each of these webs 24, 24a are formed hollow cylindrical enlargements 25, 25a respectively, which are interiorly threaded to receive an adjusting rod 26. The threads of the projection 25 and the cooperating end portion of the adjusting rod 26 are of a right-hand character, and those of the projection 25a and the cooperating end portion of the adjusting rod 26 are of a left-hand character. The adjusting rod 26 is rotatably mounted in bearing brackets 27 secured to the underface of the plate 21 of the beam 12. The tailstock end of this adjusting rod 26 is provided with a manually-operated adjusting wheel 28 by the rotation of which the headstock and tailstock bodies can be caused to approach each other or recede from each other.

65 The base plate 18 of the headstock and tailstock bodies are held against upward displacement and in engagement with the ways 20 by means of slide plates 29 which engage the underface of the plate 21 and are secured to the underface of the base 18. A head chuck 30 is provided with an integrally formed sleeve 31 which is rotatably mounted within a barrel 32 formed as an integral part of the headstock 14. The sleeve 31 is splined upon the spindle 13 which is mounted so as to be capable of rotation, but is longitudi-

nally stationary. Power is transmitted to the spindle 13 from a motor 33 through a variable-speed drive in the box 15 and a flexible coupling 15a. A tail chuck 34 is rotatably mounted at one end of the spindle 16. This spindle is splined within a barrel 35 which is an integral part of the tail stock body 17. A helical spring 37 interposed between an annular shoulder 36 of the spindle 16 and a ring 38 threadedly secured to the end of the barrel 35 tend to retract the tail chuck 34 from a ball 39 which is positioned between the head chuck and tail chuck for the winding operation. By means of a bell crank lever 40, a detent pin 41 may be caused to engage the shoulder 36 to prevent this movement of retraction, or it may be disengaged from the shoulder 36 to permit the spring 37 to withdraw the tail chuck 34 from contact with the ball 39. With the detent pin 41 in elevated position, a ball can be removed from or inserted between the head chuck and tail chuck of the machine. To secure a ball in position between the two chucks for the winding operation, the headstock and tailstock bodies are first adjusted in proper position with respect to each other by the adjusting wheel 28. The spindle 16 is then manually moved forward until the tail chuck 34 engages the ball, at which time the detent pin 41 is dropped into position to lock the shoulder 36 against longitudinal movement.

Feed heads 42 and 43 are each carried by the upper end of an upright standard 44. The feed head 42 comprises a pulley 45 mounted between the forked branches of the upper end of the upright 44. One edge of the pulley 45 is provided with a flange 46a to prevent a thread 46 from passing off the end of the pulley as the head is moved bodily in a circular path in a direction of rotation away from the flanged edge of the pulley, as will be presently explained. That portion of the ball 39 in contact with the pulley 45 moves downwardly and the thread 46, as it leaves the pulley 45, also moves downwardly in contact with the ball. The head 43 differs from the head 42 in the provision of a second pulley 47, in addition to a pulley 45' corresponding to the pulley 45, both pulleys being mounted between the two branches of the forked upper end of their standard 44. A thread 46' passes around the upper side of this pulley 47 and thence around the lower side of the pulley 45' from which it is fed to the ball in an upward direction.

A vertical shaft 48 is mounted in a bearing sleeve 49 with the axis of the shaft passing through the center of the position occupied by the ball 39. This bearing sleeve 49 is rigidly carried by a tubular portion 50 of a frame casting 51 bolted to the upper face of the plate 21 of the beam 12. A turntable 52 is keyed to the shaft 48. The turntable 52 is supported vertically upon a worm gear wheel 53 which is rotatably mounted upon the exterior face of the cylindrical bearing sleeve 49. An annular friction plate 54 is secured to the underface of the turntable 52 and another similar annular friction plate 55 is secured to the upper face of the worm gear wheel 53. The frictional connection thus provided between the turntable 52 and the worm gear wheel 53 makes it possible to either transmit rotary motion from the gear wheel to the turntable or permit the turntable to be manually rotated relative to the gear wheel when the gear wheel is stationary. The gear wheel 53 is vertically supported upon the upper end of the tubular portion 50 of the casting 51 by means of a bearing washer 56. The friction be-

