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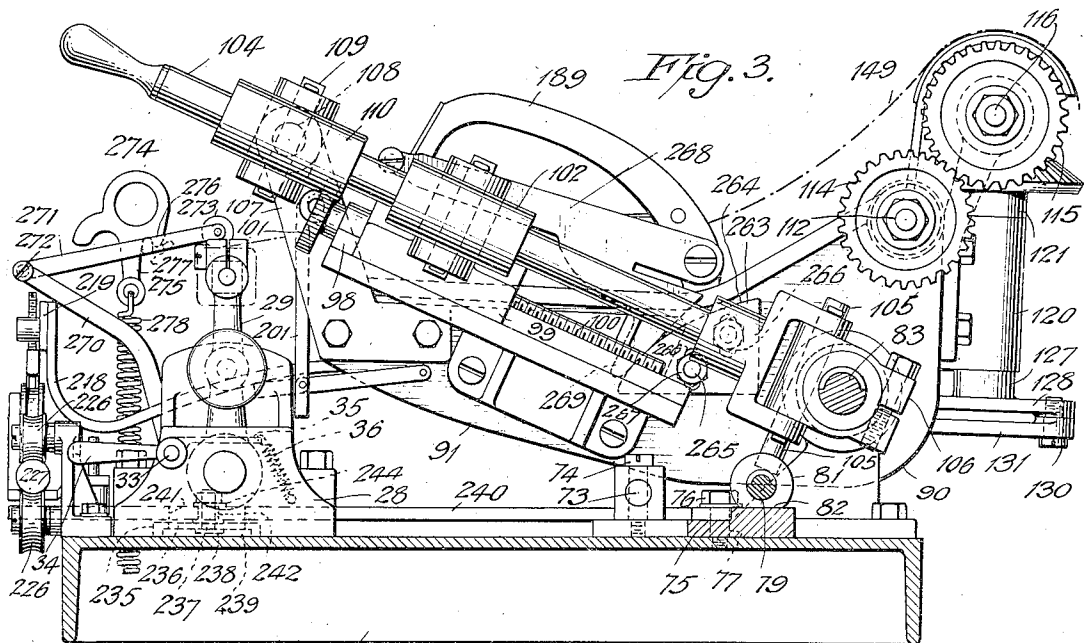
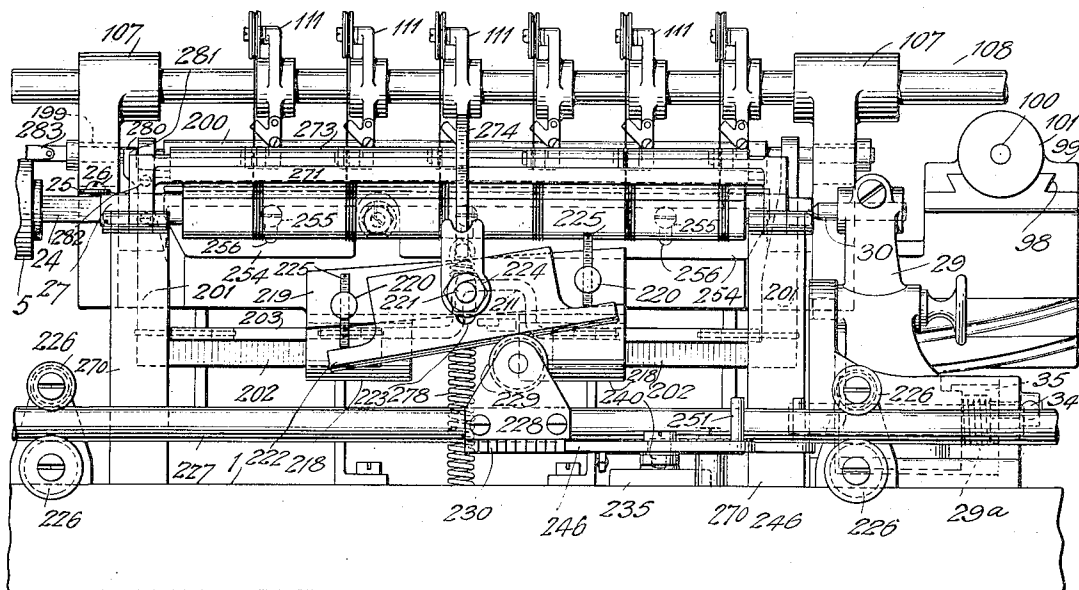
B. F. JOHNSON

WINDING MACHINE

Filed May 22, 1923

6 Sheets-Sheet 2

Fig. 2.



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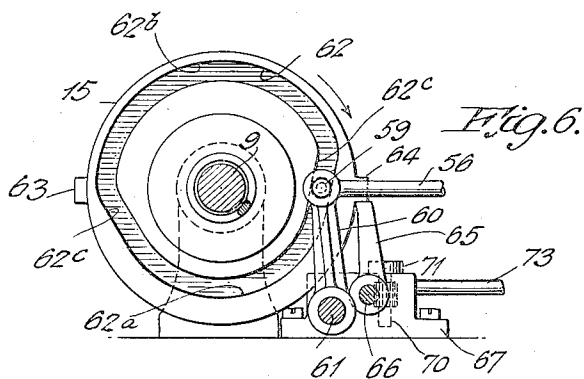
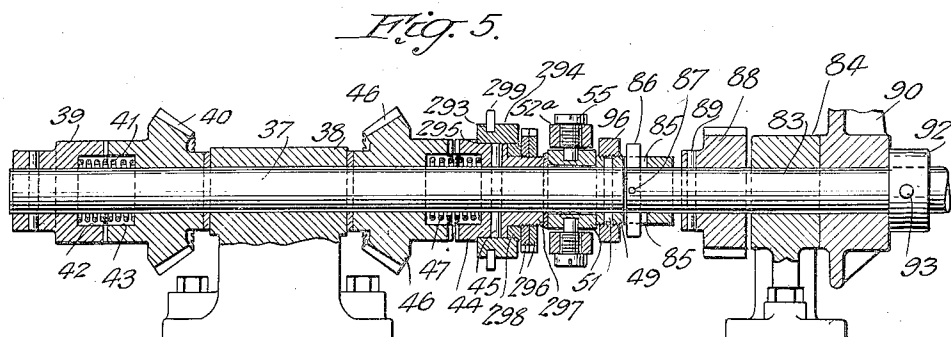
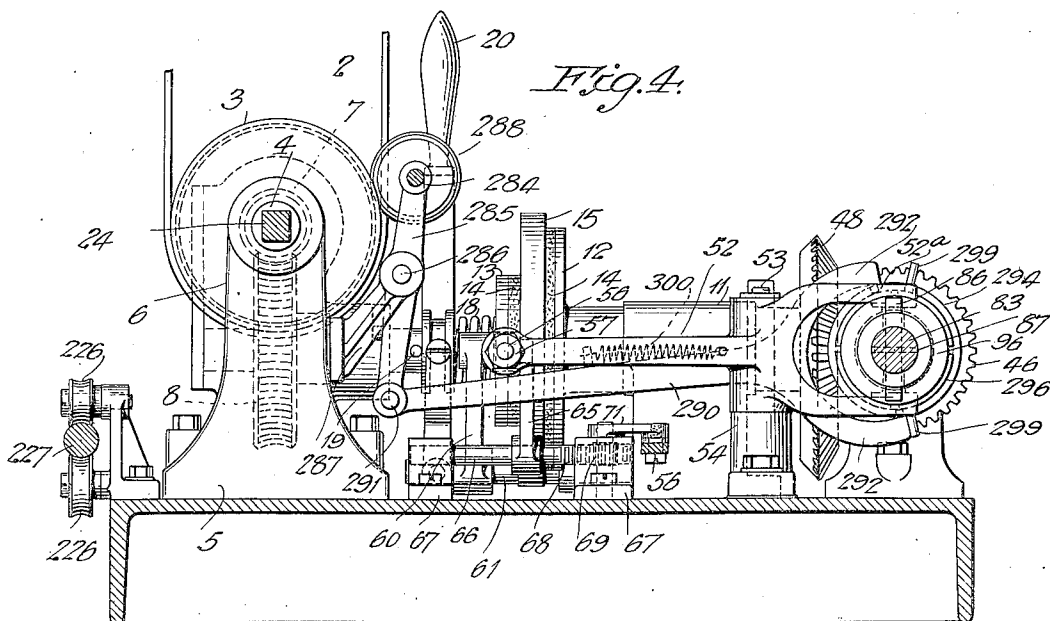
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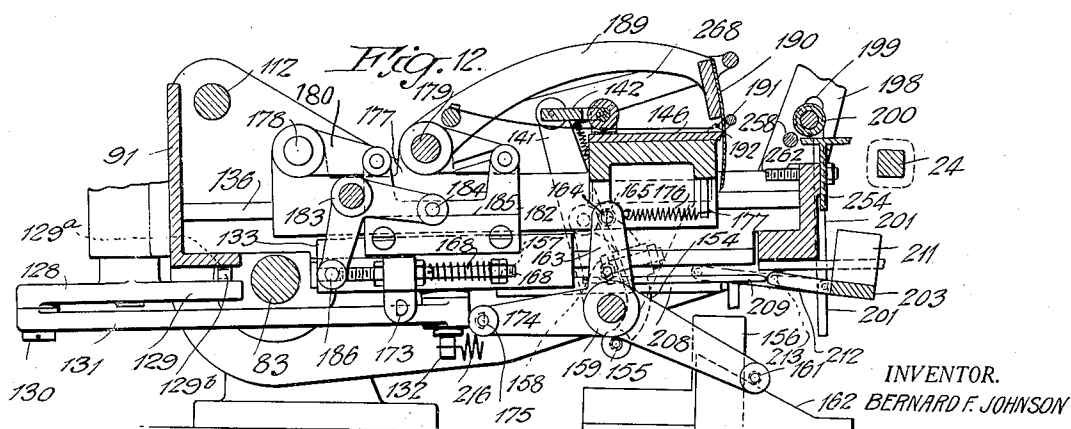
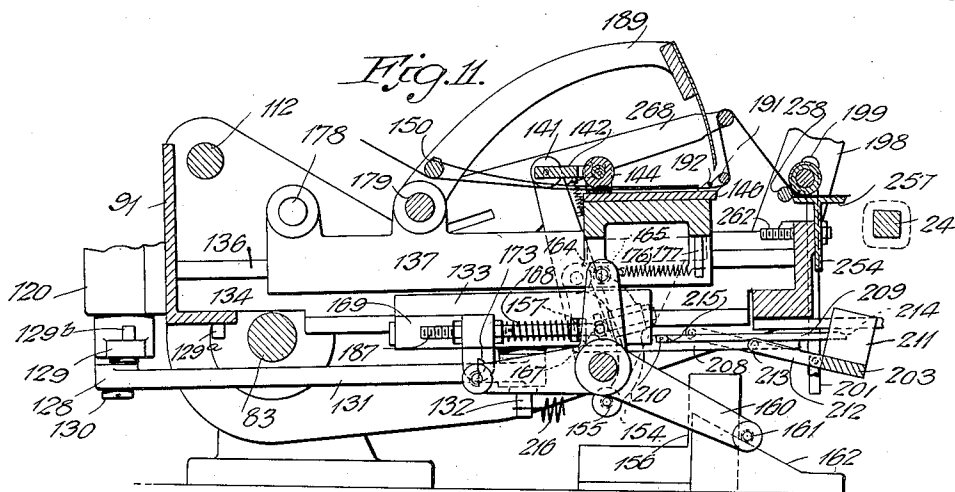
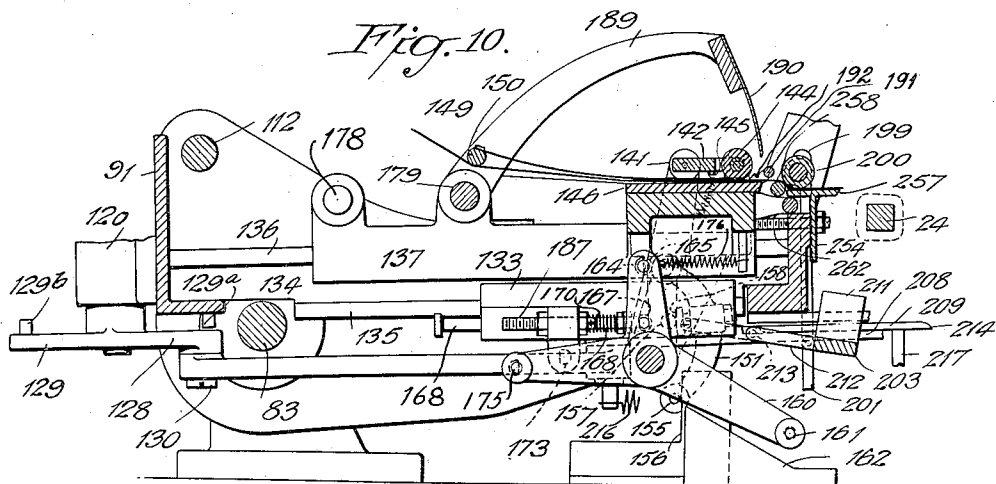
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WINDING MACHINE

