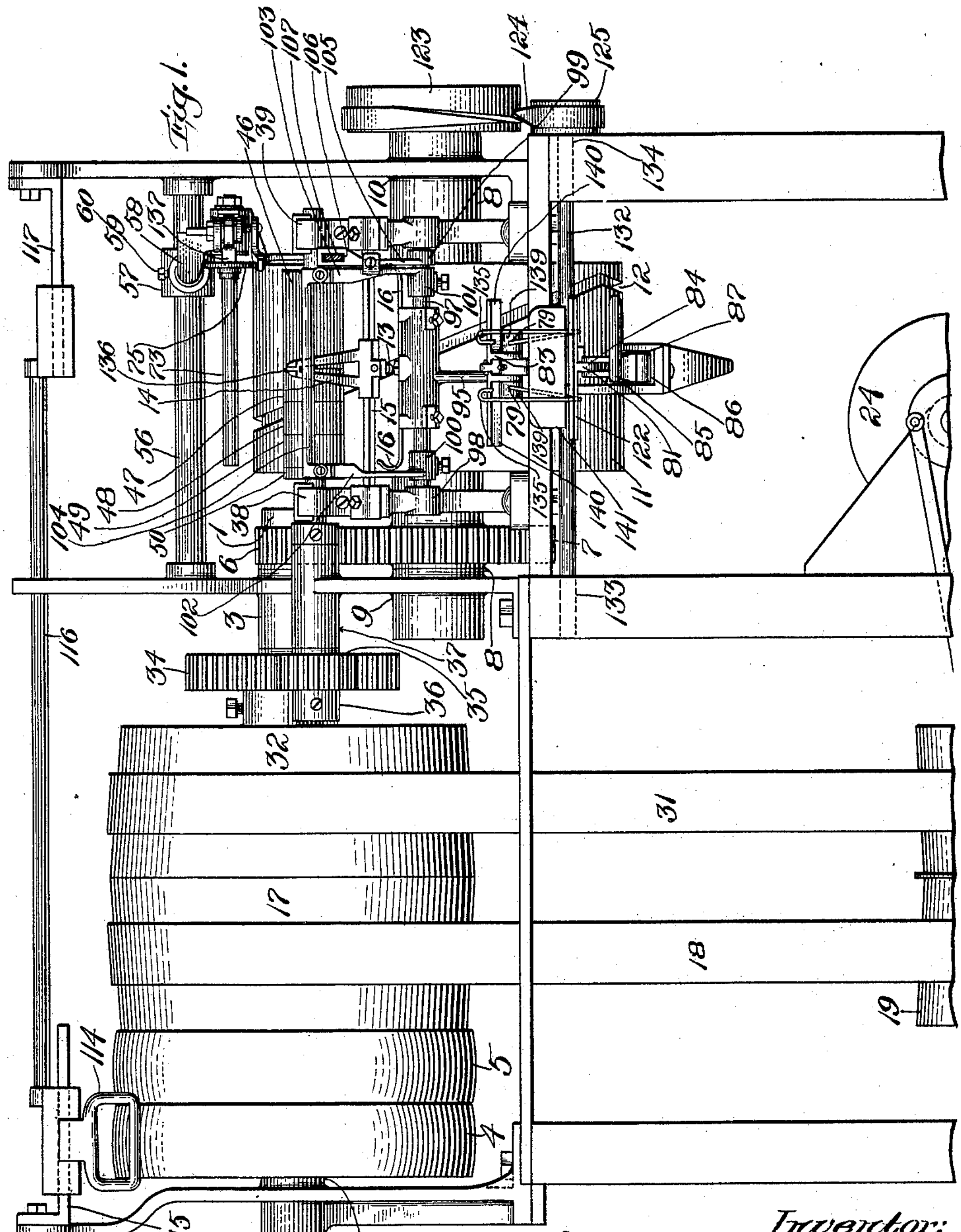
No. 716,923. **Patented Dec. 30, 1902.**

**J. O. McKEAN.**

**WINDING MACHINE.**

(Application filed Sept. 25, 1901.)

(No Model.) 4 Sheets—Sheet 1.

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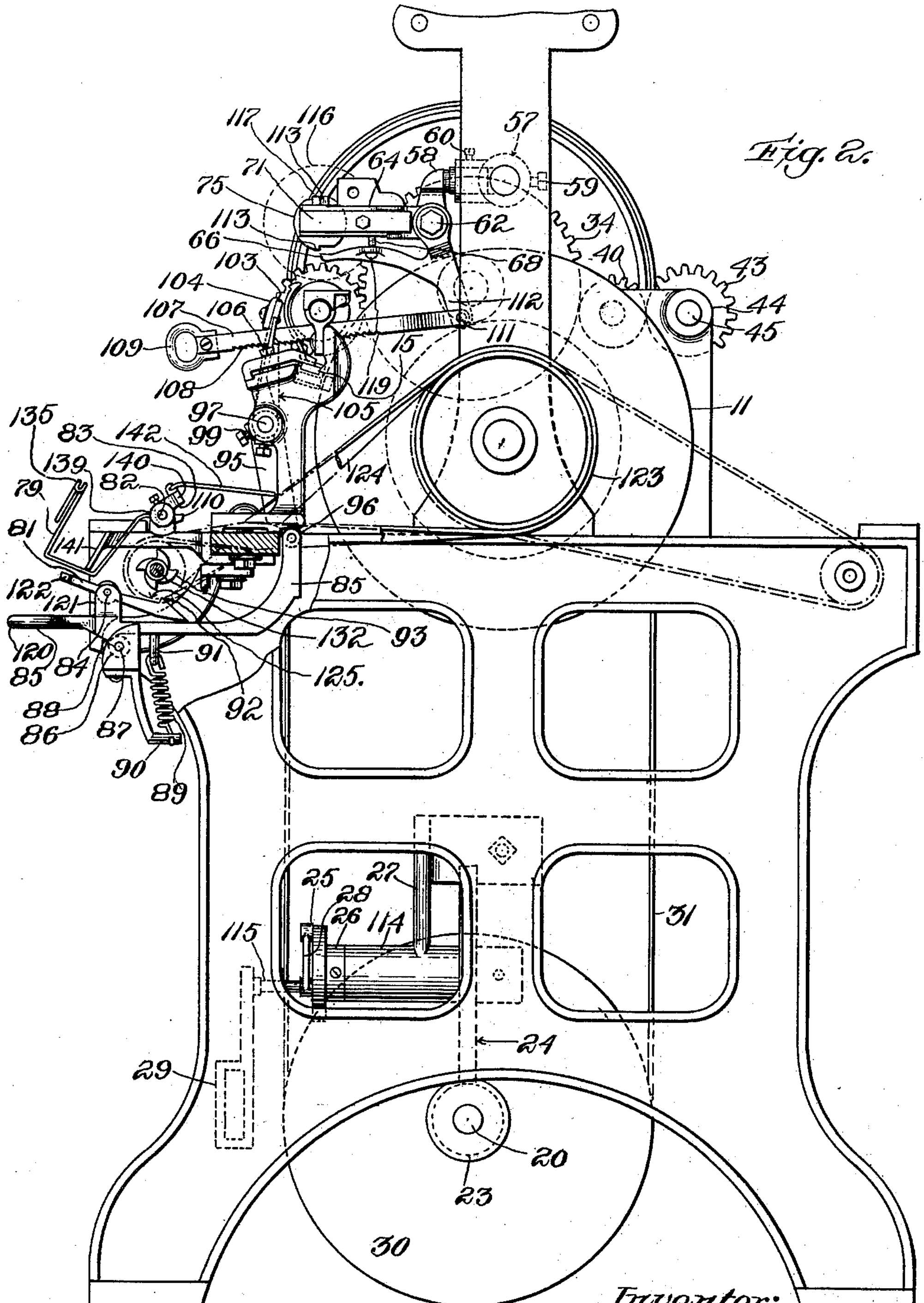


