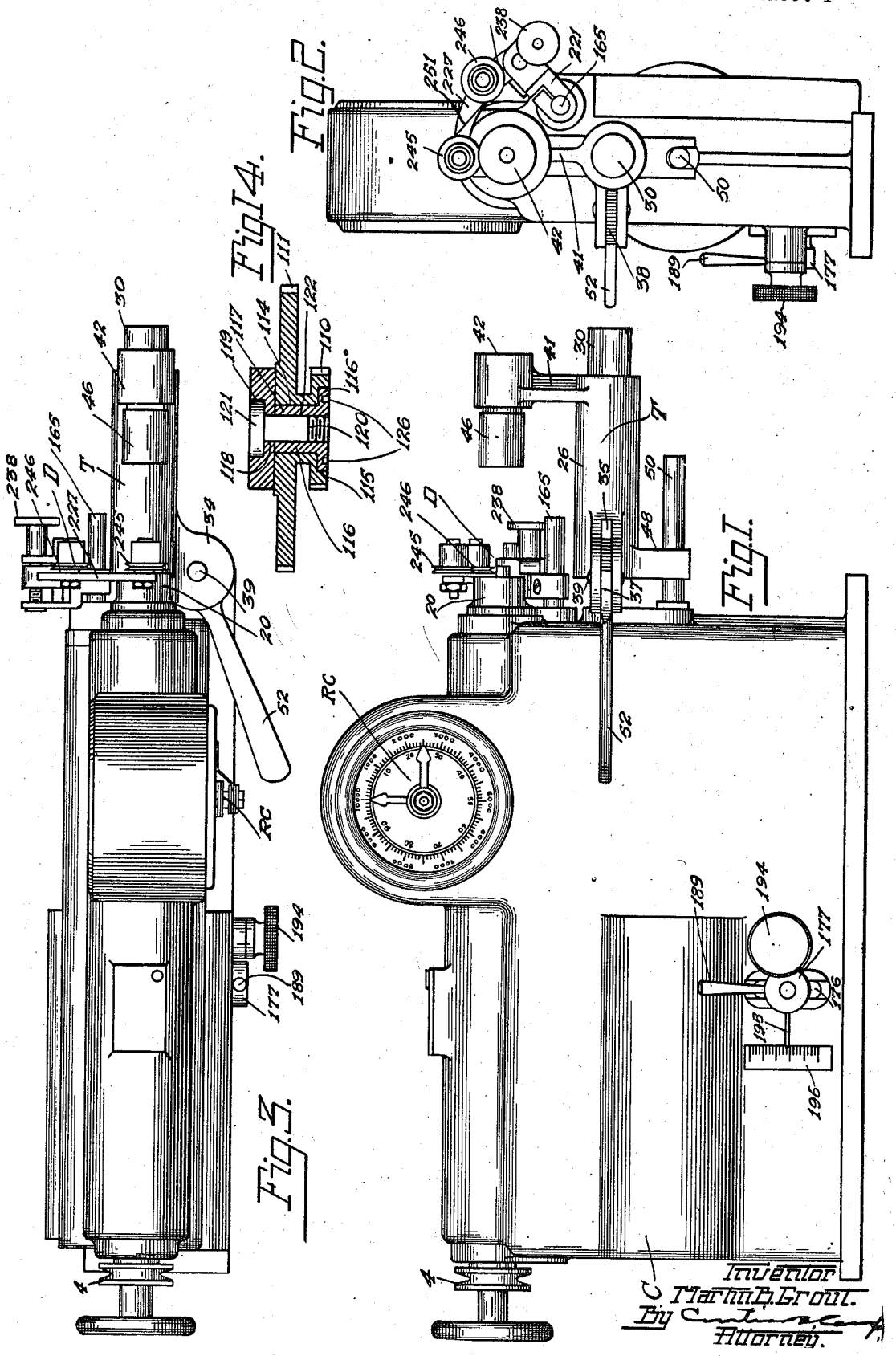
Dec. 14, 1926. 1,610,281

M. B. GROUT

WINDING MACHINE

Filed July 17, 1925 4 Sheets-Sheet 1



Dec. 14, 1926. 1,610,281

M. B. GROUT

WINDING MACHINE

Filed July 17, 1925 4 Sheets-Sheet 2

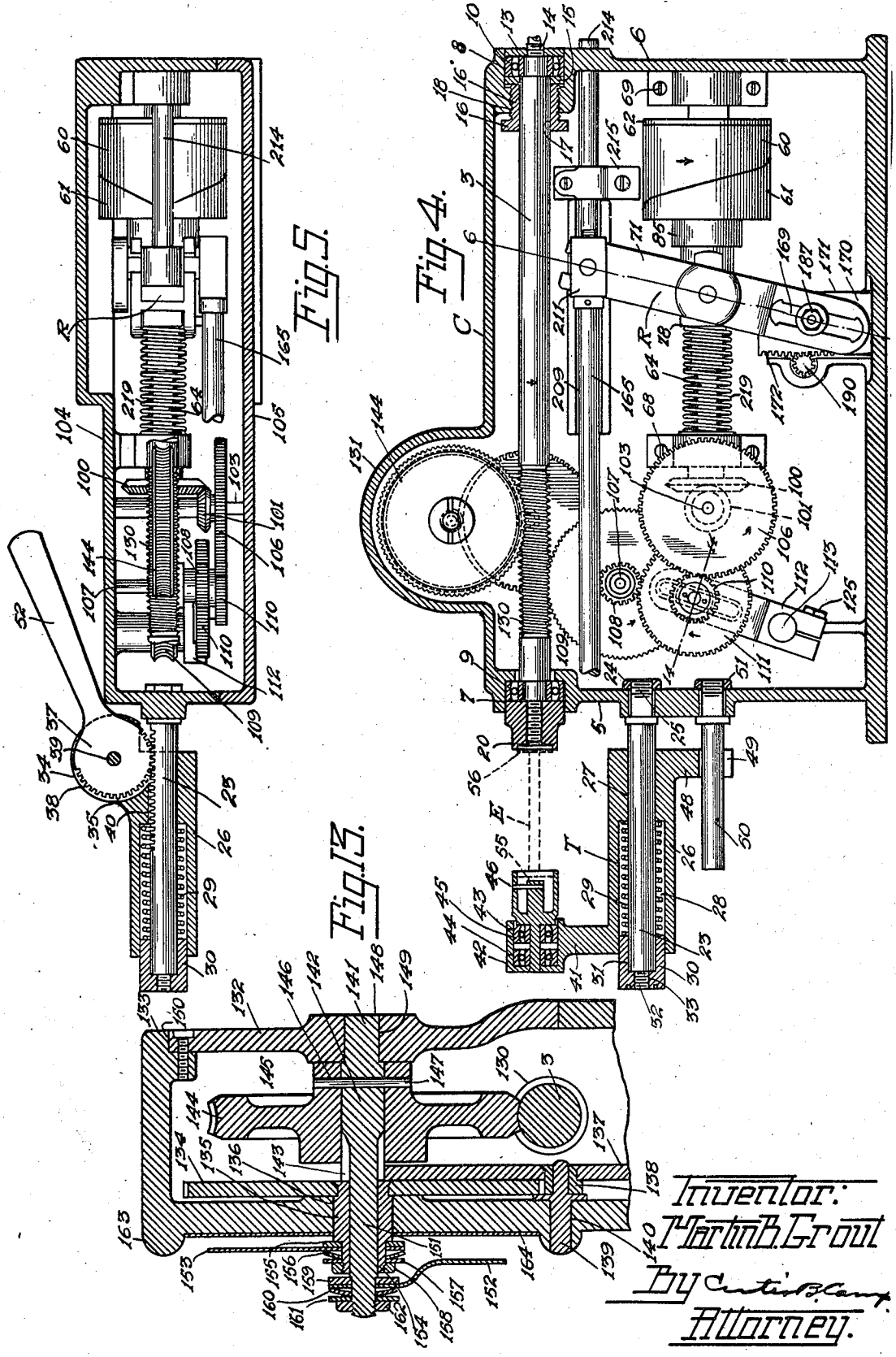


Fig. 5.