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6 Sheets-Sheet 5



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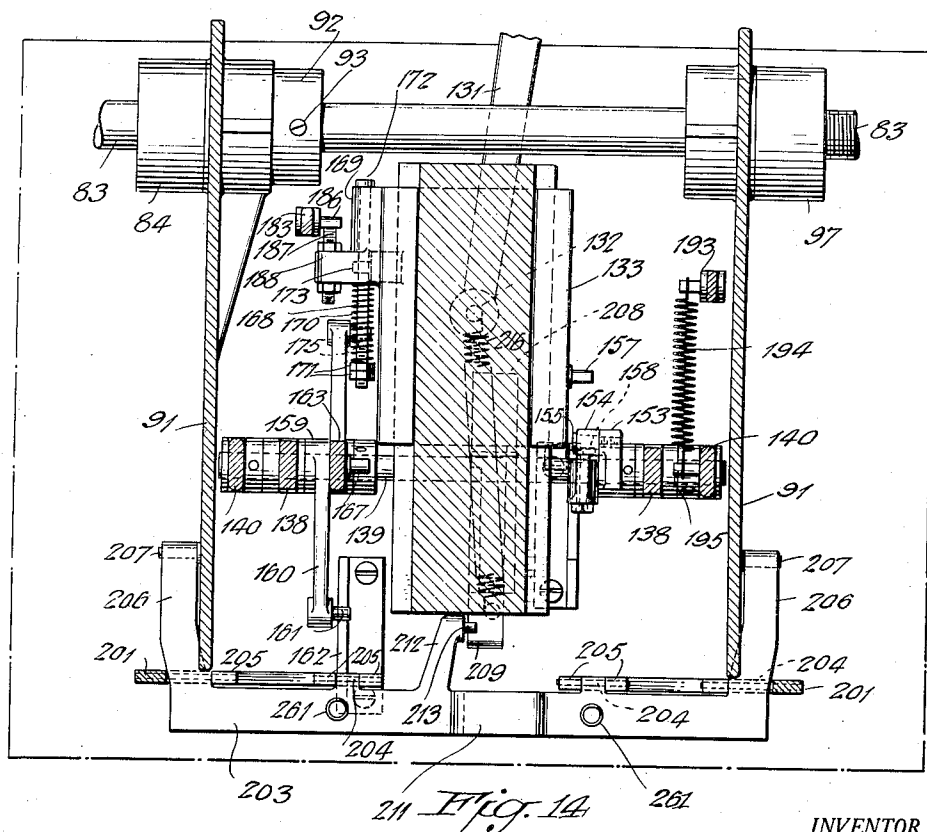
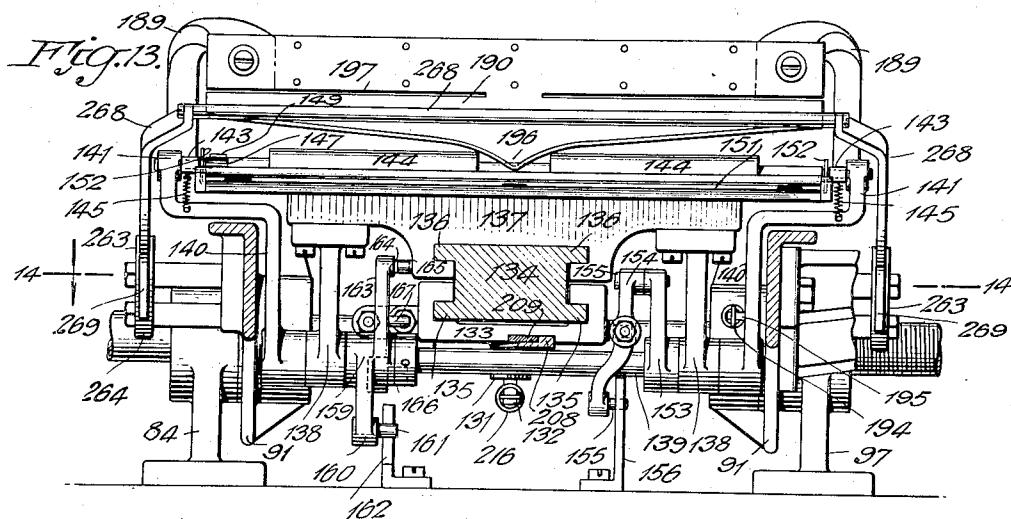
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WINDING MACHINE

Filed May 22, 1923

6 Sheets-Sheet 6



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UNITED STATES PATENT OFFICE.

BERNARD F. JOHNSON, OF JERSEY CITY, NEW JERSEY.

WINDING MACHINE.

Application filed May 22, 1923. Serial No. 640,686.

To all whom it may concern:

Be it known that I, BERNARD F. JOHNSON, a citizen of the United States, residing at Jersey City, in the county of Hudson and State of New Jersey, have invented certain new and useful Improvements in Winding Machines, of which the following is a full, clear, and exact description.

This invention relates to machines for winding strands of material such as wire, thread, ribbon or filaments into coils, helices or bobbins, and more particularly to machines for winding copper wire into coils or helices for use in various kinds of electrical apparatus. The particular machine, which will be herein described for the purpose of explaining the nature of the invention, is of the same general character as those set forth in U. S. Patents Nos. 654,538, issued July 31, 1900, 1,368,536, issued February 15, 1921, and 1,427,509, issued August 29, 1922. In the patented machines a plurality of coils are wound simultaneously in separated zones upon a single spindle or mandrel form, the convolutions of wire being wound in layers which are superposed one upon the other, and the machines are adapted to introduce or inject sheets of paper between the adjacent layers of each coil for insulation purposes during the winding or building up of the coils. The layers in all of the coils are finished at the same instant, and at that instant a sheet of paper, of a length sufficient to make one wrapping around the coil with some overlap, and of a width greater than the length of the coils upon the mandrel form, is delivered to the mandrel form and wound thereon as a foundation for the next succeeding layer. When the desired number of layers have been wound upon the mandrel form, the machine is stopped and the spindle with all of the coils thereon removed together as a unit. The wound unit is subsequently divided into individual coils by severing the various layers of paper in the space or zone between the coils. Machines of this type necessarily involve many cams and interrelated movements, and it is therefore desirable that the machines be made as simple, efficient and durable as possible so that they will require little attention after having once been properly adjusted. It is also very desirable that the paper which is inserted between the different wire layers be inserted always uni-

formly regardless of the width of the strip, in order to prevent injury thereto.

Accordingly, the invention has for an object to simplify and improve machines of this type so as to increase their efficiency, durability and reliability; to increase the rate at which the coils may be wound; to insure insertion of the paper between the layers of wire of the coil evenly, and with certainty, at the proper time, without danger of folding, tearing or otherwise injuring the paper; and to insure these results regardless of the width of the strip. Other objects and advantages will be apparent from the following description of an embodiment of the invention and the novel features will be particularly pointed out hereinafter in claims.

In the accompanying drawing:

Fig. 1 is a plan of a machine constructed in accordance with the invention;

Fig. 2 is a front elevation of a portion of the same;

Fig. 3 is a transverse sectional elevation of the same, taken substantially along the line 3—3 of Figure 1;

Fig. 4 is another transverse sectional elevation of the same, taken substantially along the line 4—4 of Figure 1;

Fig. 5 is a sectional elevation of a portion of the reversing mechanism of the same, taken substantially along the line 5—5 of Figure 1;

Fig. 6 is a sectional elevation of another portion of the reversing mechanism, the section being taken substantially along the line 6—6 of Figure 1;

Fig. 7 is a transverse sectional elevation of the machine, taken substantially along the line 7—7 of Figure 1;

Fig. 8 is a similar elevation with the parts in a different relative position which they assume during the operation of the machine;

Fig. 9 is a sectional elevation of a portion of the reversing mechanism, the section being taken substantially along the line 9—9 of Figure 1;

Fig. 10 is a sectional elevation similar to figures 7 and 8, with the parts in a different relative position;

Fig. 11 is a similar elevation with the parts in the relative positions they assume at another point in the cycle of operation of the machine;

Fig. 12 is a similar view of the same with

the parts in another relative position which they assume at another point in the cycle of operation of the machine;

Fig. 13 is a sectional elevation through a portion of the machine, taken substantially along the line 13—13 of Figure 7; and

Fig. 14 is a sectional plan of a portion of the machine taken substantially along the line 14—14 of Figure 13.

In the illustrated embodiment of the invention a suitable frame base 1 serves as a support for the operating mechanism. A suitable prime mover, such as a motor, (not shown) is provided, which by means of a belt 2 (see Fig. 1) drives a pulley 3 that is fixed upon a shaft 4. The shaft 4 is rotatably mounted in a suitable bearing 5 and a bearing housing 6. Within the housing 6 the shaft 4 is provided with a worm screw 7 meshing with and driving a worm wheel 8, which is carried by a shaft 9 extending at right angles to, but offset from, the shaft 4. The shaft 9 is rotatably mounted in the housing 6 and in a suitable bearing 11, and carries thereon a pair of discs 12 and 13. The disc 12 is fixed to the shaft for rotation therewith and the disc 13 is keyed to the shaft so as to rotate therewith and slide thereon to a limited extent. Friction discs or washers 14 are provided upon the shaft 9 between the discs 12 and 13.

A cam 15 is rotatably mounted upon the shaft 9 between the friction discs or washers 14. A collar 17 is slidable upon the shaft 9 for rotation therewith, and a helical spring 18 is compressed between the collar 17 and the disc 13 so as to yieldingly press or clamp the disc 13 against the cam element 15, and the latter against the disc 12. A removable pin 19 on the shaft 9 prevents movement of the collar 17 in a direction to release the spring 18. The spring 18 thus serves to clamp the cam 15 frictionally to the shaft. If for any reason it is desired to unclamp the cam from the shaft 9, it is merely necessary to remove the pin 19, whereupon the collar 17 may be shifted longitudinally of the shaft 9, by a suitable operating handle 20 which is pivoted to the frame and carries a pin 21 running in an annular groove in the collar. The shaft 4 extends through the housing 6 and into a housing 22, where it is connected to a suitable dial indicator 23 for indicating the number of revolutions of the shaft 4.

The end of the shaft 4 which projects through the bearing 5, is provided with an axial recess in which a suitable winding spindle 24 may be removably chucked. In the type of machine illustrated this winding spindle is square in cross section and carries upon one face a suitable washer 25 which is secured thereagainst by a screw 26. The tubular mandrel or form 27, upon which the plurality of coils are to be wound, is

slid over the spindle 24 until an end edge extends beneath the washer 25. By tightening the screw 26 the form may be clamped to the spindle and held against axial displacement thereon. In a small frame 28 at the opposite end of the spindle 24, a bearing block 29 is mounted for oscillation about an axis parallel to, but off-set from, the axis of the spindle 24. The bearing block carries a conical bearing pin 30 which is adapted to enter a recess in the end of the spindle 24 and rotatably support the same. The pin 30 is mounted upon the bearing block 29 so as to be in alignment with the axis of rotation of the spindle 24 when rotated about its axis into one position.

The bearing block 29 is also free to slide upon its pivotal support in the frame 28, being stressed toward the winding spindle by a compression spring 29^a, and a pin 31 on the bearing block 29 is adapted to enter a recess 32 in an end wall of the frame 28, when the bearing block 29 is shifted axially in a direction to carry the bearing pin 30 into supporting position for the spindle 24. The engagement of the pin 31 in the recess 32 prevents oscillation of the bearing block until the block has been withdrawn axially sufficiently to remove the bearing pin 30 from engagement with the spindle 24.

A small spindle or shaft 33 is rotatably mounted in an outer end wall of the frame 28 and carries upon its outer end an operating handle 34, and upon its inner end, and adjacent the block 29, an offset arm 35. When the handle 34 is operated in one direction, it will carry the offset arm 35 into a position between the block 29 and an end wall of the frame 28 so as to lock the bearing block 29 in supporting engagement with the spindle. A spring 36 (see Figure 3) is connected between the offset arm 35 and any suitable part of the frame 28, so as to normally hold the offset arm in a position in which it locks the bearing block against axial displacement.

A shaft 37 (Figs. 1 and 5) is rotatably mounted in a bearing 38, secured to the frame base 1, so as to extend along the rear of the frame base 1 parallel with the shaft 4, and in the plane of the shaft 9. The shaft 37 extends in opposite directions from the bearing 38, and has fixed upon one end thereof a clutch element 39. Between this element and the bearing is loosely mounted a bevel gear 40. A helical spring 41 (Fig. 5) is disposed in complementary recesses 42 and 43 in the abutting faces of the clutch element 39 and the bevel gear 40, and the end face of the bevel gear 40 facing the clutch element 39 is provided with clutch teeth which cooperate with complementary clutch teeth on the abutting end face of the clutch element. The spring 41 normally stresses the bevel gear 40 against the

bearing 38 and in a direction out of clutching engagement with the clutch element 39.

Upon the opposite side of the bearing 38 the shaft 37 is provided with a second clutch element 44, which may be secured to the shaft 37 for rotation therewith in any suitable manner, such as by a pin 45 which passes through both clutch element and shaft. A second bevel gear 46 is loosely mounted upon the shaft 37, between the clutch element 44 and the bearing 38 and the abutting end faces of the bevel gear 46 and clutch element 44 are provided with complementary clutch teeth. A coil spring 47, similar to the coil spring 42, is disposed in complementary recesses in the abutting end faces of the bevel gear 46 and clutch element 44, so as to normally press the bevel gear 46 against the end face of the bearing element 38.