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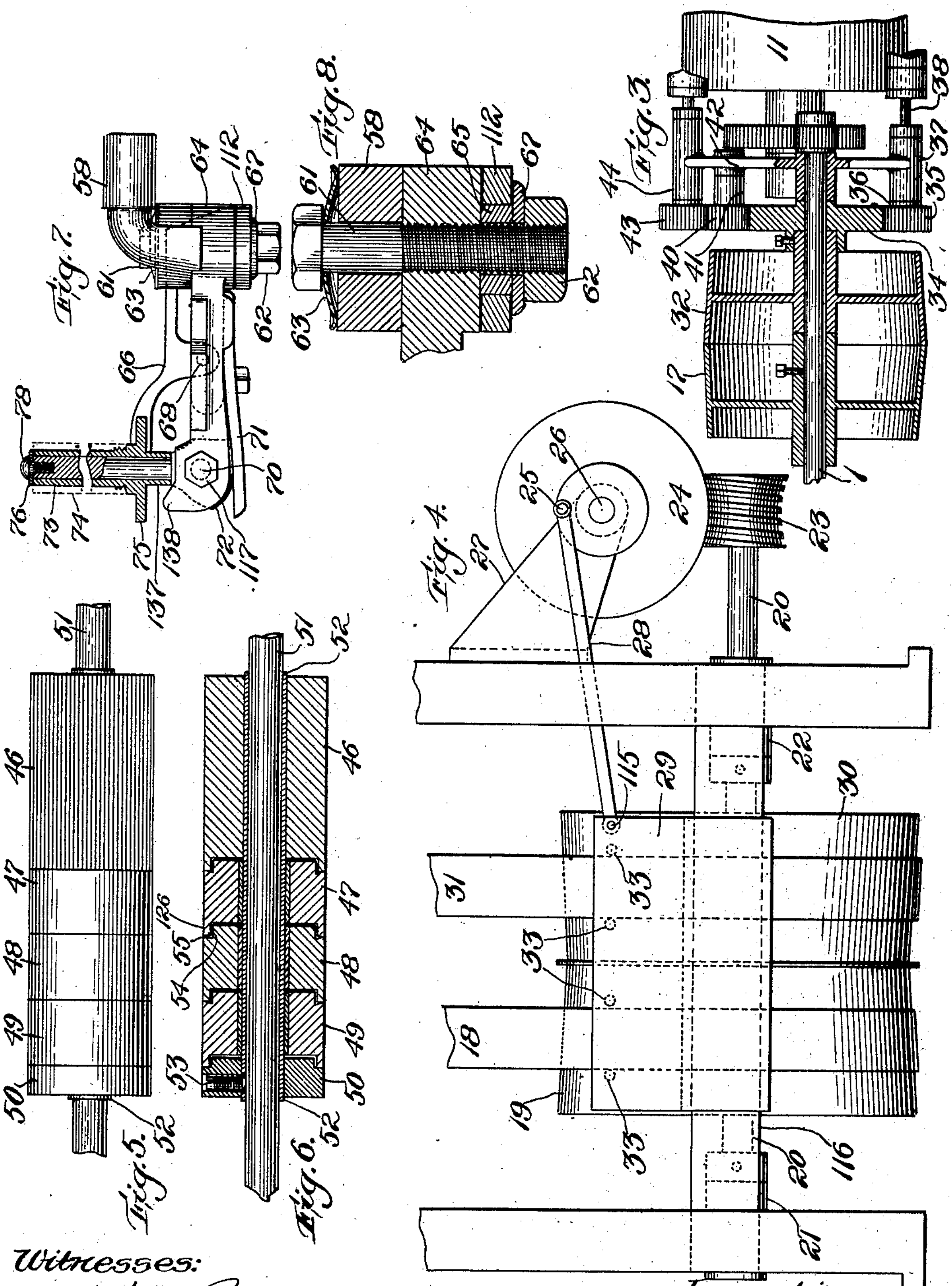


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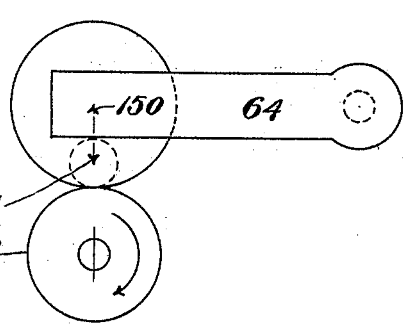
(No Model.) 4 Sheets—Sheet 4.

Fig. 9.



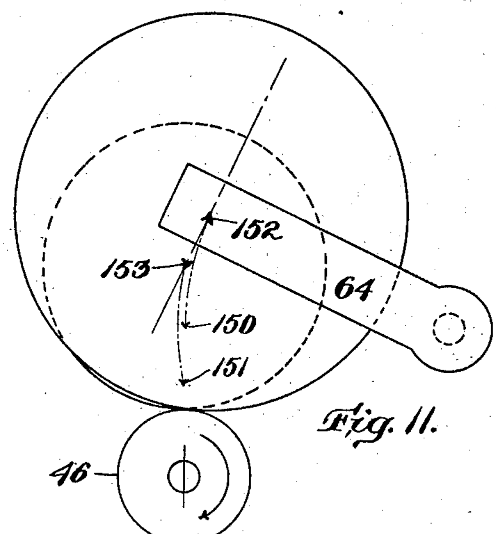




Fig. 11.