tween the plates 54 and 55 can be adjusted by varying the pressure between these two plates. To vary this pressure, a helical spring 57 is seated between the upper face of the turntable 52 and the lower face of an inverted cup-shaped washer 58. By means of nuts 59, the position of the washer 58 can be regulated upon the shaft 48. To the lower end of the shaft 48 is rigidly secured a bevel gear wheel 60. The spring 57 acts to hold this bevel gear wheel 60 vertically upward against the lower end of the bearing sleeve 49 which is, in turn, held in contact with the lower end of the tubular portion 50 of the casting 51. The spring 57 also acts to urge the turntable 52 downward against the worm gear 53 which is supported in fixed position vertically upon the upper end of the tubular portion 50 of the casting 51.

The turntable 52 is formed with two diametrically opposite wings 61. Each of these wings 61 supports a base plate 62 connected to it by a dovetailed sliding joint which permits horizontal radial movement of the plate 62 on the wing 61 with respect to the vertical axis of the ball 39. Each of the arms 44 is hinged at its lower end to an associated one of base plates 62 in such manner that it is free to oscillate in a vertical plane passing through the center of the ball. A coiled spring 63 anchored at its lower end upon the base plate 62 and secured at its upper end to the arm 44 holds the feed head 42 in resilient contact with the ball. The length of the arms 44 is such that the heads 42 and 43 lie in the horizontal plane passing through the center of the ball. A rod 64 fastened at the outer end of each of the base plates 62 extends upwardly and outwardly therefrom and is provided at its outer end with a guide loop 65 through which the thread 46 or 46' passes on its way to the feed head 42 or 43, respectively.

Power transmitting devices are provided for rotating the turntable 52 at a speed which is adjustably related to the speed of rotation of the ball in the lathe. This is accomplished in the following manner:

A bracket 66, which is rigidly mounted upon the beam 12, is provided at its upper end with a horizontal shaft bearing 67 for the spindle 13 and at the outer end of an arm 66a formed upon the bracket 66, it is provided with a vertical shaft bearing 68 in which is rotatably mounted a shaft 71. Above the bearing 68, this shaft 71 carries a bevel gear wheel 70 which meshes with a bevel gear wheel 69 keyed to the spindle 13. Rotary motion of the shaft 71 is transmitted to a horizontal shaft 74 mounted in bearings 75 by means of a worm wheel 72 on the shaft 71 and a worm gear wheel 73 of the shaft 74. Rotary motion of the shaft 74 is in turn transmitted to a horizontal shaft 77 mounted in bearing supports 79 through a friction wheel 76, slidably splined and adapted to be adjustably secured longitudinally upon the shaft 74, and a friction disc 78 on one end of the shaft 77. At the other end of the shaft 77 is a worm wheel 80 which engages the teeth upon the worm gear wheel 53. By moving the friction wheel 76 to different positions upon the shaft 74, the relative speed of the feed heads 42 and 43, in their arcuate paths about the ball, to the speed of rotation of the ball, can be adjusted as may be desired to regulate the distances between adjacent convolutions of the thread as it is laid upon the ball.

As was said at the beginning of the description of our invention, it is desirable, under some circumstances, to so feed the thread to the ball that

it will be laid thereon with little or no tension. To make provision for this, we show two means for feeding the thread to the feed heads at least as rapidly as the feed heads lay it upon the ball. One of these means is shown in Figs. 1 to 5 and 7, and an alternative form is shown in Figs. 8 to 10.