When the shaft 37 is displaced axially in one direction, such as to the left from the position shown in Figure 5, the clutch element 39 will be carried out of clutching engagement with the bevel gear 40 and the clutch element 44 will be carried into clutching engagement with the bevel gear 46. The spring 41 will keep the bevel gear 40 against the bearing 38 and prevent it from shifting accidentally into clutching engagement with the clutch element 39. When the shaft 37 is shifted to the right, and into the position shown in Figure 5, the clutch element 39 will move into clutching engagement with the bevel gear 40 and the clutch element 44 will move out of clutching engagement with the bevel gear 46. The spring 47 maintains the bevel gear 46 against the bearing 38 so as to prevent its accidental movement into clutching engagement with the clutch element 44.

The bevel gears 40 and 46 are continually in mesh with a bevel gear 48 which is mounted upon the end of the shaft 9 adjoining the shaft 37. Thus when the shaft 9 is driven from the shaft 4, the bevel gears 40 and 46 will be continually driven in opposite directions. By shifting the shaft 37 in either direction, to the limit of its movement, either of the clutch elements 39 and 44 may be engaged with the bevel gears, so that the shaft 37 will be driven therefrom in a direction corresponding to the direction of rotation of the particular bevel gear which is at that time clutched to the shaft.

A collar 49 (Figs. 1 and 5) is secured by a pin 50 to the shaft 37, in a position slightly spaced from the clutch element 44. Between the collar 49 and the clutch element 44, a bushing 51 is loosely mounted upon the shaft for rotation thereon, the inner diameter of the bushing being slightly greater than the diameter of the shaft.

Referring particularly to figures 1 and 4,

a lever 52 is pivotally mounted at 53 to a suitable bracket 54 carried upon the frame base 1, between the shaft 37 and the cam element 15. The end of the lever 52, at the side of its pivot towards the shaft 37, is forked, the arms 52^a of which embrace the bushing 51 (Figs. 1 and 5). A screw pin 55 is provided upon each arm 52^a of the forked end of the lever so as to extend radially of the shaft 37 from opposite sides and engage in the bushing 51. The bushing 51 is therefore held against rotation with the shaft, and when the lever 52 is oscillated about its pivot, it will be shifted in a direction axially of the shaft. Since the bushing 51 is confined between the clutch element 44 and the collar 49, the bushing 51, in moving axially, will shift the shaft 37 axially in a direction corresponding to the direction of movement of the bushing. The looseness between the bushing and the shaft compensates for the slight arcuate movement of the pins 55 when oscillated about the pivotal axis 53.

The end of the lever 52, opposite the forked end, is provided with an aperture through which passes loosely a rod 56 (Figs. 1 and 4) in a direction parallel with the shaft 37. The rod 56, upon the end passing through the lever 52, is threaded, (Fig. 1) and is provided with nuts 57 in spaced relation thereon and upon opposite sides of the lever 52. A helical spring 58 is disposed on the rod 56 between each nut 57 and the lever, which may be placed under varying degrees of compression by adjusting the nuts along the rod 56 and toward the lever 52 to various extents. The springs 58 press against opposite sides of the lever 52, and when the rod 56 is operated in either direction to shift the shaft 37 and thereby operate the clutches, the springs 58 will yield in case the clutch teeth which are to be brought into engagement do not mesh and continue the stress upon the lever in a direction to cause a clutching of the clutch element in one of the bevel gears as soon as the abutting clutch teeth thereof are brought into alignment with one another.

The rod 56 is pivotally connected by a pin 59, to the upper end of a rocker arm 60, (see Figs. 1, 4 and 6) and the latter is secured at its lower end to a shaft 61, extending parallel with the shaft 9 and rotatably mounted in suitable bearings upon the frame base 1. The pivot pin 59, by means of which the rod 56 is connected to the roller 60, extends in a direction normal to one face of the cam 15 and acts as a follower running in a cam groove 62 (see Figs. 1 and 6), formed in a face of the cam 15. The cam groove 62 is divided into two sections which are approximately semi-circular about the axis of rotation of the cam, the radius of one section 62^a being less than

the radius of the other section 62^b. The adjoining ends of the semi-circular portions of the cam groove are connected by inclined guideways 62^c. Thus, as the cam 15 rotates through a half revolution from the position shown in Figure 6 and in the direction of the arrow, the pin 59 will be carried in a direction away from the shaft 9 as it moves into the cam groove section 62^b, and will be held in that position for approximately a half revolution. When the rod 56 is operated by the cam groove, it serves to shift the clutch controlling lever 52 and effect a shifting of the clutch elements for a purpose to be hereinafter explained.

The periphery of the cam 15 is provided with two diametrically arranged lugs 63 and 64 (Figs. 1 and 6) which are disposed in offset planes, transversely to the shaft 9, so that they will move in different paths of rotation when the cam 15 rotates. A pawl 65 is fixed to a shaft 66 which extends in a direction parallel with the shaft 9 and is slidably mounted in suitable bearing blocks 67, secured upon the frame base 1. The shaft 66 is slidable axially to itself in the bearing blocks 67, and, upon the end extending into one of the bearing blocks, is provided with rack teeth 68 (see Fig. 1) which mesh with a pinion 69. The pinion 69 is carried by a vertical stub shaft 70 (Fig. 6) which is rotatably mounted in one of the bearing blocks and extends vertically above the bearing block. The upper end of the shaft 70 is provided with a crank arm 71 (Fig. 1) which, at its outer end, is pivotally connected by a pin 72 to a rod 73.

The rod 73 extends longitudinally of the machine and is pivotally connected, by a pivot 74, to a plate 75 which is mounted upon the frame base 1 for sliding movement lengthwise of the machine, the plate being guided and limited in its movement by headed guide pins 76 which pass through elongated slots 77 in the plate and enter the frame base 1. The plate 75 is provided with upstanding ears 78 which rotatably and non-slidably support a threaded shaft 79, also extending lengthwise of the machine, that is, in the direction of sliding movement of the plate 75. An operating button 80 (Fig. 1) is provided upon one end of the rod 79 by which the rod may be rotated in the bearing ears 78.

Between the bearing ears, the rod is threaded in opposite directions at the opposite ends. That is, the threads from the central portion toward one end are left hand threads, and those from the central portion toward the opposite end are right hand threads. Nuts 81 are provided upon each threaded portion of the rod 79, and each nut is provided with a flattened peripheral portion 82 (see Figs. 3 and 9) which fit rather closely against the upper face of the plate

75 so as to prevent rotation of the nuts without preventing their sliding movement relatively to the plate 75. Thus when the rod 79 is rotated, by rotating its button 80, the nuts 81 will be held against rotation by the engagement of their flattened peripheral portion 82 with the plate 75, and by reason of their threaded engagement with the rod 79 the nuts will be separated or caused to approach, depending upon the direction of rotation of the rod 79. To set the nuts 81 at any selected distance apart, it is merely necessary to rotate the rod 79 sufficiently to carry them into the desired relative position.

Referring particularly to Figures 1 and 5, a shaft 83 is rotatably mounted in a bearing 84 carried by the frame base 1, and is disposed in alignment with the shaft 37. The collar 49 on the end of the shaft 37, extends for some distance over the abutting end of the shaft 83 and is provided with diametrically disposed longitudinally extending slots 85. A pin 86 is set into a slot in the end of the shaft 83 so as to extend diametrically thereacross and from opposite sides thereof into the elongated slots 85. The pin 86 is secured against separation from the shaft 83 by means of a smaller pin 87 which passes through both the shaft and the pin 86. Thus, when the shaft 37 is rotated, the shaft 83 will be driven therewith through the collar 49 and the pin 86. At the same time the shaft 37 will be free to slide longitudinally to an extent permitted by the slots 85.

A gear 88 (Fig. 5) is secured upon the shaft 83 by a pin 89. An arm 90 of a swinging frame 91 (Figs. 5 and 14) is rotatably mounted on the shaft 83 between a collar 92, joined to the shaft by a pin 93, and the bearing 84 upon the opposite face thereof from the gear 88. The shaft 83 is capable of a limited longitudinal sliding movement which is limited in a direction to the left (Fig. 5) by the collar 92, and in the opposite direction by the gear 88, the extent of movement being substantially equal to that provided for the shaft 37. An adjustable stop 94 is provided at one end of the frame base 1, so as to extend into and abut against the end of the shaft 83 and limit movement of the shaft in a direction away from the shaft 37. Thus by adjusting the stop 94, which is threaded through a suitable bearing block 95, the longitudinal movement of the shaft 83 may be permitted or prevented. The stop 94 also acts as a bearing for the shaft 83.

The collar 49, which is joined to an end of the shaft 37, is externally threaded, and a sleeve 96 (Figs. 1 and 5) is threaded upon the periphery of the collar 49. When it is desired to couple together for simultaneous endwise movements, the shafts 37 and

83, the sleeve 96 is adjusted upon the collar 49 in a direction to abut against the pin 86 (Figs. 1 and 5) and force it to the opposite end of the slots 85. This will prevent relative movements between the shafts and effectually couple them together for simultaneously longitudinal movements. It is then necessary to operate the stop 94 to permit sliding movement of the shaft 83 with the shaft 37. The reason for coupling the shafts in this manner is for imparting to the wire or thread, a sharp reverse movement at each end of a layer to prevent the wire from piling up, as will be more fully hereinafter explained.

Another arm 90 of the carriage 91 is rotatably mounted upon the shaft 83, and the shaft 83 is also rotatably mounted in a bearing 97 (Figs. 1, 13 and 14) arranged adjacent to the last named arm 90 and supported from the frame base. The frame 91 on one end, such as at the right in Figure 1, is provided with a dove tail guide or track 98 (Figs. 1, 2 and 3) which extends in a direction from front to rear of the machine and a block 99 is slidably mounted and confined to the track 98 by reason of a guide groove which is complementary to and attached to the track 98. A threaded rod 100 extends lengthwise of the track 98, and is rotatably carried thereby above its upper face with a threaded engagement with the block 99, so that when the rod 100 is rotated, such as by an operating button 101, the block 99 will be adjusted along the track 98. A bearing sleeve 102 (Figs. 1 and 3) is connected by a pivot 103 to one side of the block 99, so as to be adjusted from front to rear when the block 99 is adjusted along the track. At the same time the sleeve 102 is free to oscillate about the pin 103, which extends transversely of the direction of movement of the block 99.

A rod 104 is slidable through the sleeve 102 and extends in both directions therefrom. At one end it is pivotally connected, by a pin 105, to a split nut 106 which has threaded engagement with a threaded section of the shaft 83 extending to the right (see Fig. 1) from the frame 91. Thus, when the shaft 83 is rotated, the split nut 106 will be held against rotation therewith by reason of its connection with the rod 104 and will be caused to move longitudinally along the shaft 83 in a direction depending upon the direction of rotation of the shaft 83. The rod 104 will slide in the sleeve 102 to compensate for the movement of the split nut 106 in a straight line instead of an arcuate line. The movement of the split nut 106 will therefore oscillate the rod 104 about the pin 106. By adjusting the block 99 from front to rear or vice versa, the lever arm between the sleeve 102 and the split nut may be varied, which will

vary the arc of oscillation of the end of the rod 104 which is upon the opposite side of the sleeve 102 from the nut 106.

The pivoted frame 91, at its forward edge, is provided with upstanding ears 107 (Figs. 1, 2 and 3) that serve as bearings for a rod 108 which extends in a direction parallel with the shaft 103 but along the forward edge of the machine. The rod 108, at one end, is pivotally connected by a pin 109 to a sleeve 110 (Figs. 1 and 3), through which the free end of the rod 104 passes and slides. Thus, as the rod 104 is oscillated by the nut 106, the rod 108 will be reciprocated in the bearings 107 of the frame 91. The sliding of the sleeve 110 upon the rod 104 will compensate for the arcuate movement of the rod 104. The rod 108, between the bearings 107, is provided with spaced suitable wire guides 111 by means of which the wires or threads to be wound into coils are guided to the tubular form carried by the winding spindle 24. The guides, as illustrated, are provided with grooved pulleys which guide the wires or threads to the tubular form on the spindle and at the same time serve to feed the wire or thread progressively in directions from end to end of the winding spindle with the reciprocations of the rod 108 upon which they are carried. The wires or threads may be conducted to the guides 111 from any suitable source, which is not shown in order to simplify the disclosure. Thus, when the winding spindle 24 is rotated from the shaft 4, the tubular form will be rotated and the wire will be guided in layers thereon by the guides 111.

The rotation of the shaft 4 will be transmitted through the shaft 9 to the bevel gears 40 and 46, and by reason of the connection between the cam 15 and the clutch lever 52, one of the bevel gears 40 or 46 will always be clutched to the shaft 37 so as to rotate it in a direction dependent upon the position of the cam 15. Assuming that the shafts 37 and 83 are not coupled for concomitant, sliding or longitudinal movement, the shaft 83 will merely be rotated by the shaft 37 in opposite directions depending upon the position of the cam 15. As the shaft 83 is rotated, the nut 106 will be fed along the same, and the pin 105 which serves as a connection between the nut and the rod 104 extends between the nuts 81 which are provided upon the threaded rod 79, so that when the nut 106 has been moved far enough to carry the pin 105 into engagement with one of the nuts 81, the plate 75 will be shifted endwise, and by reason of its connection to the rod 73 will rotate the crank arm 71.