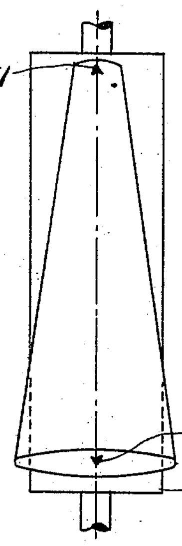



Fig. 10.

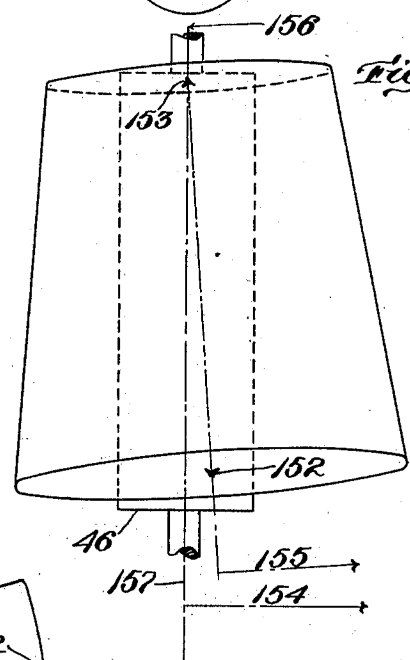



Fig. 12.

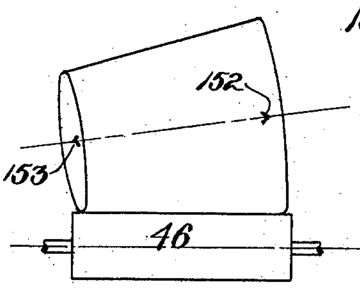



Fig. 13.

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# UNITED STATES PATENT OFFICE.

JOHN O. McKEAN, OF WESTFIELD, MASSACHUSETTS, ASSIGNOR TO FOSTER MACHINE COMPANY, OF WESTFIELD, MASSACHUSETTS, A CORPORATION OF MAINE.

## WINDING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 716,923, dated December 30, 1902.

Application filed September 25, 1901. Serial No. 76,495. (No model.)

*To all whom it may concern:*

Be it known that I, JOHN O. MCKEAN, of Westfield, in the county of Hampden and State of Massachusetts, have invented an Improved Winding-Machine, of which the following is a specification, reference being had to the accompanying drawings, in which—

Figure 1 is a front elevation of the upper part of a winding-machine embodying my invention, showing the spindle in position for winding a cylindrical cop. Fig. 2 is an end elevation of the same viewed from the right side of Fig. 1. Fig. 3 is a top view, partly in longitudinal section, of certain details of my machine. Fig. 4 is a front view of part of the speed-changing mechanism of my machine not shown in Fig. 1. Fig. 5 is a front view of the drive-roll in my machine. Fig. 6 is a partial longitudinal sectional view of this drive-roll. Fig. 7 is a top view of the spindle and the arms supporting it, shown partly in longitudinal section. Fig. 8 is a partial longitudinal sectional view of the joints between the arms shown in Fig. 7. Fig. 9 is a diagram showing an elevation of the position of a conical cop at the beginning of the wind, as seen from the right side of Fig. 1. Fig. 10 is a plan view of Fig. 9. Fig. 11 is a diagram showing an elevation of the position of a conical cop after the winding has progressed some time, as seen from the same point of view as Fig. 9. Fig. 12 is a plan view of Fig. 11. Fig. 13 is a front elevation of Fig. 11 on a reduced scale.

My invention relates to winding-machines, and especially to that class of winding-machines in which the cop is actuated by a drive-roll in contact with its surface and in which the thread-guide is reciprocated rapidly, so as to lay the thread obliquely upon the cop. In these machines each successive thread must be laid upon the cop at some distance from the last. Otherwise the threads would merely pile one on top of another and would not form a regular cop at all. This distance between successive threads on the cop is called the "gainage" and depends upon the relative speeds of the thread-guide and the cop. In machines in which the cop is driven by frictional contact of a drive-roll with its surface its speed varies inversely as its diameter. As the winding progresses the diameter of the cop increases very slowly, and the change in its speed is correspondingly slow. At various points in the winding the relative speeds of the cop and the thread-guide are such that the successive spirals are laid close side by side. This continues for a number of reciprocations of the thread-guide and forms a ridge of close-wound thread upon the cop. While this close wind is forming, the threads at the ends of the cop between the different parts of the ridge are left for some time without being bound in by other threads on top of them. At these exposed points the centrifugal force stretches the yarn, forming loops which fly out from the thread mass and break themselves upon the drive-roll. This is especially true when soft yarns are wound. In winding conical cops this tendency to form loops is very greatly increased, because the rotary force of the drive-roll is during a large part of the time applied to the cop obliquely and not at right angles to its axis. This tends to draw the threads toward one end and stretch them. One feature of my invention is to provide a machine which prevents the formation of these loops and the breakage of the threads resulting therefrom. To accomplish this, I provide automatic means to increase and decrease alternately the speed of the drive-roll, so that the variation in the relative speeds of the cop and thread-guide is rapid and the threads are at no time laid close side by side for more than two or three reciprocations of the thread-guide. Thus no ridge of close-wound thread can be formed, no threads are left unprotected long, and there is no opportunity for the formation of loops.

In winding a conical cop it is necessary to use a sectional drive-roll, the section at one end being fast upon the shaft and the rest free to revolve thereon. This avoids the twisting of the cop which would result from the use of a solid drive-roll. There must be sufficient clearance between the sections of the drive-roll to allow the sections to revolve freely at different speeds. When a thread breaks in winding, the end is frequently caught in the space between two of these sections and is drawn down and wound tightly around the shaft. This prevents the free revolution of the loose sections, and the machine must be stopped while the thread is removed. One feature of my invention is to provide a machine with a sectional drive-roll from which broken threads may be easily and quickly removed when they are drawn into the spaces between the sections. To accomplish this, I provide upon the end of each section a cylindrical portion of slightly smaller diameter than the drive-roll, and over this I lap the end of the next section. When a thread is drawn in between the two sections, it is wound around this smaller cylindrical portion and being near the surface may be easily extricated. This results in a great saving of time.

In all winding-machines it is necessary that the cop be stopped promptly when a thread breaks. This is commonly accomplished in machines in which the cop is surface-driven by raising the cop from the drive-roll automatically upon the breaking of a thread. In all machines of this character with which I am familiar the cop makes several revolutions from its own momentum after it is raised from the drive-roll before it comes to a full stop. When two threads are winding simultaneously on one cop, as is frequently done, and only one of them breaks, the other continues to wind and must be unwound back to the point of breaking and all that has been wound since the break must be broken off and thrown away. A third feature of my invention is to provide a machine in which the spindle is stopped upon the breaking of a thread before it has made more than a fraction of a revolution. To accomplish this, I provide a toothed disk upon the spindle near its base and a pawl which upon the breaking of a thread is pressed against the disk, raising the cop from the drive-roll and at the same time engaging one of the teeth on the disk, thus stopping the spindle within one revolution.