In the embodiment of our invention shown in Figs. 1 to 7, the thread is carried upon two reels 81 suitably mounted with their common axis parallel to the axis of the lathe chucks. A shaft 82 upon which the reels are mounted has keyed upon it at one end a sprocket wheel 83. The sprocket wheel 83 is driven by a sprocket chain 84 and another sprocket wheel 85 keyed upon a shaft 86. The shaft 86 is mounted horizontally in bearing supports 87 secured to the underface of the beam 12. At the other end of the shaft 86 from the sprocket wheel 85 is splined a friction disc 88. By means of a bell crank lever 89 pivotally mounted on the beam 12, the friction disc 88 may be retracted against the pressure of a spring 90 which normally holds it in contact with a friction wheel 91. The friction wheel 91 is splined upon the lower portion of the shaft 71 which is mounted in bearing supports 92 and 93 secured to the beam 12. The friction wheel 91 is rotatably mounted upon one end of a sleeve 94 which is free to reciprocate upon the shaft 71 but does not rotate therewith, being held angularly stationary by a pin and slot connection 95 with a lever 96. This lever is rigidly secured to a pin 97 rotatably mounted in a bearing 98 which is adjustably slidably mounted in a slot 98a formed in the left-hand web 12a of the beam 12. (See Fig. 7.) The lever 96 serves to vary the longitudinal position of the sleeve 94 on the shaft 71 and thereby through the friction drive 91, 88 to vary the speed of rotation of the reels 81. The movement of the lever 96 is correlated with the movement of the feed heads 42 and 43 so as to deliver the threads from the reels at a varying linear speed which shall at all times be substantially equal to the linear speed at which the feed heads lay the thread upon the ball. This latter speed varies from a maximum when the feed heads are in their central position to a minimum when the feed heads are adjacent the chucks.

The movement of the lever 96 is controlled in the following fashion: A second lever 99 is immovably secured to the outer end of the pin 97 in any suitable manner. As shown in the drawings, this lever 99 is formed with a square opening at its one end which fits over a squared end of the pin 97. It will be observed from Fig. 7 of the drawings that the means of rigidly securing the lever 96 to the pin 97 is adjustable in character, a set screw 100 permitting the levers 96 and 99 to be rigidly related to each other in varying angular positions. The drawings show these two levers adjusted with respect to each other at an angle of 180° but, for some conditions of operation, a different angular relationship is required.

Angular movement of the lever 99 about the axis of the pin 97 is imparted to it by a heart-shaped cam plate 101. A pin 102 is fastened in a slot 104 formed in the outer end of the lever 99 by means of a nut 103. The slot 104 permits the pin 102 to be immovably secured to the lever 99 at different distances from the pin 97 to accord with the different positions of the bearing 98, and in that manner the range of movement of the sleeve 94 on the shaft 71 may be varied to

correspond with the diameter of the ball which is being wound. The inner end of the pin 102 carries a small roller 105 adapted to travel in a slot 106 formed in the lateral face of the cam plate 101. The cam plate 101 is keyed upon a shaft 107 mounted in bearings 108 formed in the side walls 12a of the beam 12. Also, keyed upon the shaft 107 is a bevel gear wheel 109 which meshes with the bevel gear wheel 60 which has already been referred to as keyed to the shaft 48. The cam slot 106 is so shaped that the pin 102, as it moves along the arc shown in dotted lines 110, shifts the friction wheel 91 to unwind the thread from reels 81 at a linear speed always substantially equal to the linear speed of the thread as it is wound upon the ball.

Figs. 8, 9, and 10 illustrate another means of supplying the thread to the feed heads at the correct speed. In this form of our invention, the means for regulating the speed of supply of the thread to the feed heads is provided on the feed head itself. Referring to Figs. 8, 9, and 10, the upper end of the arm 44a is forked to provide prongs 111 and 112. Between these prongs are rotatably mounted shafts 113 and 114 on which are keyed pulleys 115 and 116, respectively. Also, keyed upon the shafts 113 and 114 are two spur gears 117 and 118, respectively, which mesh with an intermediate gear 119 rotatably mounted upon a stub shaft 120 which is stationarily secured to the prongs 111. The pulleys 115 and 116 are provided with flanges 121 and 122, respectively, to prevent the thread from lateral displacement on the pulley. A sheet metal clip 121a secured to the prong 112 is shaped to provide a divider plate 112a which is disposed in a plane perpendicular to the axis of the shaft 114 approximately midway between the flanges 122 of the pulley 116. The inner edge of this plate 122a is adjacent to, and conforms to, the cylindrical face of the pulley 116. The diameter of the pulley 116 is slightly greater than that of the pulley 115. Since the diameters of the spur gears 117 and 118 are equal, it follows that thread 123 is drawn from a spool 81a at a linear speed which is slightly greater than the linear speed at which the thread passes around the pulley 115 and is laid upon the ball. This causes a loop of thread 124 between the two pulleys to lengthen and bow outwardly, with the result that the frictional grip of the pulley 116 upon the thread is sufficiently decreased to allow this pulley to slip somewhat with respect to the thread wound upon it. In this manner, the loop 124 is maintained substantially constant in size and the thread is drawn from the spool 81a at the same speed at which the thread is fed to the ball. At the same time and by the same means, there is always provided sufficient slack in the loop 124 to insure the thread being laid upon the ball without appreciable tension.