The crank arm, by reason of its connected pinion 69, will operate the rod 66 in an endwise direction and carry the pawl 65 transversely across the peripheral surface of the cam 15 so as to move from beneath one of

the lugs 63 or 64 and release the cam 15. The cam 15 will then be driven, by friction, with the shaft 9 until the other lug 63 or 64, which is offset from the released lug, engages with the end of the pawl 65, whereupon the movement of the cam will be checked, the friction drive of the cam permitting continued rotation of the shaft 9. During this half revolution of the cam 15, the follower pin 59 will be shifted toward or from the shaft 9, which will cause a movement of the rod 56, and through it a portion of the clutch lever 52, to reverse the direction of rotation of the shaft 37. When the rotation of the shaft 37 is effected, the shaft 83 will also have its rotation reversed, and the nut 106 will be fed in an opposite direction. During this opposite movement the rod 108 will be shifted in a direction opposite to its prior movement and guide the wire or thread in a new layer being progressively formed in the opposite direction.

When the pin 105 engages with the other nut 81, the plate 75 will be operated in the reverse direction so as to shift the rod 73, crank arm 71, and rod 66 in opposite directions from those in which they were previously moved, and the movement of the rod 66 will carry the pawl 65 from beneath the lug 63 or 64 with which it engages, so as to release the cam 15, whereupon the latter will again rotate through a half revolution until the lug opposite from that last released is stopped by its engagement with the pawl 65. During this half revolution of the cam 15, a reverse operation of the clutch lever 52 will be effected, and the movement of nut 106, and through it movement of the rod 108, will be reversed.

A shaft 112, (Figs. 1, 7 and 8) is mounted in the swinging frame 91, in proximity and parallel to, but spaced from, the shaft 83, and upon one end carries a gear 113 which meshes with, and is driven by, the gear 88 fixed upon the shaft 83. The shaft 112, at its opposite end, is provided with a pinion 114 which meshes with and drives a gear 115. The gear 115 is fixed upon a shaft 116, also rotatably mounted in the frame 91 so as to extend parallel with the shaft 112. The shaft 116 also carries a bevel gear 117, which meshes with and drives a bevel gear 118. The bevel gear 118 is rotatably mounted upon a vertically extending shaft 119, also rotatably mounted upon the frame 91, by means of a bearing 120. The shaft 119 is provided with a collar 121, fixed thereon and abutting against the upper end of the bearing 120 (Fig. 7), and the gear 118 abuts against the collar 121 with a friction washer 122 interposed between them and recessed into the under face of the bevel gear 118 as shown in Figure 7.

A collar 123 is fixed to the shaft 119 at its upper end, and compresses a helical

spring 124, surrounding the shaft, against a washer 125 which abuts against the upper face of the bevel gear 118, with a friction disc 126 interposed between the washer and gear, also as shown in Figure 7. The spring 124 serves to frictionally couple the gear 118 to the shaft 119 through the application of friction to both faces of the gear.

The lower end of the shaft 119 is provided with a collar 127 carrying crank arms 128 and 129 extending in opposite directions laterally therefrom. The arm 128 is connected by a pivot pin 130 to a connecting rod 131, which is in turn pivotally connected to a pin 132 which depends from the lower face of a carriage 133. A pin 129^b depending from the swinging frame 91 is disposed within the path of a pin 129^a on the arm 129 so as to limit the rotation of the shaft 119 to approximately 360°.

The carriage 133 (see Figs. 7, 8, 13 and 14 particularly) is mounted for sliding movement upon the lower part of a guide bar 134, which is carried by the frame 91 so as to extend in a direction from front to rear thereof. As shown particularly in Figure 13, the guide bar 134 has flanges 135 on opposite sides along its lower edges, which are embraced by overhanging flanges of the carriage 133. When the shaft 119 is rotated, this rotation will be translated into reciprocating movement of the carriage 133 in a direction from front to rear of the machine.

The guide bar 134 is also provided along its upper side edges with flanges 136 which mount and guide a second or upper carriage 137 in a direction from front to rear of the machine. This upper carriage 137 is clearly shown in Figures 7, 8 and 10 to 14.

Arms 138 (Fig. 13) depend from the sides of the upper carriage 137 and rotatably mount a shaft 139 which extends transversely of the direction of sliding movement of the carriage 137 and beneath the lower carriage 133. Upon the ends of the shaft 139, which extend through the bearings 138, are fixed arms 140 which extend upwardly to approximately the upper level of the upper carriage 137 then outwardly and then upwardly to form bearing ears 141. A plate 142 (Figs. 1, 7, 8, and 10 to 12) extends between and is pivoted in the ears 141. The plate 142 is provided at its ends with forwardly extending ears 143 (Figs. 1 and 13) between which a paper feeding roller 144 extends and is rotatably mounted. A spring 145 is connected between each of the arms 140 and the plate, so as to yieldingly stress the plate 142 in a direction to carry the roller 144 towards a plate or table 146 provided upon the upper face of the upper carriage.

One end of the roller 144 is provided with teeth 147 (see Fig. 1), and a spring pawl 148 is secured to the plate 142 with its free

end extending into engagement with the teeth 147 so as to limit the rotation of the roller 144 to one direction. The permitted direction of rotation is that which occurs when the roller is carried rearwardly upon the plate 146. When the arms 140 are swung forwardly the roller 144 will be carried forwardly, and the pawl 148 will prevent rotation of the roller. The roller being pressed against the plate will frictionally engage with a continuous sheet of paper 149, which is conducted from a suitable supply roll over a guard 91^a, beneath a guide bar 150, and between the roller 144 and the plate 146. The roller 144, in moving forwardly, frictionally grips the paper and carries it forwardly over the surface of the plate 146.

A thin strip 151 extends parallel with the roller 144 and beneath the same, and at its ends is provided with upturned ears 152 (Figs. 1 and 13) which are slotted from their free ends so as to slidably embrace the pivots of the roller 144. The strip 151 rests and slides upon the upper surface of the plate 146, and the paper strip 149 is passed between the strip and the roll so as to be gripped between them by the pressure of the spring 145 (Figs. 10 to 12). The frictional resistance to forward movement of the paper will be entirely that existing between the strip 151 and the plate 146. There will therefore be no tendency for the paper strip to stick at any one point and thus cause it to feed more at one edge than the other.

Referring again particularly to Figures 13 and 14; the shaft 139, which is suspended from the upper carriage 137, is provided with an arm 153 which is fixed thereon, and a link 154 is pivoted at 155 to the free end of the arm 153, so as to depend freely therefrom. At its lower end, the link 154 is provided with a transversely extending pin 155, which is within the path of an upstanding abutment 156 provided upon the upper face of the frame base 1. The lower carriage is provided, upon the side edge at which the link 154 is disposed, with an operating pin 157 (see Fig. 14 particularly) which moves with the lower carriage and is adapted, as it moves forwardly, to engage against a pin 158 which extends rearwardly from the link 154 midway of its ends. The pin 158 is adjustable through the link 154 so as to project to variable extents therefrom and thus vary the point in the travel of the lower carriage at which the pin 157 thereof engages with the pin 158.

A three armed crank 159 (Figs. 7, 8 and 10 to 14) is rotatably mounted upon the shaft 139, upon the side of the carriage opposite from the depending link 154, and one arm 160 of this crank depends below the shaft 139 and carries a transversely extending pin 161. An inclined cam 162 is carried by the frame base 1 within the path of this

pin 161 as it moves rearwardly with the lower carriage so that the pin 161 will, at a particular point in its travel, be engaged with, and cammed upwardly by, the inclined cam 162, for a purpose which will be hereinafter explained.

Another arm 163 of the crank 159 (see Figs. 10 to 14) extends upwardly along one side of the upper carriage 137, and carries a pin 164 extending towards the carriage. A pin 165 is provided upon the adjacent side of the upper carriage 137, and within the path of the pin 164 of the crank 159 (see Fig. 13), for limiting the rotation of the crank in one direction. The three arm crank 159 is confined upon the shaft 139, and against one of the bearings 138, by a collar 166 which is fixed on the shaft.

The arm 163 of the three arm crank is also provided with another pin 167 extending laterally towards the lower carriage 133 and within the path of a threaded rod 168 which is carried by the lower carriage. The rod 168 is slidably mounted for longitudinal movement in a bearing lug 169 at one side of the lower carriage (see Fig. 14 particularly), and a helical spring 170 surrounds the rod and is compressed between a pair of nuts 171 thereon and the bearing lug 169, so as to normally stress the rod 168 in a direction forwardly of the machine. The rod, at its rear end, is provided with a head 172 which limits its forward movement under the action of the spring 170. When the lower carriage 133 is moved forwardly by the link 131, the rod 168 will engage with the pin 167 of the three arm crank 159 and rotate it forwardly (see Figs. 13 and 14) so as to carry the pin 164 of the crank against the pin 165 of the upper carriage. Continued forward movement of the lower carriage will then move the upper carriage with the lower carriage, because the shaft mounting the three arm crank is carried by the upper carriage and one arm of the crank is pressed against the pin 165 of the upper carriage.

The lower carriage is also provided, below the bearing lug 169, with a half round pin 173 (Figs. 10 to 12) with the plane face of the pin vertical and facing rearwardly of the machine. A third arm 174 of the crank lever 159 extends rearwardly of the shaft 139 and carries, upon its free end, a half round pin 175 with its plane face vertical and facing forwardly of the machine. A tension spring 176 (see Figs. 10 to 12) acts between a pin 177 on the upper carriage and the vertical arm 163 of the crank 159, so as to stress the latter in a direction to carry the pin 161 of the arm 160 against the inclined cam 162. This movement however, is limited by the engagement of the pin 164 of the crank with the pin 165 on the side of the upper carriage (see Fig. 13), and in this

limited position the pin 175 will be about half way within the path of the pin 173 of the lower carriage (see Fig. 12).

During the forward travel of the lower carriage, and before the rod 168 engages with the pin 167 of the three arm crank, the pin 173 of the lower carriage will engage with the pin 175 (curved surface against curved surface) and cam the crank arm 174 downwardly sufficiently to pass the same and continue in its forward movement. During the rearward travel of the lower carriage, however, shortly after the three arm crank is released by the rod 168, the plane face of the pin 173 will engage with the plane face of the pin 175 and draw the crank 159 and through it the upper carriage rearwardly until the pin 161 on another arm of the three arm crank is cammed upwardly by the inclined cam 162, sufficiently to carry the pin 175 out of locking engagement with the pin 173 of the carriage, whereupon the lower carriage will be free to continue its rearward movement leaving the upper carriage substantially where it has been released.

The upper carriage is provided at its rear end with parallel bearings 176 and 177 (see Figs. 1 and 10 to 12) in which shafts 178 and 179 are rotatably mounted respectively. A crank arm 180 is fixed upon each end of both shafts, and the free ends of the crank arms at each side of the carriage are connected by links 181 and 182. The links 181 and 182 are pivotally connected to the crank arms 180, so that the shafts 178 and 179 have a corresponding rotation, the links 181 and 182 with the crank arms acting somewhat like parallel link mechanism. A bell crank 183 is pivotally mounted upon an arm 90 of the swinging frame 91 (see Figs. 1 and 12 particularly), and one arm of this bell crank is provided with a transversely extending pin 184 which rides upon a rail 185 which is provided upon the link 182. The other arm of the bell crank 183 is provided with a pin 186 which, in one angular position of the crank, lies within the path of a rod 187 which is threaded through a lug 188 on the lower carriage 133.

When the lower carriage moves rearwardly to approximately the limit of its movement in that direction, the rod 187 will engage with the pin 186 of the bell crank 183 and rock the latter and cause its pin 184 to depress the link 182 and produce concomitant rotation of the shafts 178 and 179. Arms 189 are fixed in spaced relation upon the shaft 179, extend upwardly and forwardly over the upper carriage, and carry at their forward end a knife 190, which, when the shaft 179 is rotated at the last part of the rearward movement of the carriage, will descend between the roller 191 and the forward edge of the plate 146 of the upper

carriage (see Fig. 12) and sever the sheet of paper. A wire 192 extends parallel to the roller 191, but over and in close proximity to the plate 146 along its forward edge, so as to hold the cut edge of the paper supply strip flat against the plate 146. A plurality of spring fingers 140^a are carried by the guide bar 150 which is supported by and extends between the knife carrying arms 189. These fingers extend forwardly and between the roller 144 and the strip 151, the roller having annular grooves (see Fig. 1) to clear the fingers. The fingers also hold the paper supply strip flat against the plate 146 ready to be fed forwardly beneath roller 200.

An arm 193 (Figs. 1 and 14) is fixed upon and depends from the shaft 179, and a tension spring 194 is connected between the lower end of the arm 193 and a pin 195 carried by one of the arms 140 of the paper feed mechanism. This spring tends to resiliently hold the knife carrying arms in their upper position with the knife above the paper, which is a position shown in Figures 10 and 11, and also to yieldingly hold arms 140, and through them the roller 144 in its extreme rearward position relatively to the upper carriage.