Referring to the drawings, 1 is the main driving-shaft, journaled on bearings 2 and 3 on the frame of the machine. Upon the shaft 1 are a loose pulley 4 and a tight pulley 5, adapted to be driven from a source of power. Shaft 1 carries also the spur-gear 6, which is tight on the shaft 1 and engages the spur-gear 7 upon the shaft 8. Shaft 8 is journaled upon bearings 9 and 10 upon the frame of the machine, and fast upon it is the cam 11. In the surface of the cam 11 is the oblique cam-groove 12, which engages the pin 13, which is attached to the thread-guide 14. Thread-guide 14 is adapted to reciprocate upon the bar or raceway 15, which is fast at its ends upon the frame of the machine and is parallel with the axis of the cam 11. At each end of its stroke the thread-guide strikes the spring 16, which is fast upon the shaft 97 and is wide enough to allow the thread-guide to strike it in any position which that shaft takes in the operation of the machine, as explained later. This relieves the jar which would otherwise result from the rapid reciprocation of the thread-guide. The upper end of the thread-guide is provided with a groove 136, through which the thread passes to the cop. This groove is merely a channel with straight sides and open at the top, so that the thread may be easily thrown out of it whenever desired. Cone-pulley 17 is fast upon shaft 1. This pulley is connected by belt 18 with cone-pulley 19, which is fast upon a shaft 20. Shaft 20 is parallel to shaft 1 and is journaled on bearings 21 and 22 upon the frame of the machine. It carries fast upon it the worm 23 and cone-pulley 30. This pulley 30 is connected by the belt 31 with cone-pulley 32, which is loose on shaft 1. The worm 23 engages spur-gear 24, which is fast upon shaft 26. Shaft 26 is horizontal and perpendicular to shaft 20 and is journaled upon a bearing 114 upon the arm 27, which is attached to the frame of the machine. Upon the shaft 26 is the crank 25, which reciprocates the shipper 29 through the crank-arm 28 and the pin 115. Shipper 29 is adapted to slide back and forth upon the square bar 116. Bar 116 is parallel to shaft 20 and is attached at its ends to the frame of the machine. Four pins 33 on shipper 29 engage belts 18 and 31, so that when the shipper is reciprocated both belts are shifted back and forth together. Cone-pulleys 17 and 32 are placed with their large ends together and pulleys 19 and 30 with their small ends together. Thus the shipping of the belts from one end to the other of the cones alternately raises and lowers the speed of the pulley 32. As will be readily seen, this goes on constantly while the machine is in operation. I have found these cone-pulleys and shipper compact and convenient; but the particular combination shown is not essential, and any automatic speed-changing device may be employed without affecting my invention.

Upon the hub of pulley 32 is spur-gear 34, which engages spur-gear 35 on shaft 36. Shaft 36 is parallel to shaft 1 and is journaled on bearings 37, 38, and 39 upon the frame of the machine. On it is the sectional drive-roll 46–52, which is described in detail below. This drive-roll is parallel to the path of motion of the thread-guide, and the latter reciprocates about an eighth of an inch from the surface of the drive-roll, with its upper end well above the center of the drive-roll. The drive-roll rotates in a direction such that its upper surface moves toward the cam. Between the cam and the drive-roll is a guard to prevent oil from the cam-groove from flying off against the drive-roll, and thus soiling the cop. This guard I have not shown in the drawings.