To insure that all points on any vertical latitudinal circle travel in the same circular path without eccentricity, the ball must be so positioned with respect to the chuck that its horizontal axis longitudinal of the machine and about which it rotates must be coincident with the horizontal axis of the two chucks. It is also necessary that the center of the ball be vertically above the center of the turntable 52 in order that the arc of travel of the feed heads 42 and 43 shall be concentric with the horizontal great circle of the ball. The ball must then be centered with respect to the machine in a vertical direction, in a horizontal direction trans-

versely of the machine, and in a horizontal direction longitudinally of the machine. For the purpose of thus positioning the ball properly in the machine, we provide a centering ring 125 carried in vertical position by two arms 126 which project upwardly from the two sides of a frame member 127. This frame member comprises two sleeves 128 held in horizontal parallel relationship with each other by an integrally-formed yoke 129. The sleeves 128 are slidably mounted upon two parallel rods 130 which project horizontally from, and are stationarily mounted upon, the casting 51. Adjustable stops 131 fix the inner limit of movement of the member 127 upon the rods 130 and the inner limit of movement of the ring 125. Stops 132, fixed upon the outer end of the rods 130, prevent the member 127 from being moved so far outwardly from the machine as to become disengaged from the rods 130. Horizontal movement of the member 127, and the centering ring 125 which it carries, is accomplished by means of a U-shaped rod 133, the ends of which are secured at 134, 134, to the arms 126, respectively. The cross arm 135 of the U-shaped rod 133 is provided with a furrule 136 to serve as a hand grip with which to slide the member 127 and the centering ring 125 toward and away from the machine. Since the two rods 130 are equally spaced from the shaft 48, the axis of which passes through the center of the ball when it is properly placed and since, further, the center of the ring 125 is in the same horizontal plane with the axis of the chuck, it is obvious that by properly positioning the adjustable stop 131 for a ball of any given diameter and then drawing the centering ring toward the machine until the inner ends of the sleeves 128 contact the stops 131, the centering ring is in such position that, if the ball to be wound is held by the hand of the operator so that it is lightly in contact with the said ring and all parts of the centering ring contact some point on the ball, the ball will be centered vertically and centered horizontally, both longitudinally and transversely of the machine.

In the operation of the machine, the stops 131 are adjusted to the position corresponding to the diameter of the ball to be wound. The hand wheel 28 is used to separate the chucks somewhat more than is necessary to receive the ball. The centering ring 125 is pulled toward the machine until the sleeves 128 contact the stops 131. The ball is then held lightly against the centering ring and in contact with all points thereof. The hand wheel 28 is turned until the head chuck contacts the ball lightly. The tailstock spindle 16 is pushed forward until the detent pin 41 can be dropped into position back of the shoulder 36, at which juncture the tail chuck should be lightly in contact with the surface of the ball. The centering ring insures that the horizontal axis of the ball, longitudinal of the lathe, is coincident with the axis of the chucks. If the headstock body and tailstock body are correctly assembled upon the threaded adjusting rod 26, the horizontal axis of the ball, which is transverse of the lathe, should be centered with respect to the chucks, and the vertical axis of the ball should be vertically over the center of the turntable 52.

The friction wheel 76 is then set in position on the shaft 74 to move the turntable at the speed which will give the desired distance between the axes of adjacent strands of the winding. If the strands are to be in contact with each other, the

position of the friction wheel on the shaft 74 will be determined by the diameter of the strand. For any given strand diameter, the wheel 76 will be moved toward the shaft 77 to increase the interval between strands.