Fig. 4.

Fig. 13.

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M. B. GROUT

WINDING MACHINE

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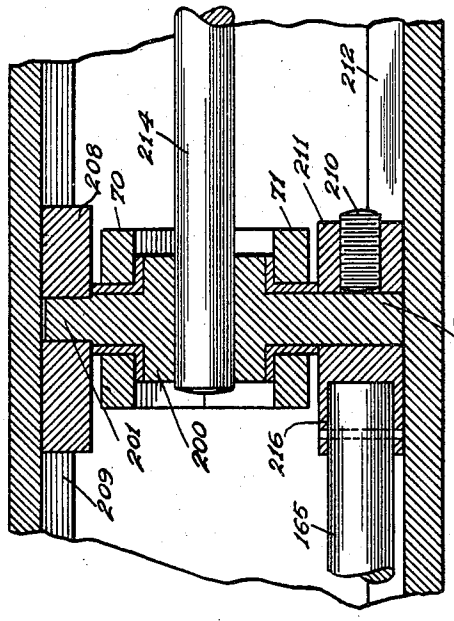

Fig. 7

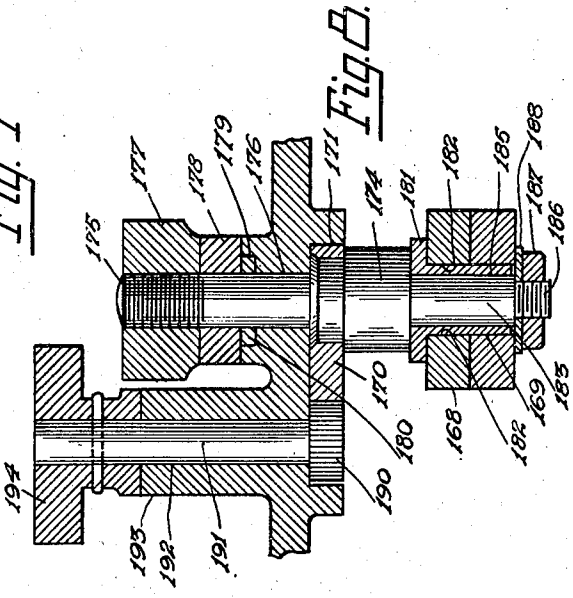

Fig. 8.

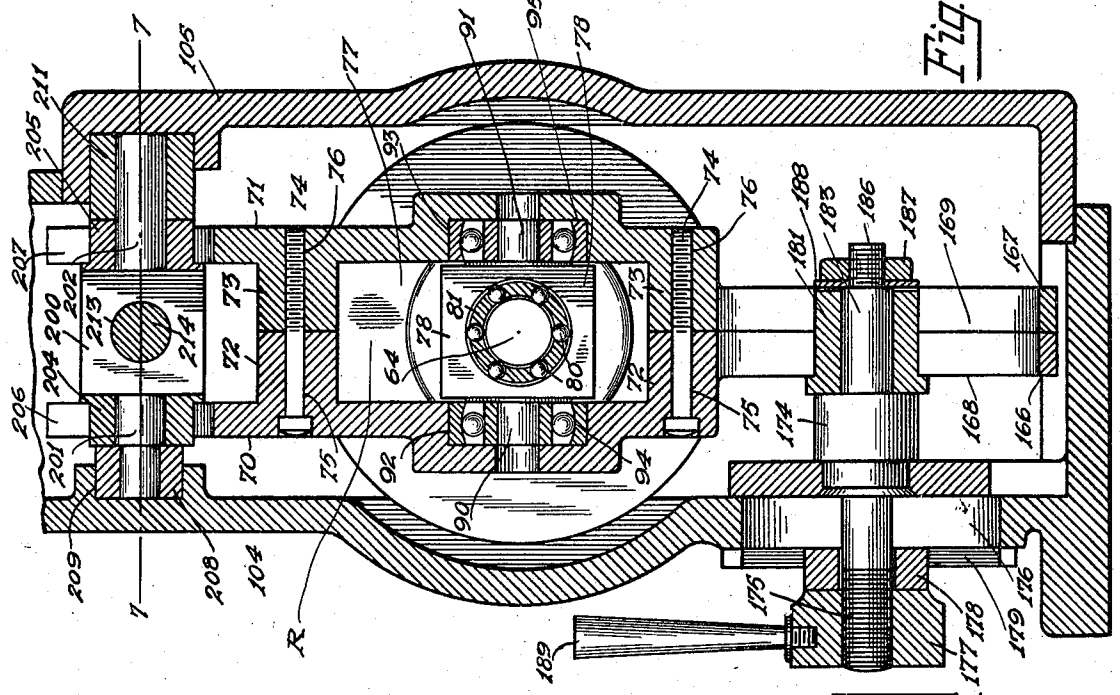

Fig. 6.

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M. B. GROUT

WINDING MACHINE

Filed July 17, 1925 4 Sheets-Sheet 4

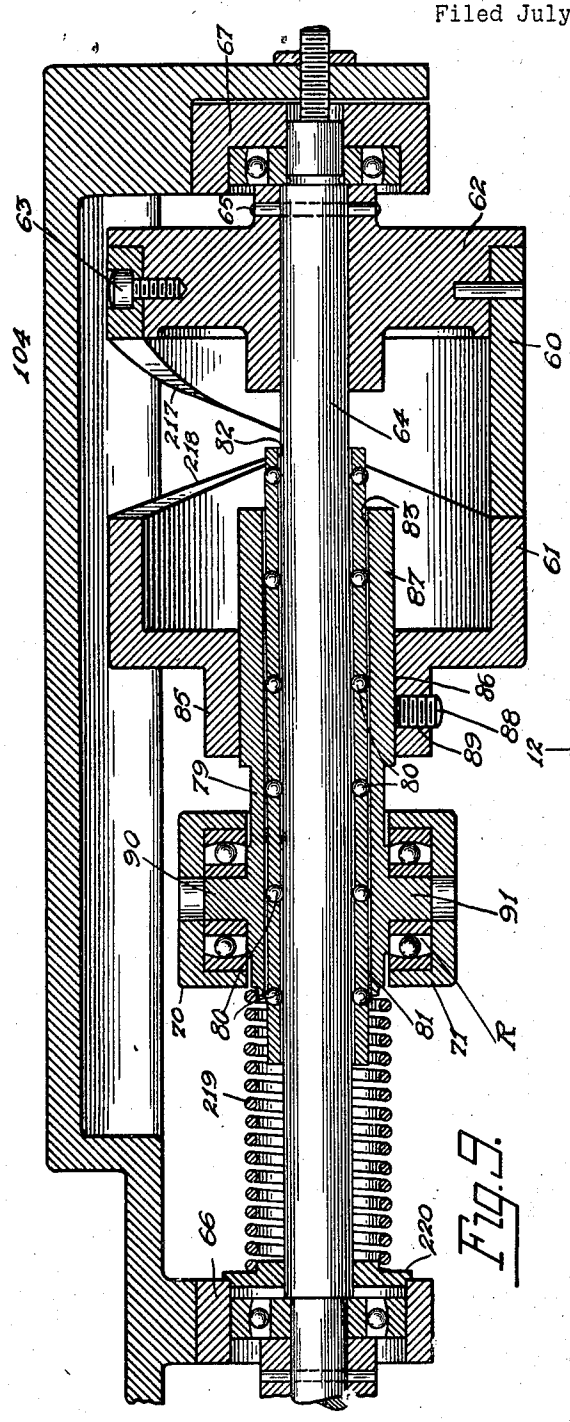

Fig. 9.