Directly over the cam 11 and parallel to the shaft 8 is the bar 56, attached to the frame of the machine. Upon this bar slides the block 57, which is held in any desired position by the set-screw 59. In this block is a hole perpendicular to the rod 56, in which hole fits the end of the arm 58, where it is held in place by the set-screw 60. Through the other end of arm 58 passes the bolt 61. When the machine is in operation, the arm 58 is so adjusted in the block 57 that the bolt 61 is parallel to the shaft 8 and the drive-roll. Arm 58 is loose upon bolt 61, which turns freely therein. After passing through arm 58 bolt 61 passes through a screw-threaded hole in arm 64, which arm is perpendicular to bolt 61. 65 is a washer which slips over the bolt 61 and serves as a bearing upon which swings arm 112. This arm is held in place by washer 67. The nut 62 screws upon the end of bolt 61, binding the washers 65 and 67 firmly together and acting as a check-nut to prevent the movement of arm 64 upon the bolt. Washer 65 is made thick enough so that arm 112 may move upon it with perfect freedom. Between arm 58 and the head of bolt 61 is the spring-washer 63. The tension between arm 58 and arm 64 may be regulated by turning bolt 61 in arm 64. The arm 64 is forked near its free end, and through the fork passes the bolt 70. Upon this bolt swings the stud 72, which is held in a position perpendicular to arm 64 by the spring 71. Upon stud 72 is the spindle 73, held in place by the washer 76 and the screw 78. Spindle 73 is free to rotate on stud 72 when in a position perpendicular to arm 64. The spindle is screw-threaded for a short distance near its base to hold in place a paper shell 74, upon which the thread is wound. Near the base of the spindle is a square portion 137, which engages a projection 138 on arm 64 when the spindle is swung forward from its normal position, holding the spindle firmly, so that it cannot revolve in either direction. While the spindle is thus held, the shell may be easily screwed on or off. Both cylindrical and conical shells are used. The forks of arm 64 may be placed so that the spindle makes any desired angle with the drive-roll 46–49. The drive-roll 46–49, the spindle 73, and the arm 64 are so placed with relation to one another that when the winding begins the shell is in contact with the drive-roll throughout its length, and as the winding progresses the increasing thread mass gradually swings up the arm 64, keeping always in contact with the drive-roll. The friction between arm 58 and arm 64 may be so varied by bolt 61, as above explained, that the friction between the drive-roll and the thread mass is just sufficient to cause them to revolve together. The thread-guide is so placed that the channel 136, from which the thread is fed, is reciprocated close to the line of contact of the thread mass and the drive-roll without touching either, and the thread is drawn in between them and thus pressed into its place immediately after leaving the thread-guide. When a cylindrical cop is wound, the spindle remains always parallel to the drive-roll, and the rotary force from the drive-roll is always applied in a direction perpendicular to the axis of the spindle. When a conical cop is to be wound, the spindle is so placed that when the winding begins the drive-roll and the shell are in contact along a line in the plane of their axes. This position of the cop is illustrated in Figs. 9 and 10. In these diagrams the axis of the cop is represented by line 150 151, which is in a plane with the axis of the drive-roll. The contact-line between the cop and the drive-roll is in the same plane, which is perpendicular to arm 64. The rotary force is thus applied to the cop at right angles to its axis. The spindle is not parallel to the drive-roll, but slants downward from arm 64. As the thread mass grows and swings arm 64 upward the axis of the spindle is gradually thrown out of the plane of the axis of the drive-roll. As has been explained, arm 64 swings upward on bolt 61, which is parallel to the drive-roll. It therefore swings in a plane perpendicular to the drive-roll, which is the plane on which Figs. 9 and 11 are projected. Whatever position arm 64 takes in this plane the relative position of line 150 151 and arm 64 will therefore remain the same—that is, the angle between them is always a right angle. As arm 64 swings from a horizontal toward a vertical position line 150 151 will swing from a vertical toward a horizontal position, each finally assuming the positions shown in Fig. 11. To look at the matter in another way, in Fig. 11 arcs 150–152 and 151–153 represent, respectively, the paths of point 150 and 151 as they swing upward. As the latter point starts behind the former and swings on a slightly-longer radius, the two points will never be in a vertical line after the start—that is, line 152 153 will gradually swing farther and farther from a vertical position. The effect of this swing on the relation of the cop to the drive-roll is shown clearly in Fig. 12, which is a plan view of the position shown in Fig. 11. Point 152 being now considerably to the right of point 153 is clearly outside the plane represented by 156 157, which passes through the axis of the drive-roll and point 153. The drive-roll and the cop are thus in the position of a skew-gear. The result is that the rotary force of the drive-roll is in this position applied not in a direction perpendicular to the axis of the cop shown by arrow 155, but slanting toward the large end in the direction of arrow 154. This tends to crowd the thread on the surface toward the large end of the cop, thus pulling the cop out of shape and stretching such threads as are exposed to the action of the drive-roll for any considerable number of revolutions without protection from other threads being wound on top of them. It is true that this tendency may be lessened somewhat by starting the wind with the arm 64 slanting downward, so that the cop is at angle with the drive-roll with the small end slightly back of the large end. Then as arm 64 swings up the cop will reach the position shown in Figs. 9 and 10 and then pass on toward the position of Figs. 11 and 12. During all the rest of the wind the rotary force is applied to the cop with a slant toward one end or the other, and this slant is sufficient, at least during considerable portions of the wind, to pull and stretch the threads on the surface. As a matter of fact, the cop and the drive-roll cannot possibly be in relation such that the rotary force is applied in a direction perpendicular to the axis except for one instant during the wind. This instant is when the cop and the drive-roll are in the position shown in Figs. 9 and 10 and may by adjustment be made to come at the beginning of the wind or at the end or at any intermediate point. At the end of the cop toward which this force tends this pulling action, together with centrifugal force, frequently stretches the yarn, so that large loops are formed which project beyond the end of the cop and are very liable to be broken, either by striking against the drive-roll or by catching on something when the cop is being handled after it is wound. To remedy this, I provide a machine in which the relative speeds of the thread-guide and the drive-roll are changing constantly and rapidly. In all machines of this type with which I am familiar the speed of the drive-roll is constant as compared with that of the thread-guide. The speed of a surface-driven cop varies inversely as its diameter. As the thread mass grows its speed slowly diminishes, and at several points in the winding the cop makes an exact number of revolutions during one stroke of the thread-guide. Assuming, for example, that at the beginning the cop makes between ten and eleven revolutions while the thread-guide passes once across it and back as its speed diminishes it will presently reach the point where it is making exactly ten revolutions during that time. At this point in the wind one spiral will be laid on top of the one preceding it, and the change of speed resulting from the growth of the cop alone is so gradual that for thirty or forty revolutions just before this point is reached and for a like number of revolutions thereafter the successive spirals will be laid very close together, producing about half a layer of close wind. During these sixty or eighty revolutions the strands not covered by this close wind are left unprotected, and the centrifugal force, added in the conical cops to the oblique pulling action of the drive-roll, described above, stretches the threads, and especially at the ends of the cop forms the loops mentioned above, which fly off and break themselves against the drive-roll. This is especially true in soft yarns. This close wind and the loops resulting from it will be repeated when the cop reaches, successively, the points where it makes nine, eight, &c., revolutions during one stroke of the thread-guide. In my machine by rapidly varying the speed of the cop I reduce to a minimum the time during which successive strands are laid close together, so that there is no long period when any of the threads are without the protection of other threads wound on top of them. It is obvious that the same results are accomplished if the speed of the drive-roll is constant and that if the thread-guide is changed or if the speed of one is made to increase while that of the other is diminishing, and vice versa; but the power necessary to actuate the cam and the thread-guide is much greater than that necessary to drive the spindle. It is therefore an advantage that the latter be driven through the cone-pulleys and not the former. This advantage is gained by the construction I have shown and described.

It is obvious that means to vary the relative speeds of the spindle and the thread-guide may be applied to winding-machines in which the spindle is central driven or is journaled on a carriage, as well as to the machine described above.

In practice I gear up from gear 34 to gear 35 in a ratio of three to one and down from gear 6 to gear 7 in the same ratio, and I make the pitch of the cone-pulleys such that while the thread-guide is going back and forth once the drive-roll makes about eight revolutions at its lowest speed and about ten at its highest. Gear 24 is made with sixty-five teeth, so that the drive-roll changes from its highest to its lowest speed once while the thread-guide is moving across and back about ten times, so that during each full stroke of the thread-guide the drive-roll makes, roughly, one-fifth of a revolution more or less than during the full stroke next preceding. This makes it impossible that any close wind be laid or that any threads remain long unprotected by threads laid on top of them binding them in. These proportions are not essential to my invention; but I have found that they are convenient and produce very good results.

The drive-roll in my machine is made in sections, as shown in detail in Figs. 5 and 6. On the shaft 51 fits the shell 52, which is of metal or other suitable material. Sections 46 to 49 are made, preferably, of wood. Section 46 is fast upon the shell 52. This is the driving-section, and its surface is corrugated longitudinally, as shown in Fig. 5, to give it a better hold on the cop. The other sections, 47, 48, and 49, are loose upon shell 52 and free to revolve thereon. They may be lined with metal where they bear upon shell 52 to reduce friction and give a better wearing-surface. Section 50 is a mere binder and is preferably made of metal. Through a screw-threaded hole in section 50 passes the binder-screw 53, which then passes through a hole in the shell 52 large enough to allow the binder to be moved back and forth on the shell for a short distance. By this screw the binder-section 50 is held in place on the shell 52 and the shell 52 on the shaft. When cylindrical cops are wound, the binder-section 50 may be moved up, so that no space is left between the various sections and all revolve together like a solid roll, each section acting as a driving-section.