The cutting edge of the knife 190 is angular (Figs. 1 and 13), with the two portions diverging upwardly from a central piercing point 196, and the knife blade is slotted, as at 197, from each end to approximately the center so that the wings thereof may yieldingly press closely against the forward edge of the plate 146 (see Fig. 12) and effect a clean shearing or cutting of the paper.

The swinging frame 91, at the forward corners, is provided with upstanding ears 198 (see Figs. 1 and 10 to 12) having elongated inclined slots 199 therein. A paper gripping and feed roller 200 extends between the ears 198 and through the slots 199 so as to rotate therein and also move vertically in the said inclined slots. Arms 201 (Figs. 2, 3, 7 and 8) are rotatably and dependingly carried by the shaft of the roller 200 on the ends thereof and between the ears 198. Each arm 201 is provided at its lower end with an angular extension 202 (see particularly Figs. 2 and 14) which approach one another, but do not meet. A plate 203 is pivotally mounted, by pins 204, between the arms 201 and ears 205 on the angular extensions of the arms 201, as shown particularly in Figure 14. The plate 203 is U-shaped, and the arms 206 thereof, extend along the outer sides of and embrace the frame 91, and at their ends are pivotally connected thereto by pins 207. When the plate 203 is elevated or lowered by swinging it about the pins 207, it will elevate or lower the arms 201 and through them the roller 200, to an extent permitted by the

elongated slots 199 of the ears 198 of the frame

A plate 208 (Figs. 2, 7, 8 and 10 to 14) is secured to the under face of the lower carriage and carries a rail 209 which is pivoted thereto by a pin 210, so that the rail 209 can swing vertically away from the plate 208. The rail 209 rests upon the plate 208, which prevents downward swinging movement of the rail beyond the normal position shown in Figures 10 to 13. The plate 203 is bowed upwardly at its central portion, as designated by the reference 211, so as to clear the plate 208 and rail 209 as the latter move forward with the carriages. The plate 203 is also provided with a rearwardly extending arm 212 (see Fig. 14 particularly) which carries a pin 213 adapted to ride either upon or beneath the rail 209, and act as a cam follower for the rail 209 which serves as a cam.

The forward end of the rail 209 is beveled upon its upper face as at 214, and at its opposite end is beveled upon the lower face as at 215 for a purpose to be explained hereinafter. A helical tension spring 216 is connected between the pin 132 on the lower carriage 133 and a pin 217 which depends from the forward end of the cam rail 209. The spring 216 is normally under tension and yieldingly holds the cam rail 209 in its lower position against the plate 208.

A pair of arms 218 (Figs. 1, 2 and 3) extend forwardly from the swinging frame 91, and at the forward end extend upwardly in a vertical direction. The forward vertical ends are connected by a plate 219 carrying adjacent its ends, two lugs 220, and centrally of its ends a threaded pin 221 (Figs. 1 and 2). A cam plate 222 is provided with an elongated slot 223 through which the pin 221 may be passed, so as to mount the cam plate upon the connecting plate 219. A nut 224 is provided upon the outer end of the pin 221 so as to clamp the cam plate 222 against the connecting plate 219 in different angular positions about the pin. The lugs 220 are provided with screws 225 (see Fig. 2) which extend transversely there-through within the plane of the cam plate 222, the cam plate having lateral extensions against which the ends of the threaded rods 225 are adapted to abut when they are threaded through the lugs sufficiently. By adjusting the screws 225 to relatively different extents through the lugs 220, the cam plate 222 can be shifted about the pin 221 into different angular positions, so as to present the lower edge thereof in different angularly inclined positions.

The frame base 1, along its forward edge, is provided with pairs of rollers 226 which are adapted to mount a rod 227 for reciprocation along the forward edge of the frame base. The rod 227 is provided with a lat-

eral extension 228 which carries a peripherally grooved roller 229 beneath the lower edge of the cam plate 222. The swinging frame 91 is supported in the position shown in the drawings by the engagement of the cam plate upon the roller 229. When the rod 227 is shifted endwise, the roller 229 will elevate or lower the pivoted frame to an extent depending upon its endwise movement and also upon the angle of inclination of the lower edge of the cam plate. By adjusting the angular inclination of the cam plate, the extent of elevation of the pivoted frame for any selected movement of the rod 227 may be varied. The cam plate 222 runs in the groove of the pulley which holds the rod 228 against rotation.

The lateral extension 228 of the rod 227 is provided upon opposite faces with ratchet teeth 230 and 231 (see Figs. 1 and 2). A holding pawl 232 is pivoted at 233 to the frame base, and has a nose 234 adapted to engage with the ratchet teeth 231 and prevent endwise movement of the rod 227 in one direction.

A plate 235 (see Figs. 1 and 3) is secured upon the upper face of the frame base 1, beneath the pivoted frame 91, and is provided with an elongated slot 236 extending in a direction from front to rear of the machine. A screw or bolt 237 extends through the elongated slot 236 and has a non-circular head 238 slidable in a groove 239 in the under face of the plate 235, so that the screw may slide in a direction from front to rear of the machine and be held against rotation. A lever 240 is provided intermediate of its ends with a longitudinally elongated slot 241 through which the pin 237 passes when the link is placed upon the plate 235. A sleeve 242 is disposed over the pin 237 and within the slot 241 of the lever 240, and a nut 243 is threaded upon the upwardly projecting end of the pin 237 so as to prevent removal of the lever 240 from the pin. If desired, a washer 244 may be introduced between the nut and the sleeve 242. The length of the sleeve 242 is such that the nut can never clamp the lever 240 tightly, but will prevent its removal from the pin 237 while permitting sliding and oscillatory movement of the lever upon the pin.

The lever 240 is pivotally connected, by a pin 245 (see Fig. 1), to the connecting link or rod 73, so that when the latter is operated to effect an operation of the clutch lever 52 through the release of the cam 15, the lever 240 will be rocked about the pin 237. At its forward end, the lever 240 is provided with a pawl 246 which is pivotally connected thereto, as at 247, and the pawl is provided with a nose 248 which is adapted to engage with the ratchet teeth 230 and cause reciprocation of the rod 227 in one

direction when the lever 240 is oscillated. A tension spring 249 (Fig. 1) is connected between the nose ends of the pawls 232 and 246 so as to yieldingly hold them in engagement with the ratchet teeth 230 and 231.

Pins 250 and 251 are provided upon the pawl levers 232 and 246, respectively, at the ends which are on the opposite sides of their pivots from the nose ends, so that when it is desired to release both of the pawls it is merely necessary to press the pins 250 and 251 toward one another and carry the nose ends of the pawls out of engagement with the ratchet teeth 230 and 231. Thereupon the rod 227 may be shifted in a direction opposite from that imparted thereto by the operation of the lever 240. This direction will be to the right in Figure 1, and will be limited by an adjustable stop screw 252, carried by a suitable bracket 253 on the frame base 1. If the throw of the pawl 246 for each oscillation of the lever 240 is to be varied, the nut 243 on the bolt 237 may be loosened, and the latter shifted along the slot 236 to provide the necessary proportions between the arms of the lever 240 on each side of the pivot, whereupon the nut 243 may be tightened to clamp the bolt 237 firmly to the plate 235 and hold it in adjusted position.

An apron plate 254 (Figs. 10 to 12) is secured to the forward face of the pivoted frame 91 by cap screws 255, which pass through vertically elongated apertures 256 in the apron plate and are threaded into the frame 91, so as to clamp the apron plate to the frame and permit of its vertical adjustment thereon. The apron plate is provided with a head 257 which serves as a table or apron over which the paper is fed to the coils. A roller 258 (Figs. 7, 8 and 10 to 12) extends between and is rotatably mounted in the upright arms 198, with its lower edge adjacent to, but slightly above, the upper surface of the apron 257 for the purpose of guiding the paper from the carriage over upon the head of the apron plate.

The arms 218 which extend forwardly from the swinging frame 91 (see Fig. 7) are provided with sleeves 259 which are closed at their upper ends by screw plugs 260. The sleeves are open at their lower ends with their apertures aligned with apertures in the arms 218. A coil spring 261 is disposed in each sleeve 259 so as to extend through the bottom thereof and the corresponding arm 218, and press upon the plate 203 (see Figs. 7 and 14). The springs 261, by pressing downwardly upon the plate 203, serve to depress the arms 201 and carry the roller 200 downwardly into engagement with the upper face of the head 257 of the apron plate 254. The springs 261 serve to equalize the pressure of the feeding

roller 200 upon the apron plate. The swinging frame 91 is provided with an adjustable stop 262 within the path of the upper carriage 137 (see Figs. 2, 7, 8 and 10 to 12) for limiting its forward travel.

The swinging frame 91 is provided at opposite sides with cam plates 263 (see Figs. 1, 3 and 13) each with an arcuate upper cam surface 264. The cam plates 263 are secured to lugs on the frame 91 by screws 265 which pass through vertically elongated slots 266 in the cam plates, and clamp them in different vertically adjusted positions. The arms of a bail 268 extend along the two sides of the frame 91 and are pivoted upon the shaft 179, so as to be free to move vertically upon the shaft independently of the movement of the knife-carrying arm 189. The bail extends forwardly beyond the knife 190 and, the cross arm thereof is adapted to drop forwardly and below the roller 191 (see Figs. 7, 8 and 10 to 12), so as to rest upon the frame 91 and slide thereon forwardly beneath the roller 258 and the head 257 of the apron plate into the position shown in Figure 8 when the upper carriage completes its forward travel. The bail adjacent its pivotal connection to the shaft 179 at each side, is provided with runners 269 (see Figs. 1 and 3) which are adapted to engage with the arcuate cam surfaces 264 of the cam plates 263, when the upper carriage has traveled rearwardly for a short distance, and be cammed upwardly thereby to an extent depending upon the extent of rearward travel of the upper carriage.

Referring particularly to Figs. 1 and 3, a pair of arms 270 are secured to the upper face of the frame base 1 so as to extend forwardly over the rollers 226. A bail-like frame 271 has its arms pivotally connected, by pivot pins 272, to the upper ends of the arms 270. The frame extends rearwardly and mounts a roller 273 extending parallel with the winding spindle 24 upon which the coils are to be wound. An eyelet hook 274 has a shank 275 passing through the space between the arms of the bail-like frame 271, and is provided with a depending hook or nose 276 which is adapted to be received within a recess 277, provided in the upper face of the cross arm of the bail-like frame 271. A helical spring 278 is attached to the shank 275 of the eyelet hook and passes downwardly through the frame base 1 (see Fig. 3) where it is connected to a vertically operating lever (not shown), which controls the operation of the machine. The spring 278 is normally under some tension so as to pull the frame 271 downwardly and yieldingly hold the roller 273 in contact with the surface of the tubular form upon which the coils are wound or upon the successive layers of wire.

When the lever (not shown) is operated to render the machine active, additional tension is supplied to the spring 278, so as to exert considerable pressure through the roller 273 upon the coil being wound, and iron out the same and prevent the formation of wrinkles or loosening of the wires and paper when being wound. When the lever is elevated to stop the machine, the tension of the spring 278 is released somewhat, so that the operator may be able, without considerable exertion, to unhook the eye-hook from the frame 271 and enable the latter to be swung upwardly and forwardly out of contact with the coils. This movement of the frame 271 is necessary when a form with the wound coils thereon is to be removed from the spindle and a new form placed thereon. After the new form has been placed on the winding spindle, the frame 271 is swung rearwardly and downwardly to carry the roller 273 into engagement with the tubular form on the winding spindle, after which the eye-hook is attached to the frame for exerting the desired pressure thereon.

The shaft of the roller 200, immediately adjacent the attachment thereto of one of the arms 201 (see Figure 2), is provided with longitudinally extending ratchet teeth 280, and a spring pawl 281 is secured by screws 282 to the adjacent arm 201 so as to cooperate with the ratchet teeth 280 and permit rotation of the roller 200 only in a direction in which it feeds the paper toward the winding spindle 24. The roller shaft 200 extends beyond the bearings 198, and has a universal connection 283 to a small shaft 284 (see Figures 1 and 4) which is rotatably carried by a lever 285. The lever 285 is pivotally mounted at 286 upon a suitable bearing bracket 287 carried by the bearing 5. A roller 288 is fixed upon the shaft 284 for rotation therewith and is adapted to be carried into frictional driving engagement with an annular groove 289 in the periphery of the driving pulley 3 when the lever 285 is rotated in one direction.

A link 290 is pivotally connected at 291 to the lower end of the lever 285 for oscillating it. The link 290 at its other end is forked with the arms 292 thereof partially embracing the shaft 37 and running in an annular groove 293 of the sleeve 294. The sleeve 294 is mounted upon the clutch element 44 (see Fig. 5) and is clamped against a shoulder 295 thereof by a pair of adjustable nuts 296, which are threaded upon a reduced extension 297 of the clutch element, with a friction washer 298 between them and the sleeve 294. The sleeve 294 will thus be frictionally driven with the clutch element 44, and will slip when sufficient retarding force is applied thereto. A pair of pins 299 are provided in the bottom of the annular groove

293, at nearly but not exactly diametrically opposite points thereto, as shown particularly in Figure 4. These pins will be carried against the ends of the arms 292 of the link 290 alternately when the rotation of the shaft 37 is reversed. When one of the pins 299 is against the arm 292, the other will be spaced by a small annular distance therefrom.