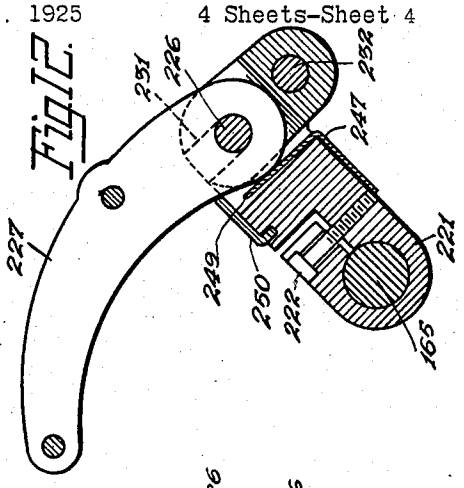

Fig. 12.

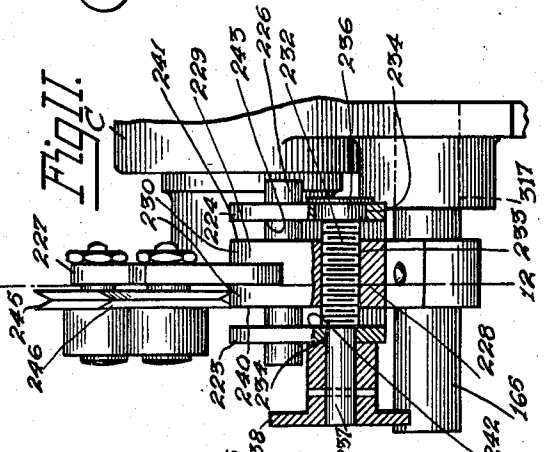

Fig. 11.

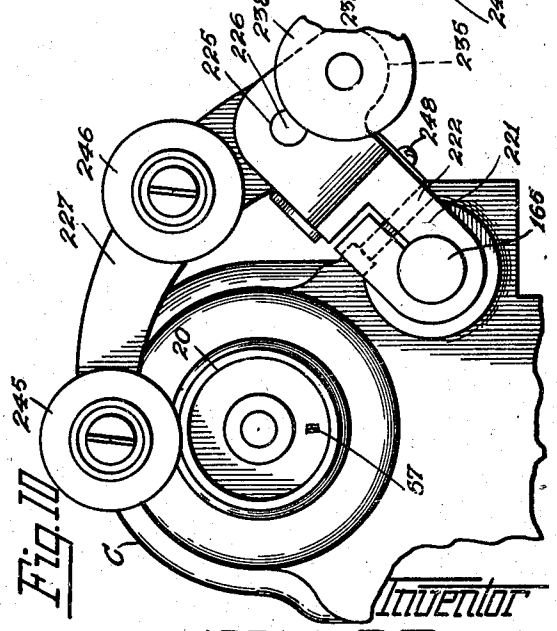

Fig. 10.

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Patented Dec. 14, 1926. 1,610,281

UNITED STATES PATENT OFFICE.

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WINDING MACHINE.

Application filed July 17, 1925. Serial No. 44,160.

My invention relates to winding machines which are used for winding a material, such as a strand of wire, into electromagnet coils, and has to do more particularly with a coil winding machine such as is used in the winding of conducting material upon a suitable spool to serve as a winding for an electromagnet, and an object of my invention is to provide a machine of the above type which is simple in construction, and by which the work of winding an electromagnet coil may be done in a rapid, efficient and economical manner.

A winding machine of the above type is provided with a distributing arm secured to a reciprocating shaft which distributes the wire from a source of supply from left to right, and vice versa, and this movement of the reciprocating shaft is controlled by suitable mechanism to place the required number of convolutions on the spool which is supported on the rotatable winding spindle.

A feature of my invention is the provision of a novel cam arrangement in association with a reciprocating shaft and suitable gearing mechanism, which accomplishes the to and fro movement of the reciprocating shaft which carries the distributing arm from left to right and vice versa, to place a predetermined number of convolutions of wire on the spool supported by the winding spindle.

Another feature of my invention is the provision of a sliding member which pivotally supports a rocker arm and also has secured thereto one of the cam members and which as a whole is slidably supported on a shaft to which the other of said cam members is secured. Through the medium of a train of gearing the shaft and its cam member is rotated to cause the sliding member and its secured cam member to slide along the shaft to bring about the rocking of the rocker arm to which the reciprocating shaft is connected to bring about its to and fro movement.

Another feature of my invention is the provision of adjustable means associated with the rocker arm which provides means whereby the angle of tilt of the rocker arm may be changed to increase or decrease the distance of travel of the reciprocating shaft from left to right and vice versa to permit the winding machine of my invention to wind electromagnet coils of varying lengths.

Another feature of my invention is the provision of adjustable means for the distributing arm which is secured to the reciprocating shaft so that the distributing arm may be moved to the right or left independent of the reciprocating shaft so as to permit the distributing arm to be placed in alignment with the spool secured to the winding spindle.

Still another feature of my invention is the provision of a tail stock which is associated with a supporting head suitably secured to the rotating spindle. The tail stock is slidably supported by a rod and its movement is controlled by a lever which through the medium of a toothed rack on the supporting rod and teeth on an operating lever causes the tail stock to slide along the rod when the lever is moved, to permit the insertion of an electromagnet spool between the supporting head and a rotatable head of the tail stock. The return movement of the tail stock is under the influence of a spring which is compressed when the tail stock is moved to insert an electromagnet spool and returns the tail stock to clamp the spool when the lever is released to clamp the spool between the rotatable head of the tail stock and the supporting head on the winding spindle.

The above features of my invention, as well as others, will be more fully hereinafter described, and for a more complete understanding of my invention reference may be had to the accompanying drawings in which like reference characters in the several views denote like parts, and in which:

Fig. 1 is a front elevation of the winding machine of my invention illustrating the distributing arm in its extreme left position;

Fig. 2 is a right side elevation of the winding machine;

Fig. 3 is a plan view of Fig. 1;

Fig. 4 is a rear view of Fig. 1 with the cover plate removed and parts in section to more clearly illustrate the interior mechanism;

Fig. 5 is a sectional view of the winding machine looking down into the interior of the enclosing casing in section to illustrate another view of the mechanism;

Fig. 6 is a sectional view along the line 6—6 of Fig. 4 clearly illustrating the rocker arm and its associated parts;

Fig. 7 is a sectional view along the line 7—7 of Fig. 6 to clearly illustrate another view of the rocker arm and its parts;

Fig. 8 is a fragmentary sectional view illustrating the adjusting means in association with the rocker arm;

Fig. 9 is a fragmentary sectional view of the cam supporting shaft and its associated parts;

Fig. 10 is a side elevation of the distributing arm and its associated parts;

Fig. 11 is a right side view of Fig. 10 with parts broken in section to more clearly illustrate the construction of the distributing arm;

Fig. 12 is a sectional view along the line 12—12 of Fig. 11.

Fig. 13 is a partial sectional view of the revolution counter to clearly illustrate its construction, and

Fig. 14 is a sectional view along the line 14—14 of Fig. 4.

Referring now more in detail to my invention as illustrated in the accompanying drawings, the winding machine comprises a suitable enclosing casing or housing C which encloses the mechanism of the winding machine of my invention.

A spindle shaft 3 has secured thereto a pulley wheel 4 which is connected to a power shaft through the agency of a suitable belt, the said power shaft being in turn connected to a suitable starting and stopping means, and, as the power transmission for starting the spindle shaft 3 forms no part of my invention it is not shown in the drawings. The ends 5 and 6 of the housing C are provided with counter bores 7 and 8 through which the spindle shaft 3 extends, and ball bearings 9 and 10 are provided which rest in the counter bores 7 and 8 in the ends 5 and 6 of the housing C, and rotatably support the spindle shaft 3. A lock nut 13 is provided which has screw threaded engagement with the reduced threaded portion 14 of the spindle shaft 3, and a collar 15 fits loosely on the shaft 3, which rests in the counter bore 8. An adjustable member 16 provided with a central orifice 17 is slipped on the spindle shaft 3, and its extended body portion 16′ is threaded and is adapted to have threaded engagement with a suitable tapped orifice 18 in the housing C. The lock nut 13, when threaded in position on the shaft 3 engages the ball race of the ball bearing 10, and the adjustable member 16 engages the collar 15 and moves the same into engagement with the ball race of the ball bearing 10 and the lock nut 13 and collar 15 retain the ball bearing 10, in the counter bore 8. The adjustable member 16 engages the collar 15 and through the agency of this loose collar 15, any lateral movement of the spindle shaft 3 may be taken up. A spool head support 20 is provided with a tapped orifice which has threaded engagement with the threaded end 21 of the spindle shaft 3, and the support 20 when in position engages the ball bearing 9 and retains it in position in the counter bore 7.