When a conical cop is wound, it is obvious that its surface speed is greatest at the large end and gradually increases toward its small end. On the conical shell ordinarily used the diameter, and hence the surface speed at the small end, is only about one-third that at the large end. Obviously if a solid drive-roll were used one end must constantly slip on the shell or thread mass. This would result in a great loss of power and would twist and pull the cop out of shape. In winding conical cops therefore the binder-section 50 is so placed as to allow the loose sections 47, 48, and 49 to revolve on the shell 52 freely and at different speeds. This necessitates leaving some clearance between the various sections. Broken threads are frequently caught and pulled down between the sections and wound around the shell 52, preventing the free revolution of the loose sections. To remove these threads, the whole machine must be stopped, the sections separated, and the threads cut and broken away from the shell. This is a slow operation and a serious loss of time. In my machine I greatly lessen this loss of time by a new and original construction of the drive-roll. Between each two sections I make a broken or lap joint. Taking sections 47 and 48 as typical, I turn off one end of 48, leaving the shoulder 55 and the cylindrical portion 54 concentric with the rest and about a quarter of an inch smaller in diameter. Section 47 at the end adjacent to section 48 I cut away interiorly, leaving the annular rim 126, which laps over the small cylinder 54 and abuts at its outer surface against the shoulder 55, touching section 48 only at the outer surface of that shoulder. This construction makes the spaces between the sections as narrow as possible at the surface and lessens the likelihood of threads getting caught in them. Furthermore, it lessens the friction between the different sections. But the great advantage of this new construction is that when a thread is drawn into the spaces between two of the sections it merely winds itself around the cylinder 54, where it is very near the surface of the roll and may be reached and removed by the operator much more easily than when wound around the shell 52.

In all machines of this type it is important that the cop stop automatically whenever a thread breaks in winding. This calls the attention of the operator to the break, so that the ends may be pieced up without delay. When two threads are wound simultaneously upon the same cop, as is frequently done, it is especially important that the cop be stopped promptly if one thread breaks. In the machines of this kind with which I am familiar the stop-motion merely throws the broken thread out of the thread-guide and raises the cop from the drive-roll. The cop then makes several revolutions from its own momentum before coming to a full stop. If one thread remains unbroken, all that is wound after the break must be unwound, broken off, and thrown away. This results in a serious waste. To remedy this, I provide a stop-motion which throws the unbroken thread out of the thread-guide, raises the cop from the drive-roll, and at the same time applies a stop to the spindle, stopping it short within a single revolution.

Referring to the drawings, 75 is a disk which is fast upon and concentric with the spindle 73 near the end adjacent to the arm 64. In the periphery of this disk are one or more ratchet-teeth 113. These teeth are pointed in the direction in which the spindle revolves when the machine is in operation. 66 is a pawl adapted to engage the ratchet-teeth 113. This pawl extends forward from the arm 112, which is pivoted upon the washer 65 on the bolt 61 and is free to move on said washer in a plane perpendicular to the bolt 61. The screw 68 passes through a hole 119 in the pawl 66 and screws into the arm 64. This screw may be set so as to allow the pawl to swing down away from disk 75 as far as is desired. The rod 107 is attached to the lower end of the arm 112 by the bolt 111, on which it is free to swing in a plane perpendicular to the bolt 61. Upon the free end of this arm 107 is a handle 109.

97 is a shaft parallel to the drive-roll, with bearings on the frame of the machine at 98 and 99. The arms 102, 103, and 105 are fast to the shaft, extending upward in a direction perpendicular to the shaft 97. The upper ends of arms 102 and 103 are connected by the bar 104, which in its normal position is near to and just below the path of the feeding-groove of the thread-guide. Over this bar 104 the thread passes on its way to the thread-guide. In the arm 105 is the vertical slot 106, the lower end of which is beveled on its rear side. The arm 107 passes through this slot, and on its lower side are the ratchet-teeth 108, with their slanting sides toward the front. These teeth engage the lower end of the slot 106, so that when arm 105 is thrown forward arm 107 is drawn with it. The arm 95 is fast upon the shaft 97 and extends downward from it. At its free end it is connected by the bolt 96 with the rear end of the bar 85, which is free to move upon said bolt. The bar 85 slides backward and forward over the roller 86 on the pin 87. At its front end is the handle 120. At the point where the bar 85 strikes the roller 86 is the projection 88 on the bar 85.

89 is a spring attached to the bar 85 by the eye 91 and to the frame of the machine below the bar at 90. On the upper side of the bar are the two projecting lips 121, through which passes the pin 84. On this pin is pivoted the arm 81, which is so balanced that in its normal position its rear end lies upon the

bar and its front end is raised, as shown in Fig. 2. Across the front end of the arm 81 is the horizontal bar 122. At the rear end of arm 81 is the pawl 92. Directly over the pawl 92 is the ratchet-wheel 93, with the slanting side of the ratchet-teeth toward the rear of the machine when on the side next the pawl. The pawl is adapted to engage these teeth. This ratchet-wheel is fast on the shaft 132, which is journaled on bearings 133 and 134 on the frame of the machine. On the shaft 8 is the pulley 123. This is connected by the belt 124 with the pulley 125 on shaft 132, upon which is the ratchet-wheel 93. The elbow-shaped wires 79 are inserted at their rear ends in the blocks 139, which are pivoted on the pins 82, attached to the frame of the machine. On the rear side of each of these blocks are the lugs 110. Upon these pins 82 is pivoted the short arm 83, on the end of which is the cross-bar 140. The arm 83 is connected with arm 95 by a wire 142. At the free ends of the wires 79 are the hooks 135, through which the thread passes before passing over the bar 104. When the machine is in operation, the wires 79 are held up against cross-bar 141 by the threads which are being wound. If either thread breaks, the wire through which it passes drops upon the cross-piece 122 of the bar 81. This bar is so balanced that the weight of one of the wires 79 is sufficient to raise the rear end of the bar, bringing the pawl 92 into engagement with one of the teeth of ratchet-wheel 93, which is revolving, so that its teeth when on the under side are moving toward the rear of the machine. When the pawl 92 engages one of these ratchet-teeth, the bar 85 is drawn back so that the pawl passes out of the reach of the ratchet-teeth. This throws back the arm 95, drawing the cross-bar 140 downward. This presses down the lug 110 and raises the wire 79 to its normal position in contact with cross-bar 141. This allows pawl 92 to fall back to its normal position, in which it may be drawn forward again without engaging the ratchet-teeth 93. When arm 85 is drawn back, it also throws forward the bar 104 and the arm 105. The latter draws forward the rod 107 and the arm 112, raising the pawl 66, which strikes the disk 75, raising the cop from the drive-roll. Until a ratchet-tooth on disk 75 engages the pawl the latter merely acts as a brake on the spindle by its frictional contact with disk 75. When a tooth reaches the pawl, the spindle is stopped short. I have found in practice that two ratchet-teeth on the disk 75 produce the best results. This prevents more than half a revolution of the cop after the thread breaks. The forward movement of the bar 104, together with the raising of the cop, throws the unbroken thread out of the open groove in the thread-guide, which saves it from being broken by slatting back and forth after the cop has ceased to revolve. When the broken ends have been pieced up and the threads again drawn through the hooks on wire 79, the bar 85 is pulled forward by the handle 120. This raises cross-bar 140, leaving the wires supported against bar 141 only by the threads passing through them and free to drop when a thread breaks. Rod 107 is then pushed back. This disengages pawl 66 from the ratchet-tooth 113 and brings it down against the head of the screw 68, pressing the cop down upon the drive-roll. As the cop grows and the arm 64 is raised it draws with it the pawl 66, gradually throwing forward the arm 112 and the rod 107, whose ratchet-teeth allow it to slide through the slot 106. Obviously the same prompt stopping of the cop would be accomplished if two separate arms were employed to take the place of pawl 66, one of them raising the cop from the drive-roll and the other operating as a brake, both being actuated simultaneously by the breaking of a thread.