Assuming the parts to be in the position shown in Figure 4, if a reversal of the direction of rotation of the shaft 37 occurs, the lower pin 299 will be carried away from the lower arm 292 of the link 290, and a spring 300 which is connected between the clutch lever 52 and the link 290 (as shown in Figures 1 and 4), will pull the link 290 further towards the shaft 37 and rock the lever 285 sufficiently to carry the roller 288 into driving engagement with the main driving pulley 3. Almost immediately thereafter, however, the upper pin 299 will engage with the end of the upper arm 292 and carry the link 290 in a direction away from the shaft 37 and rock the lever 285 in a direction to carry its roller 288 out of driving engagement with the main driving pulley 3.

Thus, at each reversal in the direction of rotation of the shaft 37, the pulley 288 will, for a short instant only, be in driving engagement with the main driving pulley 3. During this short interval of driving relationship between the pulleys 288 and 3, the roller shaft 200 will be rotated in a direction to carry a cut-section of the paper into feeding relationship with the coil being wound. This feeding movement of the roller 200 is sufficient only to engage the forward edge of the paper beneath the wire being wound upon the rotating form, and thereafter the pinching of the paper between the layers of wire is sufficient to cause the section of paper to be drawn around the form and form a foundation for the new layer of wire.

A block 301 (Fig. 1) of wood or other friction material extends slidably through an aperture in the upper carriage 137 and rides upon the upper face of the guide 134 (Fig. 13) of the carriage. A U-shaped spring clamp 302 is secured to the upper carriage so as to extend over the block 301 and press it yieldingly against the guide 134. This creates friction between the upper carriage and its guide sufficient to hold the upper carriage against displacement from the positions in which it may be disconnected by the lower carriage.

Operation.

In the operation of the device, the handle 34 is depressed to raise the arm 35 from locking engagement with the bearing block 28, whereupon the bearing block may be pulled to the right (Fig. 1) against the tension of the spring 29^a, to carry the bearing

pin 30 from engagement with the spindle 24. The bearing block 29 is then swung forwardly so as to permit the spindle 24 to be withdrawn from chucking engagement with the shaft 4. A tubular form 27 is then placed upon the spindle and the spindle is re-chucked in the shaft 4. If desired, the form may be slid upon the spindle without removing the latter from the driving shaft. The block 29 is then swung rearwardly until the bearing pin 30 becomes aligned with the spindle 24 and the dowel pin 31 on the bearing block becomes aligned with the recess 32 in the small frame 28. Thereupon the block 29 will be pressed forwardly by the spring 29^a, which inserts the bearing pin into the end of the spindle 24. When this occurs, the spring 36, (see Fig. 3) becomes active and carries the arm 35 against the block 29 and locks it in that position.

Several strings of wire are brought from spindles or bobbins over guides 111 and attached to the tubular form which has just been placed upon the winding spindle 24. A continuous sheet of paper is brought from the rear of the machine over the guiding bracket 91^a, as shown particularly in Fig. 7, beneath the bar 150 and the spring fingers 140^a, and between the roller 144 and the U-shaped strip 151 which slides over the plate 146. The paper is then carried forwardly beneath the wire 192 and the roller 191. The pawls 232 and 246 are then operated to release the rod 227, which is then shifted to the right (see Fig. 1) as far as permitted by the adjustable stop 252. It is assumed that the rod 108 carrying the guides 111 is at one end of its reciprocation, ready to start the layer, and that the clutch lever 52 has just been operated to reverse the direction of rotation of the shaft 37.

The machine is then started by operating the suitable lever (not shown) which is disposed underneath the frame base 1, whereupon the belt 2 will drive the pulley 3 and thereby rotate the shaft 4 and the winding spindle. During this rotation the wire will be drawn from the bobbins over the guides and wound around the tubular form on the winding spindle. While this is taking place, the shaft 4 acts through the worm screw 7 and worm wheel 8 to drive the shaft 9, and through it the shaft 37. The shaft 37 is coupled to the shaft 83, and the threaded portion of the shaft 83 will shift the split nut 106 longitudinally thereof. This movement of the split nut 106 will rock the rod 104 and thereby shift endwise, the rod 108 which is connected thereto. As the rod 108 moves endwise, the guides 111 for the wires will be progressively moved along the winding spindle 24, and the wires will be guided progressively to form uniform layers upon the tubular form. This will continue until the pin 105 on the nut 106 reaches one

of the nuts 81 and through it shifts the rod 79 and its attached plate 75 sufficiently to rotate the crank arm 71.

The crank arm 71, in rotating, will move the rod 66 endwise and carry its pawl 65 out of engagement with one of the lugs on the periphery of the cam 15 and into the path of the other lug. Immediately the cam 15 will rotate with the shaft 9 owing to its frictional connection therewith, and in doing so the rod 56 will be shifted in one direction or the other so as to operate the clutch lever 52 and effect an endwise movement of the shaft 37. This endwise movement serves to declutch one of the clutch elements 39 or 44 from its co-operating bevel gear, and effect a clutching engagement between the other clutch element and its co-operating bevel gear. This effects a reversal of the direction of rotation of the shaft 37. The shaft 83 will also have its direction of rotation reversed because of its coupling with the path 37, and consequently the nut 106 will be progressively moved in the opposite direction.

During the formation of the first layer, which preceded the last mentioned reversal of the shaft 37, the shaft 83 will drive the shaft 112 and through it the shaft 116. The bevel gear 117 carried by the shaft 116 will rotate the bevel gear 118. The gear 118 will frictionally drive the shaft 119 and carry the pin 129^b away from the pin 129^a. The crank arm 128 which is carried by the shaft 119, during its first half of a revolution, will operate the link 131, and through it drive the lower carriage forwardly. During its second half of a revolution the crank arm 128 will drive the lower carriage rearwardly. While the lower carriage is moving forwardly, the pin 173 thereof (Figures 7, 8, and 10 to 12) will engage with, and cam itself past, the half round pin 175 which is provided upon the three-arm crank 159 that is rotatably carried by the upper carriage 137. The spring 176 permits rotation of the three-arm crank sufficiently to allow the pin 173 to pass, and then returns the crank to its normal position (shown in Figure 8), with its pin 164 engaging with the pin 165 on the side of the carriage.

During a further increment of forward movement of the lower carriage 133, the rod 168 carried thereby will engage with the pin 167 and push it forwardly. Since the three-arm crank is carried by the upper carriage 137, and the pin 164 thereof abuts against a pin 165 on the upper carriage at one side of the axis of rotation of the crank (see Figure 13), the three-arm crank will act as an abutment, and the upper carriage will be carried forwardly with the lower carriage. During the forward movement of the carriages, the pin 155 on the depending link 154 (see Figure 13) will engage against the

abutment 156 on the frame base 1, and will be swung rearwardly about the pin 155. During further movement in the same direction the pin 157 on the lower carriage will engage with the adjustable pin 158, and since the lower end of the link has already been stopped by the abutment 156, further movement of the lower carriage will cause a rotation of the crank arm 154 which is fixed upon the shaft 139.

Inasmuch as the crank arms 140 are also fixed upon the shaft 139, the arms 140 will be carried forwardly, and in doing so will move the roller 144 and the U-shaped strip 151 forwardly over the plate 146 of the upper carriage, and carry forwardly the strip of paper 149 coming from the supply roll until the advance edge thereof passes over the roller 258 and beneath the roller 200. The springs 145 hold the roller 144 tightly against the U-shaped strip 151, and thus clamp the paper sufficiently to carry it forwardly with the roller 144. The spring pawl 148, by its engagement with the ratchet teeth 147 of the roller 144, prevents rotation of the roller 144 in a direction which would release the paper, so that the roller during this movement serves as a frictional gripping pad for tightly gripping and moving the strip of paper passing between it and the U-shaped strip 151.

During the forward movement of the upper carriage 137, the runners 269 of the bail 268 will ride down the arcuate cams 264 of the cam plates 263 and lower the forward cross arm of the bail below and forwardly of the plate 146 and the roller 258, until it rests upon the upper surface of the guide 134. The bail will then be carried forwardly by the upper carriage 137 into the space beneath the roller 258 and the head 257 of the apron plate 254, until it reaches the position shown in Figures 8 and 10. During the last part of the forward travel of the upper carriage, the runners 269 (Figure 3) will move out of contact with the cam plates 264. Near the completion of the forward movement of the upper carriage, the paper strip 149 is fed beneath the roller 200 and thereupon the roller 200 will be dropped upon the head 257 of the apron plate so as to grip the forward edge of the paper strip and clamp it firmly to the apron plate.

In Figure 8, the upper carriage 137 has been shifted forwardly until it is stopped by the adjustable stop pin 262, and the lower carriage 133 has not as yet entirely completed its forward movement. During this last increment of forward movement of the lower carriage, the rod 168 will be cammed rearwardly against the action of the spring 170, because the three-arm crank 159 carried by the upper carriage cannot move further in a forward direction. At this time the pin 157 has engaged the adjustable pin 158 on

the link 154 which has been carried into engagement with the abutment 156. As the lower carriage continues to move forwardly, the pin 157 thereof will operate the crank 154 and through it the arms 140 to carry the paper feed roller 144 forwardly and feed the paper beneath the other paper feeding roller 200. This last position is shown in Figure 10, with the roller 200 dropped into clamping engagement with the forwardly thrust paper strip.

The crank arm 128 then reverses the movement of the lower carriage and carries it rearwardly. During the first portion of the return movement of the lower carriage, the spring 170 (see Fig. 14) will hold the upper carriage 137 at its forward limit of movement, and the pin 157 on the lower carriage will recede from the link 154 and release the crank arm 153. The spring 195 will then become active, rotate the arms 140 rearwardly, and carry the roller 144 backwardly over the upper surface of the upper carriage. The roller during this movement will freely rotate, because the spring pawl 148 will snap over the ratchet teeth 147 of the roller.

During further rearward movement of the lower carriage, the flat face of the pin 173 will engage with the flat face of the pin 175 of the three-arm crank 159, and since the direction of pull upon the pin 175 will be in a line passing substantially through the axis of rotation of the crank 159, the crank 159 and the upper carriage by which it is supported, will be pulled rearwardly, as shown in Figure 11. When the pin 161 on the crank 159 engages with and rides up the inclined cam 162, the three-arm crank 159 will be rotated about the shaft 139 sufficiently to move the pin 175 thereof out of engagement with the pin 173 of the lower carriage, and thereafter the lower carriage will continue its rearward movement leaving the upper carriage where it was disconnected by the disengagement of the pins 173 and 175. The rotation of the crank 159 by the cam 162, therefore, serves to determine the time at which the carriages will be uncoupled. If the swinging frame 91 carrying the carriages 133 and 137 is elevated to an extent greater than that shown in Figures 7 and 8 for example, the carriages will travel rearwardly for a greater distance together before the pin 161 will engage with and be operated by the inclined cam, and therefore the upper carriage will have made a greater rearward travel. Advantage is taken of this fact for measuring the lengths of paper to be cut off as will be more clearly hereinafter explained.

When the carriages 133 and 137 have both reached the limit of their forward movement, as shown in Figure 10, the follower 213 carried by the plate 203 (see Figures

7, 8, 10 to 12 and 14) will have passed beyond the inner end of the cam rail 209 so as to permit downward movement of the plate 203 by the action of the springs 261 which are under compression between the plate 203 and the arms 218 of the pivoted frame 91. The downward movement of the plate 203 about its pivots 207, pulls downwardly upon the arms 201 and carries the roller 200 into gripping engagement with the forwardly thrust strip of paper. Immediately after the lower carriage 133 starts rearwardly, which will be prior to the rearward movement of the upper carriage as before explained, the follower pin 213 will engage with, and be cammed downwardly by, the beveled end 215 (see Fig. 8) at the rear end of the cam rail 209, and ride along the lower edge of the cam rail. The cam rail, therefore, serves to further depress the plate 203 and exert a greater downward pull upon the arms 201, which in turn transmit this downward pressure to the roller 200, now engaging and clamping the forward thrust strip of paper.

The spring pawl 281 (see Figure 2), by its engagement with the ratchet teeth 280 of the roller 200 will prevent rotation of the roller 200 under the rearward pull on the paper strip caused by the rearward movement of the upper carriage 137. The roller 200 therefore, during this part of the operation acts merely as a frictional clamp for gripping and holding the forward end of the paper strip. The cam rail 209 is capable of moving upwardly about its hinge pin 210, which would release the pressure exerted by the roller 200 upon the forward end of the paper strip, except for the action of the spring 216 which is continually under tension and yieldingly holds the cam rail 209 in its lower position and against the plate 208.

As the upper carriage moves rearwardly, the runners 269 of the measuring bail 268 will engage with the arcuate cam surfaces 264 of the cam plates 263 (see Figure 3), and during further rearward movement of the upper carriage the bail 268 will be cammed upwardly as the runners 269 thereof ride up the arcuate cam surfaces. The cross arm of this bail 268 engages with the under face of the paper strip and carries it upwardly, as shown in Figure 11, so as to draw forwardly a greater portion of the paper strip. The further the upper carriage 137 travels in a rearward direction, the greater will be the upward movement of the bail 268 so as to draw forwardly a greater length of the paper strip.