The spool head support 20 which forms one of the supports for the electromagnet spool to be wound is associated with a tail stock T which is slidably supported on a rod 23 secured to the housing C by means of a nut 24 which has threaded engagement with the protruding threaded end 25 of the rod 23. The tail stock T comprises a cylindrical body 26 which is provided with a central orifice 27 extending a portion of its length of a size to receive the rod 23. An enlarged orifice 28 extending into the body portion 26 a portion of its length receives a spring 29 which is slipped over the rod 23. A plug 30 provided with a central orifice 31 of a size to receive the rod 23 and a reduced threaded orifice 33 which is adapted to receive the threaded end 32 of the rod 23 to secure the same thereto. The plug 30 is of a size to permit entrance of the spring 29 into the orifice 28, and when in position serves to retain the spring 29 under compression and also serves as a bearing when the body 26 of the tail stock T is moved along the rod 23 as will presently be described.

The tail stock T is provided with circular shaped laterally extended portion 34 integrally formed with the body 26 and is provided with a slot 35 which extends into the orifice 27 which receives the rod 23. A disk 37 provided with teeth 38 around a portion of its peripheral face is pivotally secured in the slot 37 of the extended portion 34 by means of a pivot pin 39 and mesh with a toothed rack 40 cut on a portion of the rod 23 for purposes as will presently be described. The body 26 of the tail stock T is provided with an upwardly extended integrally formed member 41 provided with a cylindrical portion 42 whose axis is in alignment with the axis of the winding spindle 3. This cylindrical portion 42 is provided with an orifice 43 of a size to receive ball bearings 44 and 45 which rotatably supports a head 46 which in association with the spool head support 20, support an electromagnet spool E between them as illustrated in Fig. 4. The body 26 is also provided with a depending integrally formed member 48 which is provided with a bifurcated end 49 which straddles a rod 50 secured to the housing C by means of a nut 51 which has threaded engagement with the threaded end of the rod 50 for purposes as will presently be described.

To insert an electromagnet spool E between the heads 20 and 46 the handle or lever 52 integrally formed with the toothed disk 37 is grasped by the operator and moved to the left with reference to Fig. 5.

The movement to the left of the lever 52 causes the disk 37 to rotate as it is pivotally supported by the body 26 on the pivot pin 39 and as its teeth 38 are in mesh with the toothed rack 40 on the rod 23 this rotation of the disk 37 causes the tail stock T as a whole to be moved to the left placing the spring 29, under compression, with the rod 23 and plug 30 serving as bearings, upon which tail stock T slides, and the depending bifurcated member 48 which straddles the rod 50 prevents tilting of the tail stock T as it is moved along the rod 23.

The movement of the tail stock T to the left as a whole permits an electromagnet spool E to be inserted between the two heads 20 and 46 with the head 55 of the spool resting in the head 46. With the spool E in this position the operator now releases the lever 52 which permits the spring 29 which was placed under compression by the movement of the tail stock T to force the tail stock T to the right until the head 56 of the spool E engages the head 20 which is provided with a slight projecting portion 57. This projection 57 is provided with a knife edge which engages the face of the head 56 of the spool E and under the influence of the compressed spring 29 the spool is gripped between the two heads 20 and 46. Now when the winding spindle 3 is rotated the spool as illustrated in Fig. 4 is rotated as the knife edge of the projection 57 slightly dents the face of the head 56 to grip the same to cause rotation of the spool E and the head 46 which supports the other head 55 of the spool E is also rotated in its bearings 44 and 45 supported in the member 42 of the tail stock T.

Cam members 60 and 61 are provided which cooperate to bring about the to and fro movement of the rocker arm R. The cam member 60 is tubular in form, and a collar 62 of a size to receive the tubular cam member 60 supports the cam member 60 thereon and is secured thereon by means of screws 63 which pass through suitable orifices in the peripheral face of the cam 60 and have screw threaded engagement with suitable tapped orifices in the collar 62. The collar 62 is provided with a central orifice for receiving a shaft 64 to which the collar 62 and its supported cam 60 are secured, as a whole, in any suitable manner as by means of a pin 65. The shaft 64 which supports the collar 62 and the cam 60 as a whole, is rotatably supported by a pair of bearings 66 and 67 secured to the housing C by means of screws 68 and 69.

A rocker arm R comprises a pair of rectangular shaped plate members 70 and 71, each of which is provided with a pair of integrally formed lug extensions 72 and 73, which register when the two halves 70 and 71 are placed together. Screws 74 which pass through suitable orifices 75 in the lug extensions 72 of the half 70 have screw threaded engagement with suitable tapped orifices 76 in the lug extensions 73 to secure the plate members 70 and 71 together to form the rocker arm R. An opening 77 is formed between the lug extensions 72 and 73 when the members 70 and 71 are thus assembled and this opening is of a size to receive the square portion 78 of the sliding sleeve member 79. The sliding sleeve 79 is slidably supported on the shaft 64 by means of a plurality of ball bearings 80 which are rotatably contained in a sleeve ball retainer 81, the central orifice 82 of the ball retainer 81 being of a size to permit the same to be slipped over the shaft 64 to permit the spherical faces of the protruding ball bearings 80 to engage the circumferential face of the shaft 64 at a plurality of points. The sleeve member 79 is provided with a central orifice 83 of a size to permit the sleeve 79 to be slipped over the ball retainer 81 so that the spherical faces of the ball bearings 80 that protrude slightly above the outer circumferential face of the ball retainer 81 engage the circumferential face of the central orifice 83 of the sliding sleeve 79 at a plurality of points. The cam 61 is cup shaped and is provided with a collar extension 85 which is provided with a central orifice 86 of a size to receive the cylindrical portion 87 of the sleeve 79. A set screw 88 having threaded engagement with a suitable tapped orifice 89 engages the portion 87 of the sleeve 79 which enters the orifice 86 in the cam 61 and secures the cam 61 to the sliding sleeve 79 for purposes as will presently be described. The square head portion 78 of the sleeve 79 is provided with a pair of integrally formed laterally extending pin members 90 and 91, and the plate members 70 and 71 are provided with counter bores 92 and 93 which are adapted to receive ball bearings 94 and 95 into which the pin extensions 90 and 91 extend to pivotally support the rocker arm R on the sliding sleeve member 79. From the above description it is seen that the sliding sleeve member 79 is slidably supported by the ball bearings 80 contained in a ball retainer 81 to permit the free movement of the sliding sleeve 79 to and fro so as to reduce the friction between the sliding sleeve 79 and the shaft 64 to a minimum. The rocker arm R is pivotally supported by the ball bearings 94 and 95 to permit the free and easy movement of the rocker arm R in its tilting travel from left to right and vice versa.