If the embodiment of our invention shown in Figs. 8 to 10 is used, there is no adjustment operation required to provide the requisite slack in the thread as it is fed to the ball. If the embodiment shown in Figs. 1 to 7 is used, the position of the pin bearing 98 in the slot 98a is fixed to accord with the diameter of the ball to be wound, and the pin 102 is at the same time secured in the corresponding position in the slot 106 in the cam plate 101. As the bearing 98 is moved to the left, the throw of the lever 96 is decreased with a corresponding narrowing of the range of rotational speed of the reels 81, as is suitable for relatively small balls. Right-hand movement of the bearing 98 adjusts the reel drive for relatively large balls. By means of the set screw 100, the angular alignment of levers 96 and 99 may be adjusted to fix the initial speed of the reel drive.

The feed heads are adjusted to their initial positions adjacent the respective chucks by manually rotating the turntable upon the gear wheel 53 against the frictional resistance between the plates 54, 55. The motor 33 is energized, which turns the ball and synchronously moves the feed heads in a horizontal circular path concentric with the ball, and unwinds the thread from the reels 81 at a linear speed substantially the same as the linear speed at which the feed heads lay the thread upon the ball. At the same time, the bell crank lever is operated to release the friction drive 88, 91 to permit the friction wheel 91 to move along the shaft 71 as the turntable is rotated. Rotation of the turntable causes longitudinal movement of the friction wheel 91 by means of the shaft 48, bevel gears 60 and 109, cam plate 101, and levers 99 and 96. When the feed heads are in their initial positions, the cam plate points downward. When the double layer of thread has been applied to the ball and the feed heads have traveled across the face of the ball from one chuck to the other, the threads are cut a short distance from the rollers 45, 45' on the ball side of the feed heads, the ball is turned to a new position in the lathe, the turntable is manually reversed to its initial position and the winding operation is repeated.

In order to disclose our invention, we have described in detail a machine which embodies several of its features. We do not wish, however, to be limited to the details of construction shown in the drawings and described in connection therewith. The several features of our invention, such as the path of each feed head about the ball, the means for moving the feed head in this path, the correlated driving connection between the feed head and turntable and the chucks, and the means for varying the linear speed at which the thread is supplied to the ball correlatively with the speed of application are capable of embodiment in many detailed structural combinations other than that disclosed herein. Our invention is not limited to the embodiments herein shown and described, but is defined in the following claims.

70 We claim as our invention:

1. In a winding machine, the combination of: means for mounting a ball on a first axis thereof and rotating said ball about said axis while so mounted; a feed head for laying elongated material on the ball as it is being rotated; and means

for bodily moving said feed head in an arcuate path centered about a second axis of said ball perpendicular to said first axis.

2. In a winding machine, the combination of: means for mounting a ball on a first axis thereof and rotating said ball about said axis while so mounted; a feed head for laying elongated material on the ball as it is being rotated; and means for bodily moving said feed head in an arcuate path centered about a second axis of said ball perpendicular to said first axis, said path lying in a plane of said first axis.

3. In a winding machine, the combination of: means for mounting a ball on a first axis thereof and rotating said ball about said axis while so mounted; a feed head adapted to supply elongated material to the ball in a direction perpendicular to the surface of said ball; and means for bodily moving said feed head in an arcuate path centered about a second axis of said ball perpendicular to said first axis, with said feed head in fixed angular relationship to its radius of rotation.

4. In a winding machine, the combination of: means for mounting a ball on a first axis thereof and rotating said ball about said axis while so mounted; a feed head for laying elongated material on said ball as it is being rotated; a roller mounted on said feed head with its axis perpendicular to a second axis of said ball perpendicular to said first axis; and means for bodily moving said feed head in an arcuate path concentric with said ball and lying in a plane of said first axis with the axis of said roller in fixed perpendicular relationship to the radius of rotation of said feed head.

5. In a winding machine, the combination of: means for mounting a ball on a first axis thereof and rotating said ball about said axis while so mounted; a feed head for laying elongated material on said ball as it is being rotated; a roller mounted on said feed head with its axis perpendicular to a second axis of said ball perpendicular to said first axis; a support mounted to rotate about said second axis and upon which said feed head is pivotally mounted to swing angularly about an axis parallel to the axis of said roller; and resilient means between said support and said feed head for holding said roller in rolling contact with said ball.