The disk 75 may be made without teeth and the pawl 66 may be adapted to make frictional contact with it, operating merely as a brake; but I regard the positive braking device above shown and described as preferable.

I am aware of patent to Parker No. 525,085, dated August 28, 1894, and disclaim all that is shown therein. The construction shown in that patent will operate only with a central driven spindle, in which the axis of the spindle is stationary during the winding. My device may be used equally well and is designed, primarily, for a machine with a surface-driven cop, in which the disk is constantly receding from the drive-roll as the cop grows. Moreover, in my device one arm may be made to perform both the function of a brake and the function of raising the cop from the drive-roll.

I have described and shown only one drive-roll, spindle, and thread-guide. In the machine as built the spur-gear 34 meshes with an idler spur-gear 40 on a stud 42, and that in turn meshes with spur-gear 43 on the shaft 45, which is journaled on the bearing 44 on the frame of the machine and is parallel to the cam-shaft 8. On this shaft 45 is another drive-roll exactly like the one already described. These two drive-rolls are in corresponding positions on opposite sides of the top of the cam 11. In connection with this rear drive-roll there are a thread-guide, a spindle, and other mechanism operating in the same way as those already described. In practice the cam-shaft and drive-roll shafts extend through a number of sections like that already described, each with its cam, drive-rolls, spindles, &c. Thus the speed-changing mechanism serves for many spindles. The cams are so arranged that no two thread-guides come to the end of a stroke at the same time. The jar resulting from the rapid reciprocation of many thread-guides is thus reduced to a minimum.

It is obvious that the automatic speed-changing mechanism above described may be applied to winding-machines in which the cop is central driven, as well as to those in which it is actuated by a drive-roll.

I claim—

1. In a winding-machine, a rotatable drive-roll; a thread-guide; a rotatable cam having a groove with which the thread-guide engages to reciprocate the thread-guide; means to rotate said cam; a rotatable spindle adapted to receive a shell for receiving the thread to be wound; means to keep the shell or thread mass on the spindle normally in contact with the drive-roll near the path of motion of the thread-guide, the spindle being movable away from the thread-guide by increase of the thread mass; a cone-pulley connected with the cam; a second cone-pulley connected with the drive-roll; means to actuate one of said cone-pulleys; a belt connecting the two cone-pulleys; a shipper adapted to engage said belt; a worm connected with one of the cone-pulleys; a worm-gear engaging said worm; a crank on said worm-gear; a crank-arm connecting said crank with the shipper to reciprocate the shipper, all so combined and arranged as to vary the relative speeds of the drive-roll and the thread-guide while the machine is in operation.

2. In a winding-machine, a rotatable drive-roll; a thread-guide; a rotatable cam having a groove with which the thread-guide engages to reciprocate the thread-guide; an arm adapted to swing in a direction approximately perpendicular to the axis of the drive-roll; a rotatable spindle journaled at or near the free end of said arm and adapted to receive a shell, for receiving the thread to be wound, the axis of the drive-roll being approximately in the path of motion of the spindle; means to keep the shell or thread mass upon the spindle normally in contact with the drive-roll near the path of the thread-guide; a cone-pulley connected with the cam; a second cone-pulley connected with the drive-roll; means to actuate one of the cone-pulleys; a belt connecting the two cone-pulleys; a shipper adapted to engage said belt; a worm connected with one of the cone-pulleys; a worm-gear engaging said worm; a crank on said worm-gear; a crank-arm connecting said crank with the shipper to actuate the shipper; all so combined and arranged as to vary the relative speeds of the drive-roll and the thread-guide while the machine is in operation.

3. In a drive-roll for a winding-machine, a shaft; two cylindrical sections of the same diameter placed side by side on said shaft and concentric therewith; the sections being free to revolve independently; one of the sections having on one end a central circular depression; the second section having at one end a reduced portion adapted to fit loosely in said depression; all so combined and coöperating as to prevent threads from being drawn down between the two sections below the lateral surface of the reduced portion of the second section.

4. In a winding-machine, a rotatable drive-roll; means to rotate said drive-roll; a rotatable spindle adapted to receive a shell for receiving the thread to be wound; means to keep the shell or thread mass upon the spindle normally in contact with the drive-roll, the spindle being movable away from the drive-roll by the increase of the wound mass; a disk fast upon and concentric with the spindle; teeth on the periphery of said disk; a pawl adapted to press against said disk and to engage said teeth; and means, set in motion by the breaking of a thread in winding, to actuate said pawl; all so combined and arranged that upon the breaking of a thread in winding, the pawl is brought into engagement with the teeth.

5. In a winding-machine, a rotatable drive-roll; means to rotate it; a rotatable spindle adapted to receive a shell for receiving the thread to be wound; means to keep the shell or thread mass upon the spindle normally in contact with the drive-roll; the spindle being movable away from the drive-roll by the increase of the wound mass; a disk fast upon and concentric with the spindle; an arm adapted to press against said disk; means set in motion by the breaking of a thread in winding to actuate said arm; all so combined and arranged that upon the breaking of a thread in winding the arm is pressed against the disk in a direction away from said drive-roll.

6. In a winding-machine, a rotatable spindle adapted to receive a shell for receiving the thread to be wound; means to rotate said spindle; a thread-guide; means to reciprocate said thread-guide; and automatic means to vary the relative speed of the thread-guide and the spindle while the machine is in operation, alternately increasing and diminishing the speed of one as compared with that of the other.