The end of the shaft 64 which extends through the bearing 66 has secured to it a bevel gear 100 which meshes with a bevel pinion 101, secured to a transverse shaft 103 which is rotatably supported in suitable bearings in the front wall 104 of the hous-

ing C and the removable cover 105. A gear wheel 106 is also secured to the transverse shaft 103 for purposes as will presently be described. Another transverse shaft 107 rotatably supported in bearings in the front wall 104 of the housing C and cover 105 has secured to it a pinion 108 and a worm gear 109 also for purposes as will presently be described. A compound gear which comprises a pinion 110 and gear 111 meshes respectively with the gear 106 and pinion 108 and is adjustably and rotatably supported on an arm 112, which is adjustably secured to a stud 113, suitably secured to the housing C in any suitable manner. The compound gear is provided with a central orifice 114 (Fig. 14) and a counterbore 115 in the face of the pinion 110 which orifice 114 and counterbore 115 are adapted to receive respectively the body portion 117 and the head 116' of a lock nut 116. The arm 112 is provided with a longitudinal slot 118 and a channel 119 and a bolt 120 provided with a rectangular head 121 which rests in the channel 119 with its body portion extending through the slot 118 in the arm 112. A lock nut 116 is provided with a central orifice 122 which is partially threaded to permit threaded engagement with the threaded end of the bolt 120. When the bolt 120 and lock nut 116 are in position as just described, the compound gear which comprises pinion 110 and gear 111 is supported on the arm 112 and the same may now be adjusted in mesh respectively with the gear 106 and pinion 108. The bolt 120 permits the compound gear and its supported parts to be moved up or down in the longitudinal slot 118 in the arm 112 and the arm 112 which is supported by the the stud 113 may be rotated about the stud 113 when the screw 125 is loosened. This permits the arm 112 and its supported parts to be rotated about the stud 113 and the bolt 120 permits the compound gear to be moved up or down in the slot 118 to permit the pinion 110 and gear 111 of the compound gear to mesh respectively with the gear 106 and pinion 108. When the proper adjustment is obtained the lock nut 116 is turned down on the bolt 120 by means of a suitable spanner wrench for which I provide a pair of orifices 126 in the head 116' of the nut 116 to secure the gears and pinions in mesh. The arm 112 is provided with a split end and the screw 125 passes through a suitable orifice in one of the split portions and has threaded engagement with a tapped orifice in the other split portion of the arm 112 and after adjustment of the arm 112 is obtained the screw 125 is turned down to clamp the arm 112 on its supporting stud 113. The compound gear comprising the pinion 110 and gear 111 is thus rotatably supported on the arm 112 with the body portion 117 of the lock nut 116 serving as a bearing upon which the compound gear rotates.

The spindle shaft 3 has a worm portion 130 cut thereon and meshes with the worm gear 109 secured to the transverse shaft 107. Now as the spindle shaft 3 rotates, the worm 130 which meshes with the worm gear 109, causes rotation of the worm gear 109, and through the agency of the pinion 108 on the transverse shaft 107 and the gear wheel 111 which meshes with the pinion 108 and the pinion 110 which meshes with the gear wheel 106 and the bevel pinion 101 on the transverse shaft 103, and the bevel gear 100 on the shaft 64 rotary motion is transmitted to the shaft 64 which carries the cam member 60 to cause rotation of the cam member 60.

The winding machine of my invention is provided with a revolution counter RC for the usual purposes, and which forms an integral part of the winding machine. The housing C is provided with a semi-circular shaped extension 131 integrally formed with the housing C and which, when the cover cap 132 is in position in the circular opening in the rear face 133 of the extension 131, encloses the revolution counter mechanism. The revolution counter mechanism comprises a gear wheel 134 provided with a hub member 135 suitably secured to the gear wheel 134. The hub 135 extends through a suitable orifice 136 in the face of the housing extension 131 and rotatably supports the gear wheel 134. A gear wheel 137 having a pinion member 138 secured to it in any suitable manner, are, as a whole, rotatably supported on a stub shaft 139 which is secured in a suitable orifice 140 in the housing extension 131 by means of a drive fit, and rotatably supports the gear 137 and pinion 138. A shaft 141 is provided which extends through a central orifice in the hub 135 of the gear wheel 134, and is provided with an intermediate enlarged portion 142 upon which is cut a pinion 143 which pinion 143 meshes with the gear wheel 137. The pinion 138 which is rotatably supported on the stub shaft 139 meshes with the gear wheel 134 for purposes as will presently be described. A worm gear 144 is supported on the shaft 141 and the hub 145 of the worm gear 144 is provided with a transverse slot 146 which receives a pin 147 secured to the shaft 141. The end 148 of the shaft 141 rests in a suitable orifice 149 in the cover cap 132 which rests in a circular opening 150 in the housing extension 131 and forms a bearing for this end of the shaft 141. The other end 151 of the shaft 141 extends through the hub 135 of the gear wheel 134, and this hub 135 serves as the other bearing for the shaft 141. The worm gear 144 meshes with the worm

130 on the spindle shaft 3, and rotation of the spindle shaft 3 causes rotation of the worm gear 144. Rotation of the worm gear 144 is also transmitted to the shaft 141 upon which the worm gear is supported, due to the slot 146 and pin 147 connection between the worm gear 144 and the shaft 141, as already described. The pinion 143 on the shaft 141 transmits rotation to the gear wheel 137 and the pinion 138 secured thereto in turn transmits rotation to the gear wheel 134 rotatably supported in the orifice 136 in the housing extension 131. The rotation of the shaft 141 and hub 135 on the gear wheel 134 will rotate the indicator arms 152 and 153, respectively, secured thereto for purposes as will presently be described.

The hub 135 secured to the gear wheel 134 protrudes through the central orifice 136 in the housing extension 131, and its reduced end portion 154 is threaded. The indicator 153 is supported on the reduced portion 154 of the hub 135 between a washer 155 and a spring washer 156. A washer 157 is now placed upon the reduced end 154 of the hub 135, and a nut 158 having screw-threaded engagement with the threaded end of the hub 135 forces the washer 158 against the spring washer 156, causing it to grip the indicator 153 and frictionally hold it in position on the hub 135 between the washers 155 and 156 so that as the hub 135 rotates the indicator 153 will also move with it, and in addition, the indicator 153 can be moved about its hub support 135 to set the same at its zero position, as is readily understood. The shaft 141 which supports the worm gear 144 protrudes through the hub 135, and its end is threaded, and the indicator 152 is supported upon the shaft 141 between a washer 159 and a spring washer 160. A washer 161 is placed against the spring washer 160, and a nut 162 having screw-threaded engagement with the threaded end of the shaft 141 forces the washer 159 against the spring washer 160, springing the same and causing it to grip the indicator 152 and frictionally hold it in position on the shaft 141 between the washers 159 and 160 so that as the shaft 141 rotates the indicator 152 will also move with it, and in addition, the indicator 152 may be moved about its shaft support 141 to set the same at its zero position.

The housing extension 131 is provided with a circular ridge 163 forming a dished circular portion in which I place a dial 164, suitably calibrated, the outer scale reading from 1000 to 10000, and the inner scale reading from 1 to 100, and to associate the indicator arm 153 secured on the hub 135 with the 1000 to 10000 scale and the indicator arm 152 secured to the shaft 141 with the 1 to 100 scale, the desired gearing ratio is provided. For each revolution of the worm gear 144, the pinion 143 on the shaft 141 will rotate one revolution, and will cause the gear wheel 137 to make one-tenth of a revolution, and as the pinion 138 is secured to the gear 137, it also makes one-tenth of a revolution, and it being in mesh with the gear wheel 134, this gear wheel 134 in turn makes one one-hundredth of a revolution.

From this description it is readily apparent that for each revolution of the shaft 141, the indicator arm 152 thereon will have traveled one revolution, indicating that one hundred convolutions of wire have been placed on the spool associated with the winding spindle 3, and the indicator arm 153 of the hub 135 will point to the first graduation of the scale. For each ten revolutions of the shaft 141, the indicator 152 will also have made ten revolutions, and the hub 135, due to the gearing ratio, will have made one-tenth of a revolution and will point to one thousand on the scale.

The rocker arm R which is pivotally supported upon the sliding member 79 is associated with adjustable means which controls the length of the stroke of the reciprocating shaft 165, upon which the distributing arm D is secured, and as reciprocating shaft 165 is secured to the rocker arm R through the medium of this adjustable means various lengths of coils may be wound, as will now be described. The rectangular plates 70 and 71 which form the rocker arm R are provided with depending members 166 and 167 which, when the plates 70 and 71 are secured together, form a depending leg 168, which is provided with a slot 169.