After the upper carriage has been released or uncoupled from the lower carriage, further drawing of the paper strip will cease, and as the lower carriage con-

tinues to move rearwardly the adjustable stop 187 thereof (see Figure 14) will engage a pin 186 carried by the depending arm of the crank 183. The crank 183 will be rotated by continued rearward movement of the lower carriage, and the pin 184 on its other arm which is riding upon the rail 185 of the upper carriage will depress this rail and the link 182.

The link 182 in moving downwardly, will rotate the crank arms 180 and 181 and through them the shaft 179 which carries the knife-bearing arms 189. The knife 190 will then be carried downwardly against the action of its spring 194 which is connected to the depending arm 193 of the shaft 179. The knife in descending will pass between the wire 192 and the roller 191, and will pierce and sever the paper strip at this point. This relative position of the parts is shown in Figure 12. At this time the pin 129^b on the arm 129 which is driven by the shaft 119, will have engaged with the stop pin 129^a on the swinging frame 91, which holds it against further movement in the same direction.

The bevel gear 118 will continue to rotate by overcoming the friction between it and the friction discs or washers 122 and 126 (see Figure 7). The parts will remain in this condition until the layer of wire upon the tubular form has been completed and a reversal of the direction of rotation of the shaft 37 has been completed. At the instant of reversal of the shaft 37, one of the pins 299 which has been holding the link 290 (see Figure 4) forwardly against the action of the spring 300, will move away from this link, and the spring 300 will quickly move the link 290 rearwardly and rock the lever 285 so as to carry the roller 288 into contact with the groove 289 in the main driving pulley 3. The pulley 288 will be frictionally driven thereby and through its universal connection 283 will drive the roller 200 which has been holding the forwardly thrust strip of paper that is now severed from the main strip.

The rotation of the roller 200 will be in a direction to carry the severed section of paper forwardly and thrust it beneath the wire being wound upon the tubular form. This feeding movement will be only for an instant because the other pin 299 will engage with the link 290 and cam it forwardly so as to carry the pulley 288 out of driving relation with the main driving pulley 3 and discontinue the rotation of the roller 200. This feeding movement of the roller 200, however, is sufficient to carry the paper forwardly until it is caught between the tubular form and the wires being wound thereon, and the engagement between the wire and the form

with the paper will draw the paper forwardly and wind it around the tubular form over the previously placed layer of wire.

The roller 273 will be pressed firmly against the form on the winding spindle by the action of the spring 278 so as to iron out the paper while being wound around the form and cause the wires to lie flat upon the plane sides of the form. By the time that the lower carriage has completed its rearward movement, the follower pin 213 of the plate 203 will have passed from beneath the cam rail 209 so as to release the extreme pressure of the roller 200 upon the paper strip. The follower pin moves upwardly into the path of the beveled end 214 of the cam rail 209.

When the reversal of the shaft 37 is effected, the rotation of the bevel gear 118 will be reversed and will thereupon drive the shaft 119 in the opposite direction. This will carry the pin 129^b away from the stop pin 129^a and the lower carriage will be started forwardly. Promptly the follower pin 213 will be engaged and cammed upwardly by its engagement with the forward beveled end 214 of the cam rail 209 (see Figure 12). This raises the plate 203 and through it the arms 201 and the roller 200. The upward movement of the roller 200 provides a space between it and the apron plate through which the paper strip may be again fed forwardly for a new paper measuring operation.

During the first slight forward movement of the lower carriage, the stop 187 carried thereby will release the crank 183 and through it the link 182. This releases the shaft 179 and the spring 194 (see Figure 14) will thereupon rotate the shaft 179 and carry the knife upwardly above the paper strip into the position shown in Figure 7. During the further forward movement of the lower carriage, the cycle of movements hereinbefore described for the forward movement of the paper strip, its clamping, measuring and severing will be again repeated.

At each reversal of the clutch mechanism by the clutch controlling lever 52, the lever 240 (see Figure 1) which is connected to the rod 73 will be rocked, and will make a complete oscillation for each two reversals of rotation of the shaft 37. During one of these rocking movements of each oscillation, the pawl 246 thereof will engage with the ratchet teeth 230 and move to the left (Figure 1) the rod 227 carrying the roller 229. This movement to the left (Figures 1 and 2) of the roller 229 will cause it to cam upwardly, the pivoted frame 91 which carries the inclined cam plate 222. This elevation of the pivoted frame will elevate the parts carried by it including the three-arm crank

159, and therefore, the pin 161 will be elevated slightly. The carriages will, therefore, remain coupled for a greater distance during their rearward travel before the pin 161 engages with the inclined cam 162 and is operated thereby to uncouple the carriages. This additional rearward movement of the upper carriage causes a greater length of paper to be measured off between the forward edge and the point at which it is severed by the knife. Thus as each two layers are formed upon the tubular form on the winding spindle, the pivoted frame will be elevated to cause greater lengths of paper to be measured off and cut. This is desirable, because as the layers are built up on the tubular form, increasingly greater lengths of paper will be necessary to entirely wrap around the wound layers owing to the increase in the periphery thereof.

The throw of the pawl 246, which determines the degree of elevation of the swinging frame 91, and thereby the length of each strip of paper which will be measured out, cut and wrapped around the tubular form on the winding spindle, may be varied by shifting the pivot of the operating lever 240 (Figs. 1 and 3). This is accomplished by loosening the nut 243 (Fig. 3) and sliding the bolt 237 along the slot 236 in the plate 235. After it has been adjusted to provide the necessary relative ratio between the two arms of the lever 240, the nut may be again tightened so as to secure the head of the bolt 237 against the under face of the plate 235 and prevent its accidental displacement.

By operating the button 101 of the screw rod 100, the bearing sleeve 102 (Figs. 1 and 3) may be adjusted forwardly and rearwardly of the machine so as to change the ratio between the travel of the wire guides 111 and the rate of rotation of the shaft 83 governing the oscillation of the rod 104. The rate of rotation of the shaft 83 is of course proportional to that of the winding spindle. Obviously when using a relatively fine wire, a slower movement of the wire guides 111 in a feeding direction will be desired for a given rate of rotation of the winding spindle and the shaft 83, than when a coarser wire is to be wound into coils.

The length of the layers being wound may be varied by operating the button 80 to shift the nuts 81 on the threaded rod 79 toward or from one another. This determines the extent of operation of the machine between reversals of direction of rotation of the shaft 83.

In some instances, it is desirable that at the end of each layer, the wires be given a rapid change in direction of feed so as to prevent them from piling up on one another, while the reversal is taking place.

To obtain this effect with this machine, the sleeve 96 (Figs. 1 and 5) may be adjusted along the collar 49 so as to couple the shafts 37 and 83 together for concomitant endwise, as well as rotary, movement. The stop 94 (see Fig. 1) will also be withdrawn slightly from the shaft 83 so as to allow the latter to move endwise to a limited extent. At each reversal of the direction of rotation of the shaft 37, the latter will be given an endwise movement, and this endwise movement will be imparted to the shaft 83 and cause a rocking of the rod 104. The rod 104 shifts the rod 108 which carries the wire guides, thereby giving the wires a rapid but limited lateral movement. Since this reversal of the shaft 37 occurs at the end of each layer it will be observed that the endwise movement of the shaft 83 at this time will produce the necessary rapid change in the direction of movement of the rod 108 and the wire guides 111 which are carried thereby.

After the coil has been completely wound in this manner, the machine is stopped, and the wires leading to the coils are broken and secured against unwinding in any suitable manner. The eye hook 274 (Figs. 1 and 3) is then lifted against the tension of the spring 278 so as to release the frame 271 which may then be swung upwardly and forwardly and away from the coils. The lever 34 is then operated to release the bearing block 29, which is pulled to the right in Fig. 1 and then swung forwardly to release the winding spindle. The tubular form with the coils thereon is then slid endwise from the winding spindle, and a new tubular form placed upon the spindle and secured by tightening the washer 25 by the screw 26. The pawls 232 and 246 are then operated, by bringing the pins 250 and 251 together, to release the rod 227 which is then operated to the right (Fig. 1) against the adjustable stop 252 which lowers the frame 91 and sets the machine for cutting off the shorter lengths of paper which are to be inserted between the first layers of the coils. The operation of winding new coils proceeds as heretofore explained.

If it is desired to swing the frame 91 upwardly so as to provide access to the mechanism carried upon the under side thereof, it will be necessary to disconnect the roller 200 from the driving roller 288 (Figure 1). To permit this, the universal connection 283, which is shown in Figure 1 for connecting the shaft of the roller 200 and the shaft 284, is composed of two telescopic tubular links which may be pulled apart as the frame is swung upwardly. When the frame 91 is lowered into operative position, the tubular links may be placed in telescopic relationship for restoring the driving connection from the pulley 288 to the feed roller 200.

It is desirable that the movements of the

carriage for effecting the measuring, cutting, and spacing of the strips of paper be accomplished as slowly as possible, in order to avoid undue strain upon the mechanism, but they must be accomplished within the period between reversals of the shaft 37. It may be necessary in some instances to replace the gears 114 and 115 by gears of a different relative ratio, so that the bevel gear 118 will be driven at a rate sufficiently rapid to accomplish the operations of the carriage within the time required between reversals.

The variation in the lengths of paper to be cut off at each time, may also be varied to some extent by operating the screws 225 (Figures 1 and 2) so as to vary the angle of inclination of the cam plate 222. By decreasing the angle of inclination of the cam plate 222 the changes in the lengths of paper to be cut will be decreased because the frame 91 will be elevated to a less extent for each throw of the pawl 246.

It has been found that with a machine constructed in accordance with this invention, the paper will always be accurately measured and fed forwardly uniformly without twisting, creasing, tearing, folding, wrinkling or skewing of the paper, and the machine will operate for long periods of time at a rapid rate without special attention. Such a machine may also be successfully operated by relatively unskilled labor, and may be adjusted to meet a wide range of variations in the product to be produced.

It will be obvious that various changes in the details and arrangements of the parts, herein described and illustrated for the purposes of explaining the nature of the invention, may be made by those skilled in the art without departing from the principle and scope of the invention as expressed in the appended claims.

I claim:—

1. In a winding machine, a rotary winding spindle, means for guiding a wire, thread or filament thereto to form thereon successive overlying layers, a friction roller and an apron extending parallel with the winding spindle, means for moving said roller into and out of contact with said apron, means operative at intervals for inserting strips of sheet material between said roller and apron when the latter are separated so as to be clamped between them when the roller is moved into contact with the apron, a rotary driving connection between the spindle and said friction roller adapted to be rendered active or inactive, whereby when active the roller may be rotated concomitantly with the spindle, and means operative automatically after each layer has been wound on the spindle to render effective the connection between the roller and the spindle rotating means, whereby the roller will be rotated to feed the clamped

strip of sheet material to the spindle and beneath the wire, thread or filament, so as to be wound around the previously formed layer and serve as a foundation for the succeeding layer.

2. In a winding machine, a rotary winding spindle, means for guiding a thread, wire or filament thereto to form successive overlying layers thereon, means including a friction roller for receiving strips of sheet material, and feeding them to the spindle when the roller is rotated, and means normally inactive and rendered operative automatically after each layer of the thread, wire or filament has been wound on the spindle for causing rotation of the roller to feed one of the strips to the spindle and beneath the thread, wire, or filament so as to be wound around the previously formed layer and serve as a dividing foundation for the succeeding layer.

3. In a winding machine, a rotary winding spindle, a reciprocating guide device for guiding a wire or thread to the spindle to form successive overlying layers thereon, means for reciprocating said device, means including a friction roller for receiving strips of sheet material and when the roller is rotated for feeding them to the spindle, and automatic means normally inactive and rendered operative at the changes in direction of movement of the said reciprocating device at the ends of the layers for rotating the roller to feed one of the strips to the spindle and beneath the wire or thread so as to be wound around the previously formed layers and serve as a division between them and the succeeding layers.

4. In a winding machine, a rotary winding spindle, means for guiding a thread, wire or filament thereto to form successive overlying layers thereon, means including a friction roller for receiving strips of sheet material, and feeding them to the spindle when the roller is rotated, means operative automatically after each layer of the thread, wire or filament has been wound on the spindle for rotating the roller to feed one of the strips to the spindle and beneath the thread, wire, or filament so as to be wound around the previously formed layer and serve as a dividing foundation for the succeeding layer, and independently adjustable means for applying yielding pressure to the friction roller at a plurality of points in a strip gripping direction, whereby the pressure of the roller on the strip may be distributed along its length in a manner such that the strip will be fed evenly to the spindle.

5. In a winding machine, a rotary winding spindle, a reciprocating guide device for guiding a wire or thread to the spindle to form successive overlying layers thereon, means for reciprocating said device, means

including a friction roller for receiving strips of sheet material, and when the roller is rotated for feeding them to the spindle, automatic means operable at the changes in direction of movement of the said reciprocating device at the ends of the layers for rotating the roller to feed one of the strips to the spindle and beneath the wire or thread so as to be wound around the previously formed layers and serve as a division between them and the succeeding layers, and independently adjustable means for applying yielding pressure to the friction roller at a plurality of points, in a strip gripping direction, whereby the pressure of the roller on the strip may be distributed along its length in a manner such that the strip will be fed evenly to the spindle.