6. In a winding machine, the combination of: means for mounting a ball on a first axis thereof and rotating said ball about said axis while so mounted; a supporting member mounted to rotate adjacent said ball upon a second axis of said ball perpendicular to said first axis; an arm pivotally connected to said member on an axis perpendicular to said second axis; a roller pivoted to said arm on an axis perpendicular to said second axis; and resilient means for urging said arm toward said ball and holding said roller in contact with said ball.

7. In a ball winding machine, the combination of: a lathe having ball gripping chucks; a feed head for laying elongated material on a ball mounted in said chucks; means for bodily moving said feed head in an arcuate path centered about an axis of the ball perpendicular to the axis of said lathe chucks; a motor; power transmitting means from said motor to one of said chucks and to said feed head moving means adapted to drive said chuck and feed head moving means at rates of speed bearing a definite speed ratio to each other; and means for adjustably varying said speed ratio.

8. In a ball winding machine, the combination of: a lathe having ball gripping chucks; a feed head for laying material in strand form on a ball mounted in and rotated by said chucks; means for bodily moving said feed head in timed relationship to said chucks and in an arcuate path centered about an axis of the ball perpendicular to the axis of said chucks; a holder for said material in strand form; and means for linearly moving said material from said holder at a variable speed which is, at any point in the path of said feed head, at least as great as the speed at which said material is drawn by said ball from said feed head at said point.
9. In a ball winding machine, the combination of: a lathe having ball gripping chucks; a feed head for laying material in strand form on a ball mounted in and rotated by said chucks; means for bodily moving said feed head in timed relationship to said chucks and in an arcuate path centered about an axis of the ball perpendicular to the axis of said lathe chucks; a reel for said material in strand form; a motor; branched power transmitting means from said motor to one of said chucks and to said reel adapted to rotate said chuck and reel at related speeds; means in the branch of said power transmitting means to said reel for varying the ratio of said related speeds; and a control means for said ratio varying means operated by the branch of said power transmitting means leading to said chuck adapted to regulate said ratio varying means, for each given point in the path of said feed head, to rotate the reel at a speed to unwind the material at a linear speed at least as great as the linear speed at which said material is drawn by said ball from said feed head at said point.
10. In a ball winding machine, the combination of: a lathe having ball gripping chucks; a feed head for laying elongated material on a ball mounted in said chucks; means for bodily moving said feed head in an arcuate path centered about an axis of the ball perpendicular to the axis of said lathe chucks; a reel for said material; a motor; a power transmitting train from said motor having a first branch for driving one of said chucks, a second branch for driving said feed head moving means, and a third branch for driving said reel at three different speeds of rotation respectively, each of said speeds bearing a definite ratio to each of the other two speeds; means in said second branch for adjustably varying the speed ratio between said motor and feed head moving means; means in said third branch for varying the speed ratio between said motor and reel; and a control means for said last-mentioned ratio varying means operated by said feed head moving means and adapted to regulate said last-mentioned ratio varying means for each given point in the path of said feed head to rotate the reel at a speed to unwind the material at a linear speed at least as great as the linear speed at which said material is drawn by said ball from said feed head at said point.
11. In a ball winding machine, the combination of: a lathe having ball gripping chucks; a feed head for laying elongated material on a ball mounted in said chucks; means for bodily moving said feed head in an arcuate path centered about an axis of the ball perpendicular to the axis of said lathe chucks; a reel for said material; a motor; a power transmitting train from said motor having a first branch for driving one of said chucks, a second branch for driving said feed head moving means, and a third branch for driving said reel at three different speeds of rotation respectively, each of said speeds bearing a definite ratio to each of the other two speeds; means in said second branch for adjustably varying the speed ratio between said motor and feed head moving means; means in said third branch for varying the speed ratio between said motor and reel; and a control means for said last-mentioned ratio varying means operated by said feed head moving means and adapted to regulate said last-mentioned ratio varying means for each given point in the path of said feed head, to rotate the reel at a speed to unwind the material at a linear speed at least as great as the linear speed at which said material is drawn by said ball from said feed head at said point.
12. In a ball winding machine, the combination of: a lathe having ball gripping chucks; a feed head for laying elongated material on a ball mounted in said chucks; means for bodily moving said feed head in an arcuate path centered about an axis of the ball perpendicular to the axis of said lathe chucks; a reel for said material; a motor; a power transmitting train from said motor having a first branch for driving one of said chucks, a second branch for driving said feed head moving means, and a third branch for driving said reel at three different speeds of rotation respectively, each of said speeds bearing a definite ratio to each of the other two speeds; means in said second branch for adjustably varying the speed ratio between said motor and feed head moving means; means in said third branch for varying the speed ratio between said motor and reel; and a control means for said last-mentioned ratio varying means operated by said feed head moving means and adapted to regulate said last-mentioned ratio varying means for each given point in the path of said feed head to rotate the reel at a speed to unwind the material at a linear speed at least as great as the linear speed at which said material is drawn by said ball from said feed head at said point, said control means being adjustable to vary both the range of speed ratios between said motor and said reel and to vary the maximum speed ratio and the minimum speed ratio between said motor and said reel.
13. In a ball winding machine, the combination of: a lathe having ball gripping chucks; an arm adapted to be resiliently urged toward a ball mounted between and rotating with said chucks; a first thread-guiding pulley mounted on said arm and adapted to have rolling contact with said ball and to deliver a strand of thread to said rotating ball; and a second thread-guiding pulley mounted on said arm and arranged to be driven by said ball at a peripheral speed slightly greater than that of said first pulley, said second pulley being so positioned with respect to the direction of approach thereto of said strand of thread, and with respect to said first pulley that said strand of thread may have at least one complete wrap about said second pulley and thereafter be delivered to said first pulley so that said thread has at least one complete wrap about said second pulley.
14. In a ball winding machine, the combination of: a lathe having ball gripping chucks; an arm adapted to be resiliently urged toward a ball