A rack 170 which rests in a suitable channel 171 in the housing C is provided with teeth 172 cut in its side face 173 and is secured to a stud 174 intermediate of its ends by means of a riveting operation or any other suitable means. The forward end 175 of the stud 174 is threaded and protrudes through a slot 176 in the housing C and is adapted to receive a knob 177 and a collar 178 provided with a central orifice is adapted to be slipped over this protruding end 175 of the stud 174 and rests between the knob 177 and the housing C. The housing C is provided with a channel 179 which is adapted to receive the rectangular shaped portion 180 of the collar 178 to permit the collar 178 to slide up and down in the channel 179. The knob 177 and collar 178 are used for clamping purposes. A bushing 181 provided with flat faces 182 rests in the slot 169 in the depending leg 168 of the rocker arm R and is adapted to slide in the said slot 169. The portion 183 of the stud 174 extends through a central orifice 185 in the bushing 181 and the reduced end 186 of the stud 174 which protrudes, is threaded to receive a nut 187, a suitable washer 188 being placed between the nut 187 and the face of the depending leg 168 of the rocker arm R. The

portion 183 of the stud 174 which extends through the bushing 181 is slightly longer than the bushing 181, so that when the nut 187 is turned down, the washer 188 will be locked but at the same time allow the bushing 181 to rock on the stud 174 and permit the bushing 181 to slide in the slot 169. The knob 177 which is threaded upon the forward end 175 of the stud 174 which protrudes through the slot 176 in the housing C is provided with a handle 189 which facilitates turning of the knob 177.

The toothed rack 170 meshes with a pinion 190 integrally formed with a rod 191 which extends through an orifice 192 in a boss 193 formed integrally with the housing C and its protruding end has pinned to it a knob 194 which may be turned to rotate the pinion 190 which is in mesh with the toothed rack 170. To adjust the stud 174 in the slot 169 in the depending leg 168 of the rocker arm R the knob 194 on the rod 191 is turned to the right or left and as the pinion 190 is in mesh with the toothed rack 170 the toothed rack 170 is raised or lowered in the channel 179 as the case may be.

As before described the stud 174 is secured to the toothed rack 170 and as the rack is moved up or down the stud 174 is also raised or lowered in the slot 169 in the depending leg 168 of the rocker arm R and when the proper adjustment is obtained the knob 177 is turned down by means of the handle 189 to lock the stud 174 in its adjusted position. The knob 177 is provided with an indicator arm 195 suitably secured thereto which cooperates with a scale 196 secured to the housing C which give the operator an indication of the distance that the stud 174 is to be raised or lowered to change the throw of the rocker arm R for the various lengths of coils to be wound.

A square block 200 (Fig. 6) provided with integrally formed studs 201 and 202 are adapted to receive bushings 204 and 205 which rest in the slots 206 and 207 in the upper ends of the plates 70 and 71 which form the rocker arm R. The block 200 rests between the upper ends of the plates 70 and 71 of the rocker arm R, and when in position with its supported bushings 204 and 205, resting in the slots 206 and 207 and the end of the stud 201 which protrudes through the bushing 204 supports a shoe 208 which rests in a slot or channel 209 cut in the inner face of the housing C. The end of the stud 202 which protrudes through the bushing 205 has secured thereto, by means of a set screw 210 a shoe 211 which rests in a slot or channel 212 cut in the inner face of the cover cap 105, when the same is in position, and secured to the housing C. The block 200 is provided with a central orifice 213, which is adapted to receive a guide rod 214 which is adapted to be secured therein by means of a drive fit. This guide rod 214 extends through a guide bearing 215, and serves as a guiding means for the rocker arm R in its to and fro travel. The shoe 211 secured to the stud 202 is provided with an orifice 216 which is adapted to receive the end of the distributing bar or reciprocating shaft 165, and secured therein by means of a drive fit. This distributing bar 165 extends through an aligned orifice 317 in the side 5 of the housing 2 to which the distributing arm D is secured.

The cam members 60 and 61 as before described are secured respectively to the shaft 64 and the sliding sleeve member 79 and as the profile or lead of the cam faces 217 and 218 of the cams 60 and 61 are the same they mesh or match when the distributing bar or reciprocating shaft 165 is in its extreme left position as illustrated in Figs. 1 and 3. The cam 61 secured to the sliding sleeve member 79 is held in engagement with cam 60 by means of a helical spring 219 around the shaft 64, one end of which rests against a plate 220 resting in the bore of the bearing 66 and its other end rests against the sliding member 79 on the shaft 64. The shaft 64 when rotating causes the cam 60 to rotate and the lead angle of this rotating cam 60 engages the lead angle of the cam 61 supported on the sliding sleeve 79 and forces the sleeve 79, its supported cam 61 and rocker arm R to the left with reference to Fig. 4, against the normal compression of spring 219 and when the sleeve 79 and its supported parts have reached their limit of travel in that direction and starts their travel in the opposite direction, the sleeve 79, and its supported parts are moved in the opposite direction under the influence of the compressed spring 219 with the lead angle of the cam 61 following the lead angle of the rotating cam 60 on the shaft 64 which will be more fully hereinafter described.

Referring to Figs. 1 and 10 I show a distributor arm D secured to the reciprocating shaft 165. The distributor arm D comprises a split member 221 secured to the reciprocating shaft 165 by means of a screw 222 which passes through a suitable orifice in the upper split portion of the member 221 and has screw threaded engagement with a tapped orifice in the lower split portion of the member 221 to clamp the member to the reciprocating shaft 165. The member 221 is provided with a pair of upwardly extending arms 223 and 224 which are provided with aligned orifices 225 for receiving a shaft 226 upon which an arm 227 is secured, the said shaft 226 and its supported arm 227 being pivotally supported in the aligned orifices 225. A block 228 resting between the arms 223 and 224 of the member 221 is provided with a bifurcated portion 229 and the legs 230 of the bifurcated portion 229 are in turn provided with transverse slots 231. The block

228 is positioned between the arms 223 and 224 of the member 221 with the shaft 226 which supports the arm 227 resting in the slots 231 of the legs 230, and the arm 227 supported on the shaft 226 in turn resting in the bifurcated portions 229 of the block 228. A threaded stud 232 which is threaded through a tapped orifice 233 in the block 228 is rotatably supported in a pair of aligned orifices 234 in the ear extensions 235 of the arms 223 and 224, its one end being provided with a head 236 and its other end 237 being reduced to receive a knob 238 which is suitably pinned thereto.

From the above description it will be seen that the shaft 226 and its supported arm 227 are pivotally supported by the arms 223 and 224 of the member 221 and the block 228 provided with the slots 231 in which the shaft 226 rests and the bifurcated portion 229 in which the arm 227 rests in combination with the threaded stud 232 which is in threaded engagement with the block 228 forms adjustable means for moving the arm 227 to the right or left. With the parts linked together as just described it is readily apparent that when the knob 238 is turned to the right with reference to Fig. 10 the stud 232 is also rotated and due to the screw connection between the threaded stud 232 and the tapped orifice 233 in the block 228 the block 228 is moved to the right with reference to Fig. 11. This movement of the block 228 to the right caused the shaft 226 and its supported arm 227 to also move to the right for the reason that the arm 227 rests in the bifurcated portion 229 of the block 228 and as the shaft 226 is pivotally supported in the orifices 225 in the arms 223 and 224 of the member 221. These orifices 225 form bearings for the sliding shaft 226 in its limited travel to the right or left. The shaft 226 which rests in the slots 231 of the block 228 forms a bearing upon which the block 228 slides and also prevents tilting of the block 228 when the stud 232 is turned to move the block 228. When the knob 238 is turned to the left the block 228 is also moved to the left with reference to Fig. 11 and causes the shaft 226 and its supported arm 227 to also move to the left for reasons already described. The movement of the block 228 to the right or left is limited for when it is moved to its extreme right or left position the faces 240 and 241 of the block 228 will engage the respective inner faces 242 and 243 of the arms 223 and 224 of the member 221. The arm 227 extends forward toward the winding spindle 3 and supports a pair of ball bearing guide wheels 245 and 246 for the usual purpose of guiding the wire from the source of supply to the electromagnet spool upon which the wire is being wound. The arm 227 is adapted to be raised or lowered with reference to Fig. 10, by reason of its being pivotally supported by the shaft 226 and to maintain it in any of its adjusted up or down positions, I provide a leaf spring 247 which is secured to the member 221 by means of a screw 248. The free end 249 of the angular portion of the spring 247 engages a portion of the arm 227 and the tension of the spring 247 is such as to frictionally hold the arm 227 in any of its positions. A stop 250 secured to the member 221 limits the movement of the arm 227 in its downward movement.