6. In a winding machine, a rotary winding spindle, means for guiding a wire or thread thereto to form successive overlying layers thereon, two parts one of which is a friction roller, having relative movement toward and from one another, means yieldingly urging said parts toward one another, means for presenting a strip of sheet material between said parts to be gripped and held between them, means controlled by the presenting means during its strip presenting movement for producing a separation of the said parts to receive the strip and then releasing them to clamp the strip therebetween, means preventing rotation of the roller in a direction permitting withdrawal of the strip from the side on which the strip is presented to the roller, said presenting means being also operable for measuring and cutting the strip to the desired length while so clamped, and automatic means operative at the end of a layer for rotating the roller to feed the strip to the winding spindle.

7. In a winding machine, a rotary winding spindle, means for guiding a wire or thread thereto to form successive overlying layers thereon, two parts, one of which is a friction roller, having relative movement toward and from one another, means yieldingly urging said parts toward one another, means for presenting a strip of sheet material between said parts to be gripped and held between them, means controlled by the presenting means during its strip presenting movement for producing a separation of the said parts to receive the strip, and then releasing them to clamp the strip therebetween, means preventing rotation of the roller in a direction permitting withdrawal of the strip from the side on which the strip is presented to the roller, said presenting means being also operable for measuring and cutting the strip to the desired length while so clamped, and means operable by said strip presenting means during the measuring and cutting operation

for increasing the clamping pressure of the roller upon the strip.

8. In a winding machine, a rotary winding spindle, means for guiding a wire or thread to the spindle to form successive overlying layers thereon, a frame, means for clamping a strip of sheet material and feeding it to the spindle to be wound therearound between two successive layers, means movable on the frame in one direction for presenting a continuous strip of the sheet material to the clamping means, and then in the opposite direction for measuring and cutting off a section of the strip to be fed to the spindle, means carried by said movable means and including a bar which extends across one face of the strip and is operable to draw the strip in a feeding direction when the forward edge is clamped by the clamping and feeding means, and cooperating means carried by the frame and the means which is carried by the movable means for operating the bar to draw the strip to a greater extent than provided by the movable means during a measuring and cutting movement.

9. In a winding machine, a rotary winding spindle, means for guiding a wire, thread or filament thereto to form thereon successive overlying layers, a friction roller and an apron extending parallel with the winding spindle, means for producing relative approach and separation of the apron and roller, means operative at intervals for inserting strips of sheet material between said roller and apron when the latter are separated so as to be clamped between them when the roller and apron are brought into contact with one another, a rotary driving connection between the spindle and said friction roller adapted to be rendered active or inactive, whereby when active the roller may be rotated concomitantly with the spindle, and means operative automatically after each layer has been wound on the spindle to render effective the connection between the roller and the spindle rotating means, whereby the roller will be rotated to feed the clamped strip of sheet material to the spindle and beneath the wire, thread or filament, so as to be wound around the previously formed layer and serve as a foundation for the succeeding layer.

10. In a winding machine of the type in which strips of sheet material are inserted between successive layers of a coil being wound, means including a friction roller for receiving the strips of sheet material and feeding them to the coil, mechanism for rendering the said means active to insert a strip of the sheet material between successive layers, and independently adjustable means for applying yielding pressure

to the roller in a strip gripping direction at a plurality of points spaced along the length of the roller, whereby the pressure of the roller on the strip may be distributed along its length in a manner such that the strip will be fed evenly to the spindle.

11. In a winding machine of the type in which strips of sheet material are inserted between successive layers of a coil, feeding means for the strips comprising two members between which the strips may be fed when the members are separated and clamped when the members are brought together, adjustable means acting upon said members at a plurality of spaced points along the length of the same for applying variable yielding pressure between the members, whereby the strip of sheet material may be uniformly clamped from side to side, and means for rendering said feeding means active to insert a clamped strip between successive layers.

12. In a winding machine of the type in which a thread-like element is wound in successive superimposed layers upon a form, means including a rotating roller for feeding a strip of sheet material to the coil being wound to form a partition between two successive layers, and means for applying variable yielding pressure to the roller at a plurality of spaced points along its length, whereby the feeding action of the roller upon the strip may be made uniform.

13. In a winding machine of the type in which a strip of sheet material is inserted between successive superimposed layers of a coil being wound, strip advancing means comprising a friction roller and a member against which the roller may be pressed, means for yieldingly pressing the roller and member toward one another to grip the strip which passes between them, means for preventing rotation of the roller in a direction which would prevent retraction of the strip therefrom but permitting rotation in the opposite direction to allow advance of the strip relatively to the roller and means for translating the roller and member together to advance the strip.

14. In a winding machine of the type in which a strip of sheet material is inserted between successive superimposed layers of a coil being wound, a surface over which the strip is to be advanced, a friction roller extending parallel to and yieldingly pressed toward said surface, and mounted for translation over the said surface, a member riding upon said surface between it and the roller and connected to the roller for translation with it, while permitting movement of the roller toward and from said surface, the roller and member gripping the strip which passes between them, means for preventing rotation of the roller in a direction which

would permit retraction of the strip therefrom but permitting rotation in the opposite direction to allow advance of the strip relatively to the roller and means for translating the roller and member together over said surface to advance the strip.

15. In a winding machine of the type in which a strip of sheet material is inserted between successive superimposed layers of a coil being wound, a surface over which the strip is to be advanced, a friction roller, means for mounting said roller for rotation about its axis and parallel to and above the said surface, said mounting means permitting movement of the roller toward and from said surface, means constantly and yieldingly urging said roller toward said surface, said mounting means being capable of movement to translate the roller across the said surface in a strip advancing direction, a U-shaped member slidable over said surface beneath the roller and having its arms slotted to embrace the roller shaft whereby said member and roller will be translated together by said mounting means and said roller can move toward and from said surface independently of said member, the roller and member gripping the strip which passes between them, means for preventing rotation of the roller about its axis in a direction which would permit retraction of the strip therefrom, but permitting rotation in the opposite direction to allow advance of the strip relatively to the roller, and means for operating said mounting means to cause an advance of the strip.

16. In a winding machine, a winding spindle, a device for guiding a thread-like element to the spindle to be wound thereon, means for moving said device alternately in opposite directions endwise of the spindle for forming superimposed layers of the element thereon, means including a rotary friction roller for advancing a strip of sheet material to the spindle to be wound around the same between layers of the element, means for rotating the spindle, a driving connection between said spindle rotating means and the friction roller adapted to be made effective or ineffective, and means effective at each reversal in the direction of movement of the guide device for rendering the driving connection of the roller active to feed the strip to the spindle sufficiently far to be caught between the spindle and element and wound around the spindle, and for then rendering the driving connection of the roller ineffective.

17. In a winding machine, a winding spindle, a rotatable shaft, means for rotating the shaft alternately in opposite directions, means operated by the shaft for guiding the element, to be wound to the spindle so as to form superimposed layers there-

on of the element, each reversal of rotation of the shaft causing a start of a new layer, means for effecting a reversal of the shaft at the end of each layer, means for feeding a strip of sheet material to the spindle to be wound thereon between layers, a member frictionally rotated by the shaft and having peripherally spaced abutments, means for controlling the activity of said strip feeding means including a controlling member having walls adapted to be engaged by said abutments alternately at each reversal of the shaft whereby the controlling member will hold the first member against rotation with the shaft and be released momentarily at each reversal of the shaft as one of the abutments moves away from the controlling member and before the other engages and returns the controlling member, and a spring for yieldingly holding the controlling member against the abutments and through them holding the first member against rotation with the shaft in the interval between reversals, said spring serving to operate the controlling member and effect an operation of the strip feeding means when said controlling member is released at each reversal.

18. In a winding machine, a winding spindle, means for rotating said spindle, a shaft, a driving connection between said shaft and means permitting reversal of the direction of rotation of said shaft, means operated by the shaft for guiding to the spindle in superimposed layers an element to be wound, means including a rotary friction roller for feeding a strip of sheet material to the spindle to be wound thereon between layers, a member frictionally driven by the shaft and having two abutments spaced apart approximately diametrically, a controlling member having a forked end embracing said first member with walls on the fork arms adapted to be engaged and cammed by said abutments alternately at the reversals of rotation of the shaft, a spring device connected to said controlling member for yieldingly holding it against one or the other of the abutments and operating it when it is released by one of the abutments and before the other abutment engages and operates it in the other direction, and means including a friction pulley for rotating said friction roller and connected to said controlling member for operation thereby to carry the friction pulley into and out of driving engagement with said spindle rotating means, whereby when the controlling member is released by said abutments and operated by the spring, the friction pulley will be carried into driving engagement with the spindle rotating means to effect a rotation of the friction roller and resultant feeding of the strip of

sheet material, the operation of the controlling member in the opposite direction by the abutments serving to carry the friction pulley out of engagement with the spindle rotating means.

19. In a winding machine, a winding spindle, means for rotating said spindle, a threaded shaft mounted for rotation and limited endwise movement, a device for guiding the element to be wound to said spindle, said device being movable in a direction endwise of the spindle, means including a nut follower for said threaded shaft for shifting the said guide device progressively in one direction or the other dependent upon the direction of rotation of the shaft, means for rotating said threaded shaft including mechanism for reversing the direction of rotation of the shaft, and a connection between the threaded shaft and said mechanism whereby when the mechanism is operated to reverse the direction of rotation of the shaft and thus reverse the direction of travel of the guide device, the shaft will be given an endwise movement concomitantly with the change in its direction of rotation in order to prevent piling up of the element at the ends of the layers wound upon the spindle, said connection being disconnectable whereby the endwise movement of the threaded shaft with the reversing mechanism may be prevented.

20. In a winding machine, a winding spindle, means for rotating said spindle, a threaded shaft mounted for rotation and limited endwise movement, a device for guiding the element to be wound to said spindle, said device being movable in a direction endwise of the spindle, means including a nut follower for said threaded shaft for shifting the said guide device progressively in one direction or the other dependent upon the direction of rotation of the shaft, a second shaft aligned with the threaded shaft and coupled thereto for rotation together while permitting independent endwise movements of said shafts, reversing clutch mechanism whereby the second shaft will be driven in one direction or the other dependent upon its endwise positions, and means for shifting the second shaft endwise to effect a change in its direction of rotation and through it effect a change in the direction of travel of the guide device.

21. In a winding machine, a winding spindle, means for rotating said spindle, a threaded shaft mounted for rotation and limited endwise movement, a device for guiding the element to be wound to said spindle, said device being movable in a direction endwise of the spindle, means including a nut follower for said threaded shaft for shifting the said guide device pro-

gressively in one direction or the other dependent upon the direction of rotation of the shaft, a second shaft aligned with the threaded shaft and coupled thereto for rotation together while permitting independent endwise movements of said shafts, reversing clutch mechanism whereby the second shaft will be driven in one direction or the other dependent upon its endwise position, means for shifting the second shaft endwise to effect a change in its direction of rotation, and through it effect a change in the direction of travel of the guide device, and means for coupling the second shaft and threaded shaft for concomitant endwise movement whereby at each reversal of the direction of travel of the guide device, the endwise movement of the threaded shaft will amplify the movement of the guide device and cause a coarser spiralling of the element at the ends of the layers.

22. In a winding machine, a winding spindle, means for rotating said spindle, a threaded shaft mounted for rotation and limited endwise movement, a device for guiding the element to be wound to said spindle, said device being movable in a direction endwise of the spindle, means including a nut follower for said threaded shaft for shifting the said guide device progressively in one direction or the other dependent upon the direction of rotation of the shaft, a second shaft aligned with the threaded shaft and coupled thereto for rotation together while permitting independent endwise movements of said shafts, reversing clutch mechanism whereby the second shaft will be driven in one direction or the other dependent upon its endwise position, means for shifting the second shaft endwise to effect a change in its direction of rotation and through it effect a change in the direction of travel of the guide device, and adjustable means operable to effect an operation of the reversing clutch mechanism at selected points in the travel of the guide device.

23. In a winding machine, a winding spindle, means for rotating said spindle, a threaded shaft mounted for rotation and limited endwise movement, a device for guiding the element to be wound to said spindle, said device being movable in a direction endwise of the spindle, means including a nut follower for said threaded shaft for shifting the said guide device progressively in one direction or the other dependent upon the direction of rotation of the shaft, a second shaft aligned with the threaded shaft and coupled thereto for rotation together while permitting independent endwise movement of said shafts, reversing clutch mechanism whereby the second shaft will be driven in one direction or the other dependent upon its endwise posi-

tion, means for shifting the second shaft
endwise to effect a change in its direction of
rotation and through it effect a change in
the direction of travel of the guide device,
5 means for coupling the second shaft and
threaded shaft for concomitant endwise
movement whereby at each reversal of the
direction of travel of the guide device, the
endwise movement of the threaded shaft will
amplify the movement of the guide device 10
and cause a coarser spiralling of the element
at the ends of the layers, and adjustable
means operable to effect an operation of the
reversing clutch mechanism at selected
points in the travel of the guide device. 15

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BERNARD F. JOHNSON.