mounted between and rotating with said chucks; a first thread-guiding pulley mounted on said arm and adapted to have rolling contact with said ball and to deliver a strand of thread to
 5 said rotating ball; a second thread-guiding pulley mounted on said arm and arranged to be driven by said ball at a peripheral speed slightly greater than that of said first pulley, said second pulley being so positioned with respect to the direction
 10 of approach thereto of said strand of thread, and with respect to said first pulley that said strand of thread may have at least one complete wrap about said second pulley and thereafter be delivered to said first pulley; and guide means for
 15 laterally separating the incoming and outgoing lines of said strand of thread to and from said second pulley.

15. In a ball winding machine, the combination of: a lathe having ball gripping chucks; a
 20 centering ring; a member for mounting said centering ring in a vertical plane parallel to the lathe axis with its center in the horizontal plane of said axis; a support on which said member is mounted to slide horizontally in a direction
 25 perpendicular to the lathe axis; and an adjustable stop to limit the inward movement of said member on said support.

16. In a ball winding machine, the combination of: a lathe having ball gripping chucks; a
 30 thread storage means; and a thread feeder arranged to be shiftable across the face of the ball and comprising a first pulley adapted to have

rolling contact with the ball of a character adapted to rotatively drive the pulley, said pulley having associated therewith guiding means for applying the thread to the ball in a winding plane substantially embracing the point of said
 5 rolling contact, and a thread engaging second pulley adapted by frictional wrap of the threads thereon to draw the thread from said thread storing means and discharge it in position to
 10 pass through said guiding means and be wound upon said ball, said second pulley being operatively connected to said first pulley for being driven thereby at a gear ratio which gives a peripheral speed to the thread engaging surface of
 15 said second pulley greater than the peripheral speed of the ball in the winding plane.

17. In a ball winding machine, the combination of: a lathe having ball gripping chucks; a storage means for material in strand form; and a feed assembly bodily traversable across the face
 20 of the ball and adapted to deliver said material to said ball for winding thereon at a point transversably movable with said assembly, said assembly having a revolvable member having rolling
 25 frictional contact with the ball and adapted to be rotated thereby and said assembly having means operated by said revolvable member for pulling said material from said storage means in readiness for said winding delivery.

WILLIAM J. VOIT.
 LEITH C. WEIMER.

30

CERTIFICATE OF CORRECTION.

Patent No. 2,224,416.

December 10, 1940.

WILLIAM J. VOIT, ET AL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, first column, line 63, for the word "cause" read --caused--; page 6, second column, lines 70, 71 and 72, claim 13, strike out "so that said thread has at least one complete wrap about said second pulley"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 21st day of January, A. D. 1941.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.