The removable cover cap 105 is secured to the housing C by suitable screws which has screw threaded engagement with suitable tapped orifices in the housing C. This cover cap 105 may be removed to permit access to the mechanism of the machine. The housing C is also provided with a suitable base and the machine may be secured to a suitable table and a strand of wire 251 from a suitable supply lead over the guide wheels 245 and 246 to the spool 54 to be wound.

Having described the apparatus through the agency of which the cam 60 is rotated, and the apparatus associated therewith for controlling the length of stroke of the reciprocating shaft 165, I will now describe the operation of the winding machine and the adjusting means for adjusting the length of stroke of the reciprocating shaft 165 from left to right. Now when the clutch pedal of the power drive (not shown) is actuated the belt connection between the source of power and the pulley 4 on the spindle shaft 3 will rotate the spindle shaft 3. The worm 130 on the shaft 3 meshes with the worm gear 109, causing rotation of the worm gear 109, and through the agency of the pinion 108 on the transverse shaft 107 upon which the worm gear 109 is secured, and the gear wheel 111, pinion 110 supported by the arm 112 and the gear wheel 106 and bevel pinion 101 on the transverse shaft 103, and the bevel gear 100 on the shaft 64 rotary motion is transmitted to the shaft 64, which carries the cam 60, to cause rotation of the same.

I show the reciprocating shaft 165 in its extreme right position with reference to Fig. 4 and the arrow indicated on the cam 60 indicates the direction of travel of the cam 60 which will move the reciprocating shaft 165 to the left.

As the cam 60 rotates, the lead angle of the rotating cam 60 engages the lead angle of the cam 61 supported on the sliding sleeve member 79 and forces the sleeve 79 and its supported cam 61 and rocker arm R to the left with reference to Fig. 4, against the normal compression of the spring 219. The stud 174 which is used for adjusting the length of stroke of the reciprocating shaft 165 passes through the slot 169 in the depending arm 168 of the rocker arm R, and is locked in its adjusted position in the slot

176 in the housing C by means of the locking knob 177 and therefore the rocker arm R rocks about the stud 174 and pivots about its pivot pins 90 and 91 on the sliding member 71 and causes the upper end of the rocker arm R to tilt to the left. The shoes 208 and 211 supported on the block 200 resting in the upper end of the rocker arm R now slide to the left in their respective channels 209 and 212. The tilting of the upper end of the rocker arm R to the left is permitted, due to the fact that the studs 201 and 202 of the block 200 which support the same in the rocker arm R rest in the bifurcated ends of the rocker arm R and permit the shoes 208 and 211 supported by the block 200 to move in a horizontal plane to the left in their respective channels 209 and 212. The bushing 181 in the slot 169 in the leg 168 of the rocker arm R is slidably secured therein as before described, and as the lower end of the leg 168 of the rocker arm R moves to the right, the bushing 181 around the locked stud 174 rotates thereon to permit this movement to the right of the leg 168 of the rocker arm R. The guide rod 214 secured to the shoe 211 slides through the guide bearing 215 and the combination of the guide rod 214 and the block 200 permits the free movement of the shoes 208 and 211 in the respective channels 209 and 212, and as the reciprocating shaft 165 is secured to the shoe 211 it also moves to the left. The movement to the left of the reciprocating shaft continues until the apex of the lead angle of the rotating cam 60 passes the apex of the lead angle of the cam 61 which is supported on the sliding sleeve 79 on the shaft 64 and when in this position the reciprocating shaft 165 is in its extreme left position with reference to Fig. 4. As the shaft 64 continues to rotate the lead angle of the rotating cam 60 being in engagement with the lead angle of the cam 61 on the sleeve 79, the sleeve 79 and its supported parts are moved in the opposite direction under the influence of the compressed spring 219 which permits the lead angle of the cam 61 to follow the lead angle of the rotating cam 60 to permit the reciprocating shaft 165 to move to the right. When the lead angle of the cam 60 again matches or meshes with the lead angle of the cam 61 in which position the apexes of the respective lead angle of the cams 60 and 61 rest in the bases of the respective lead angles of the cams 60 and 61 the reciprocating shaft 165 is in its extreme right position with reference to Fig. 4.

From the above description it may be seen that the tilting of the upper end of the rocker arm R from left to right, and vice versa, causes the shoes 208 and 211 to travel in a like direction, and as the reciprocating shaft 165 is secured to the shoe 211, the reciprocating shaft 165 also receives this to and fro movement. Through the agency of the cam 61, sliding member 79, rocker arm R, and shoes 208 and 211 movement from left to right and vice versa is transmitted to the reciprocating shaft 165, and for one complete revolution of the cam 60, the reciprocating shaft 165 will have traveled from left to right and right to left to place two layers of convolutions of wire on the spool supported between the head on the spindle 3 and the tail stock T.

The length of stroke of the reciprocating shaft 165 is adjustable, and to this end I provide the sliding toothed rack 170 which is in mesh with the pinion 190.

To adjust the stroke of the reciprocating shaft 165 the locking knob 177 which is in threaded engagement with the threaded end of the stud 174 is loosened to permit the stud 174 to be moved in the slot 176 in the housing C and the slot 169 in the leg 168 of the rocker arm R. With the locking knob 177 loosened, the adjusting knob 194 secured to the rod 191 integrally formed with the pinion 190 in mesh with the toothed rack 170 may be turned. Now to decrease the throw of the rocker arm R the knob 194 is turned in the direction of the arrow indicated in Fig. 4 and causes the pinion 190 associated with the knob 194 and which is in mesh with the toothed rack 170 to move the rack 170 down. The stud 174 is secured to the rack 170 and is therefore also moved down and as the bushing 181 is supported on the stud 174 it moves down in the slot 169 in the leg 168 of the rocker arm R. This movement of the stud 174 and its supporting bushing 181 in the slot 169 increases the distance between the horizontal slidable pivoted center of the rocker arm R and the fixed locking center, which in this case is the stud 174. This increase of distance between the pivoted centers 90 and 91 of the rocker arm R intermediate of its ends, and the fixed locking center or stud 174 about which the bushing 181 supported thereon rocks, decreases the distance that the upper end of the rocker arm R tilts from left to right and vice versa, and as the reciprocating shaft is secured to the shoe 211, which is associated with the tilting end of the rocker arm, the distances that the reciprocating shaft 165 travels from left to right and vice versa is decreased.

From the description, it is readily apparent that the reciprocating shaft 165 is provided with adjusting means for accurately adjusting the length of its stroke, and it is also apparent from the description that the adjusting means is micrometric in that it provides an infinite number of adjustable positions for the fixed locking center or stud 174 to provide an infinite number of lengths of travel of the reciprocating shaft 165.

When an adjustment of the reciprocating shaft 165 is obtained for a certain length of coil to be wound, the locking knob 177 is again tightened to clamp the stud 174 in its adjusted position in the slot 176 in the housing C, to maintain the adjustment. From this it is apparent that the machine of my invention is adaptable for various lengths of coils, and that it is a simple matter to change the stroke or distance of travel of the distributing bar 165 by this simple adjusting means without the necessity of changing gears or substituting cams provided with different pitch cam faces.