7. In a winding-machine, a rotatable drive-roll; means to rotate said drive-roll; a thread-guide; means to reciprocate said thread-guide; a rotatable spindle adapted to receive a shell for receiving the thread to be wound; means to keep the shell or thread mass upon the spindle normally in contact with the drive-roll near the path of the thread-guide, the spindle being movable away from the drive-roll and the thread-guide by increase of the thread mass; and automatic means to vary the relative speed of the drive-roll and the thread-guide while the machine is in operation, alternately increasing and diminishing the speed of one as compared with that of the other.

8. In a winding-machine, a rotatable drive-roll; means to rotate said drive-roll; a thread-guide; means to reciprocate said thread-guide; a rotatable spindle adapted to receive a shell for receiving the thread to be wound; means to keep the shell or thread mass upon the spindle normally in contact with the drive-roll near the path of the thread-guide, the spindle being movable away from the drive-

roll and the thread-guide by increase of the thread mass; and automatic means to vary the relative speed of the spindle and the thread-guide while the machine is in operation, alternately increasing and diminishing the speed of one as compared with that of the other.

9. In a winding-machine, a rotatable drive-roll; means to rotate said drive-roll; a thread-guide; means to reciprocate said thread-guide; an arm adapted to swing in a direction approximately perpendicular to the axis of the drive-roll; a rotatable spindle journaled at or near the free end of said arm and adapted to receive a shell for receiving the thread to be wound; the axis of the drive-roll being approximately in the path of movement of the spindle; means to keep the shell or thread-mass upon the spindle normally in contact with the drive-roll near the path of the thread guide, the spindle being movable away from the drive-roll by increase of the thread mass; and automatic means to vary the relative speeds of the drive-roll and the thread-guide while the machine is in operation, alternately increasing and diminishing the speed of one as compared with that of the other.

10. In a winding-machine, a rotatable drive-roll; means to rotate said drive-roll; a thread-guide; means to reciprocate said thread-guide; an arm adapted to swing in a direction approximately perpendicular to the axis of the drive-roll; a rotatable spindle journaled at or near the free end of said arm and adapted to receive a shell for receiving the thread to be wound; the axis of the drive-roll being approximately in the path of movement of the spindle; means to keep the shell or thread mass upon the spindle normally in contact with the drive-roll near the path of the thread-guide, the spindle being movable away from the drive-roll by increase of the thread mass; and automatic means to vary the relative speeds of the spindle and the thread-guide while the machine is in operation, alternately increasing and diminishing the speed of one as compared with that of the other.

11. In a winding-machine, a rotatable drive-roll; a thread-guide; a rotatable cam having a groove with which the thread-guide engages to reciprocate the thread-guide; means to rotate said cam; a rotatable spindle adapted to receive a shell for receiving the thread to be wound; means to keep the shell or thread mass on the spindle normally in contact with the drive-roll near the path of motion of the thread-guide, the spindle being movable away from the thread-guide by increase of the thread mass; a cone-pulley connected with the cam; a second cone-pulley connected with the drive-roll; means to actuate one of said cone-pulleys; a belt connecting the two cone-pulleys; a shipper adapted to engage said belt; a worm connected with one of the cone-pulleys; a worm-gear engaging said worm; a crank on said worm-gear; a crank-arm connecting said crank with the shipper to reciprocate the shipper, all so combined and arranged as to vary the relative speeds of the drive-roll and the thread-guide while the machine is in operation, alternately increasing and diminishing the speed of one as compared with that of the other.

12. In a winding-machine, a rotatable drive-roll; a thread-guide; a rotatable cam having a groove with which the thread-guide engages to reciprocate the thread-guide; means to rotate said cam; a rotatable spindle adapted to receive a shell for receiving the thread to be wound; means to keep the shell or thread mass on the spindle normally in contact with the drive-roll near the path of motion of the thread-guide, the spindle being movable away from the thread-guide by increase of the thread mass; a cone-pulley connected with the cam; a second cone-pulley connected with the drive-roll; means to actuate one of said cone-pulleys; a belt connecting the two cone-pulleys; a shipper adapted to engage said belt; a worm connected with one of the cone-pulleys; a worm-gear engaging said worm; a crank on said worm-gear; a crank-arm connecting said crank with the shipper to reciprocate the shipper, all so combined and arranged as to vary the relative speeds of the spindle and the thread-guide while the machine is in operation, alternately increasing and diminishing the speed of one as compared with that of the other.

13. In a winding-machine, a rotatable drive-roll; a thread-guide; a rotatable cam having a groove with which the thread-guide engages to reciprocate the thread-guide; an arm adapted to swing in a direction approximately perpendicular to the axis of the drive-roll; a rotatable spindle journaled at or near the free end of said arm and adapted to receive a shell, for receiving the thread to be wound, the axis of the drive-roll being approximately in the path of motion of the spindle; means to keep the shell or thread mass upon the spindle normally in contact with the drive-roll near the path of the thread-guide; a cone-pulley connected with the cam; a second cone-pulley connected with the drive-roll; means to actuate one of the cone-pulleys; a belt connecting the two cone-pulleys; a shipper adapted to engage said belt; a worm connected with one of the cone-pulleys; a worm-gear engaging said worm; a crank on said worm-gear; a crank-arm connecting said crank with the shipper to actuate the shipper, all so combined and arranged as to vary the relative speeds of the drive-roll and the thread-guide while the machine is in operation, alternately increasing and diminishing the speed of one as compared with that of the other.

14. In a winding-machine, a rotatable drive-roll; a thread-guide; a rotatable cam having a groove with which the thread-guide engages to reciprocate the thread-guide; an arm adapted to swing in a direction approximately perpendicular to the axis of the drive-roll; a rotatable spindle journaled at or near the free

end of said arm and adapted to receive a shell for receiving the thread to be wound, the axis of the drive-roll being approximately in the path of motion of the spindle; means to keep the shell or thread mass upon the spindle normally in contact with the drive-roll near the path of the thread-guide; a cone-pulley connected with the cam; a second cone-pulley connected with the drive-roll; means to actuate one of the cone-pulleys; a belt connecting the two cone-pulleys; a shipper adapted to engage said belt; a worm connected with one of the cone-pulleys; a worm-gear engaging said worm; a crank on said worm-gear; a crank-arm connecting said crank with the shipper to actuate the shipper, all so combined and arranged as to vary the relative speeds of the drive-roll and the thread-guide while the machine is in operation alternately increasing and diminishing the speed of one as compared with that of the other.

JOHN O. McKEAN.

Witnesses:
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