Spools, such as are illustrated in dotted lines in Fig. 4, upon which the convolutions of wire are wound, are provided with spool heads between which these convolutions of wire are wound to form the electromagnet. The distance between the spool heads must at all times be fairly constant, as a certain number of convolutions of wire in layers must be placed on the spool between the spool heads for a coil of a predetermined size. Now, it often happens, due to the inaccuracies in manufacture, the distance between the spool heads varies slightly, and as a predetermined number of convolutions of wire must be placed thereon, if no provisions were made for adjusting the distributing bar 165 to overcome this, it may be readily seen that if the distance between the spool heads was a trifle over its fixed predetermined dimensions, that there would be a slight space between the inner faces of the spool heads and the layers of wire on the spool, permitting these unsupported ends to loosen, whereas, if this distance is below its fixed predetermined dimension, the first few end turns of each end of the layers would pile up and form a bulge at each end of the coil which would be magnified as each successive layer is placed thereon. With the adjustable means for giving the distributing bar 165 an infinite number of lengths of travel from left to right, and right to left, it is readily apparent that after the first layer of convolutions of wires are placed on the spool, the operator can readily observe either of these discrepancies, and in either case, the operator may adjust the distributing bar 165 to increase or decrease the distance of travel from left to right, and vice versa, to overcome this variance of distances between the spool heads by the simple adjusting means which includes the knob 177 and its associated rack 170.

The distance between the spool heads is constant, but due to manufacturing inaccuracies, the heads are placed at varying distances along the core of the spool, so that when they are clamped between the head of the winding spindle and the tail stock T, the first layer when wound on the core will reveal this discrepancy and I provide the adjustable means associated with the distributing arm 227 so that the operator by turning the knob 238 the threaded stud 232 will move the block 228 and arm 227 as a whole, to the right or left, as the case may be, to center the spool with relation to the distributing arm 227 so that the convolutions will be placed thereon the full distance between the spool heads without a piling up at one end of the core and a space between the end of the layer and the face of the spool head, as would be the case if this adjustment were not provided.

From the foregoing it is readily apparent that the rotation of the drive shaft not only causes the winding of convolutions of wire upon the magnet spool, but also causes the movement of the distributor member back and forth, and that the mechanism for accomplishing this result is very compact and enclosed in a casing away from dust and injury.

If it is desired to place a different number of convolutions of wire on the spool, all that is necessary to do is to change the gearing ratio between the drive shaft and the distributing member. It will be noted that the arm 112 is provided with a slot so that different size gears may be secured to this arm in mesh with gears 108 and 106.

The rotation of the drive shaft also transmits motion to the gears associated with the counter mechanism thereby causing the hands of the counter to visualize the number of revolutions of the driving shaft. The counter mechanism is all enclosed in a housing or casing, and is so situated that the visualizing mechanism of the counter device is immediately before the operator of the winding machine.

As before mentioned, the operator can change the distance of travel of the feeding mechanism while the winding machine is in operation, and the operator can also adjust the distributing mechanism to feed further to the right or left while the machine is in operation.

While I have described one particular embodiment of my invention, it is to be understood that the same is not limited to the specific disclosure, but I aim to cover all the changes and modifications that come within the scope of the appended claims.

Having described my invention, what I claim as new and desire to secure by United States Letters Patent, is:

1. A winding machine comprising an enclosing casing, a winding spindle having driving means connected to one end and a supporting head on the other end, a rod secured to said casing and a tail stock slidably supported on said rod, means including a toothed rack on said rod, a toothed disk

pivotally secured to said tail stock and meshing with said toothed rack and a lever integral with said disk adapted to rotate the said disk to move the said tail stock along said rod to permit the insertion of a winding spool between said tail stock and said supporting head and means for restoring said tail stock to clamp said winding spool between said tail stock and said supporting head.

2. A winding machine comprising an enclosing casing, a winding spindle having driving means connected to one end and a supporting head on the other end, a rod secured to said casing and a tail stock slidably supported on said rod, means including a toothed rack on said rod, a toothed disk pivotally secured to said tail stock and meshing with said toothed rack and a lever integral with said disk adapted to rotate the said disk to move the said tail stock along said rod to permit the insertion of a winding spool between said tail stock and said supporting head, spring means for restoring said tail stock to clamp said winding spool between said tail stock and said supporting head, and means for rotatably supporting said spool in said tail stock.

3. A winding machine comprising an enclosing casing, a winding spindle having driving means connected to one end and a supporting head secured on the other end, a rod secured to said casing and a tail stock slidably supported on said rod, a toothed rack on said rod, a toothed disk meshing with said toothed rack pivotally supported by said tail stock, means for moving said tail stock along said rod and spring means for maintaining said tail stock in its normal position.

4. A winding machine comprising an enclosing casing, a winding spindle having driving means connected to one end and a supporting head secured to the other end, a rod secured to said casing and a tail stock slidably supported on said rod, a toothed rack on said rod, a toothed disk pivotally secured to said tail stock meshing with said toothed rack, a lever integral with said disk for rotating said disk to move said tail stock along said rod, spring means compressed upon movement of said tail stock on said rod, said spring means restoring said tail stock when said lever is released.

5. A winding machine comprising an enclosing casing, a winding spindle having driving means connected to one end and a supporting head secured to the other end, a rod secured to said casing and a tail stock slidably supported on said rod, a toothed rack on said rod, a toothed disk pivotally secured to said tail stock in engagement with said toothed rack, a lever integral with said disk for rotating said disk to move said tail stock along said rod to permit the insertion of a winding spool between said tail stock and said supporting head, and spring means for restoring said tail stock to clamp said winding spool between said tail stock and said supporting head.

6. A winding machine comprising an enclosing casing, a winding spindle having driving means connected to one end of said spindle and a supporting head secured to the other end, a rod secured to said casing and a tail stock slidably supported on said rod, a toothed rack on said rod, a toothed disk pivotally secured to said tail stock in engagement with said toothed rack, means for rotating said disk to move said tail stock to move along said rod to permit the insertion of a winding spool between said tail stock and said supporting head, spring means for restoring said tail stock to clamp said winding spool between said tail stock and said supporting head, and means in said tail stock for rotatably supporting said winding spool.

7. A winding machine comprising a winding spindle, a rotatable shaft and a cam member secured thereto, a train of gearing for transmitting motion from said winding spindle to said shaft, a sliding member, ball bearings and a ball retainer therefor supported on said shaft, said sliding member being supported on said ball bearings and adapted to be moved to and fro by said cam member on said shaft, a rocker arm pivotally supported on said sliding member and a reciprocating shaft associated with said rocker arm adapted to receive to and fro movement by means of said sliding member and said rocker arm.

8. A winding machine comprising a winding spindle, a rotatable shaft, a cam member secured thereto, a slidable member frictionally mounted with respect to said shaft, a cam member secured to said slidable member having a profile matching the profile of said first cam member, and gearing mechanism connecting said winding spindle to said rotary shaft.

9. A winding machine comprising a winding spindle, a rotatable shaft, a cam member secured thereto, a slidable member frictionally mounted with respect to said shaft, a cam member secured to said slidable member having a profile matching the profile of said first cam member, a guiding member secured to said slidable member, adjustable means for regulating the extent of movement of said guiding member, and gearing means connecting said winding spindle to said rotary shaft.

10. A device of the character described including a shaft, a slidable sleeve member extending around said shaft, and a sleeve having ball bearings between said shaft and said slidable sleeve member, a cam secured to said shaft, a second cam secured to said slid-

able member said cams adapted to engage each other to impart a reciprocating movement to said slidable member.

11. A device of the character described including a winding spindle, a cam shaft geared thereto, a sleeve member adapted to slide back and forth, a cam secured to said slidable member, and engaging a second cam secured to said cam shaft, said second cam adapted to rotate said first cam to cause the slidable member to move back and forth, and a sleeve member having ball bearings between said slidable member and said cam shaft.

12. A device of the character described including a winding spindle, a shaft provided with a cam member connected to said winding spindle by a train of gearing, a slidable member controlling a guide member, said cam member adapted to engage a second cam member secured to said slidable member to impart a reciprocating movement to said slidable member and said guide member, and a sleeve member provided with ball bearings between said cam shaft and said slidable member.

13. A device of the character described including a winding spindle, a shaft provided with a cam member connected to said winding spindle, a slidable member controlling a guide member, a sleeve member provided with ball bearings between said cam shaft and said slidable member, and adjustable means for regulating the stroke of said guide member.

Signed by me at Chicago, in the county of Cook, and State of Illinois, this 15 day of July, 1925.

MARTIN B. GROUT.