Oct. 2, 1951 M. ROSE 2,569,618

WINDING MACHINE

Filed March 25, 1947 4 Sheets-Sheet 1

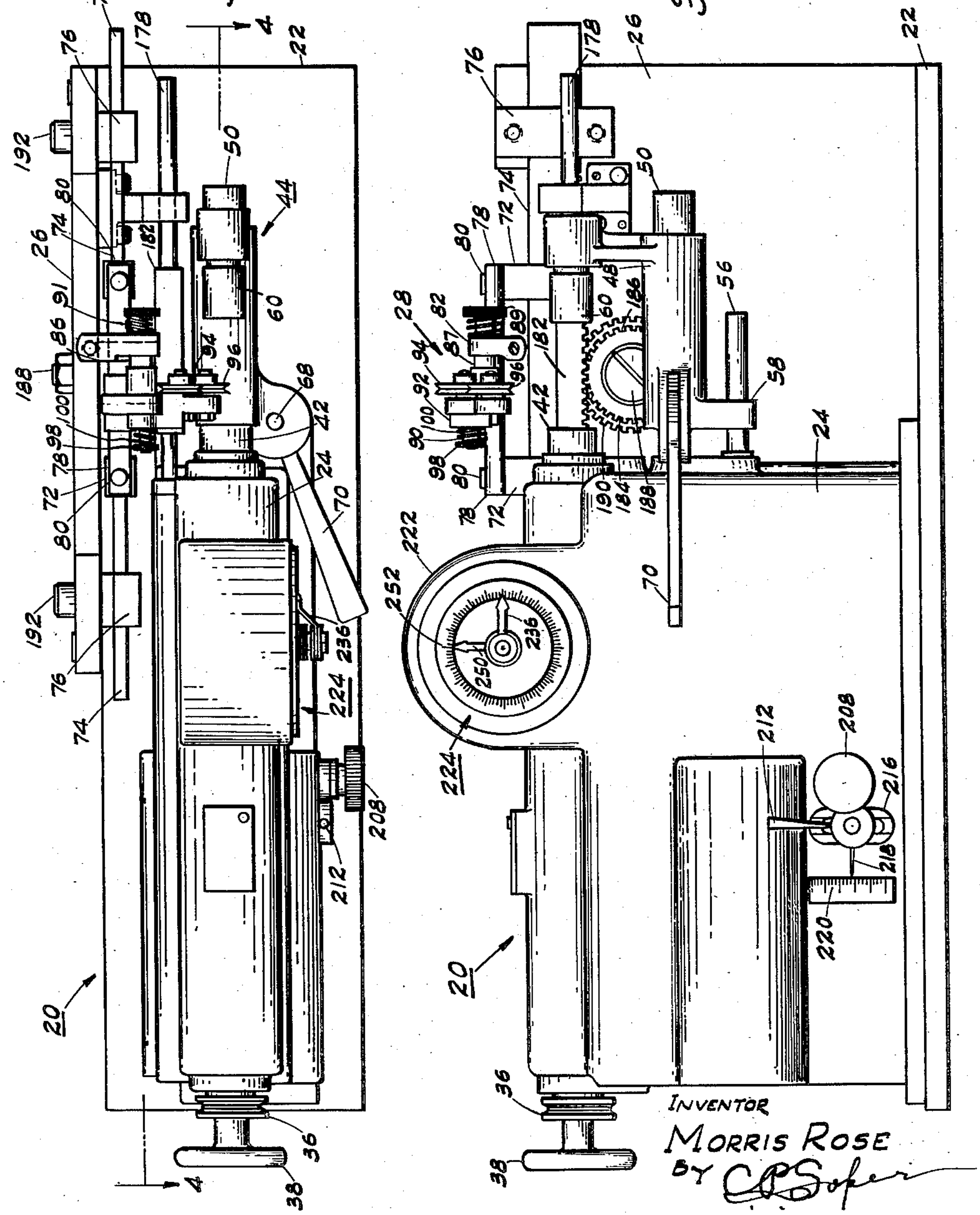

Fig. 2

Fig. 1

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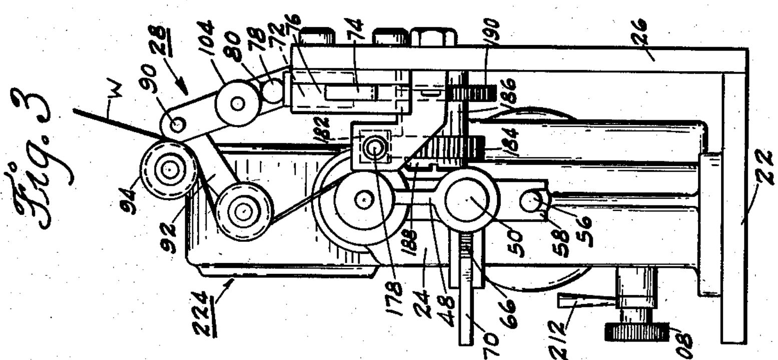

Fig. 3

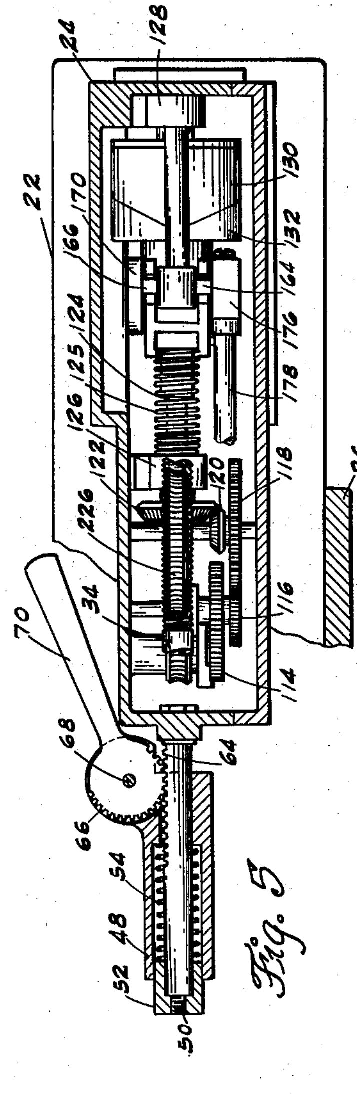

Fig. 5

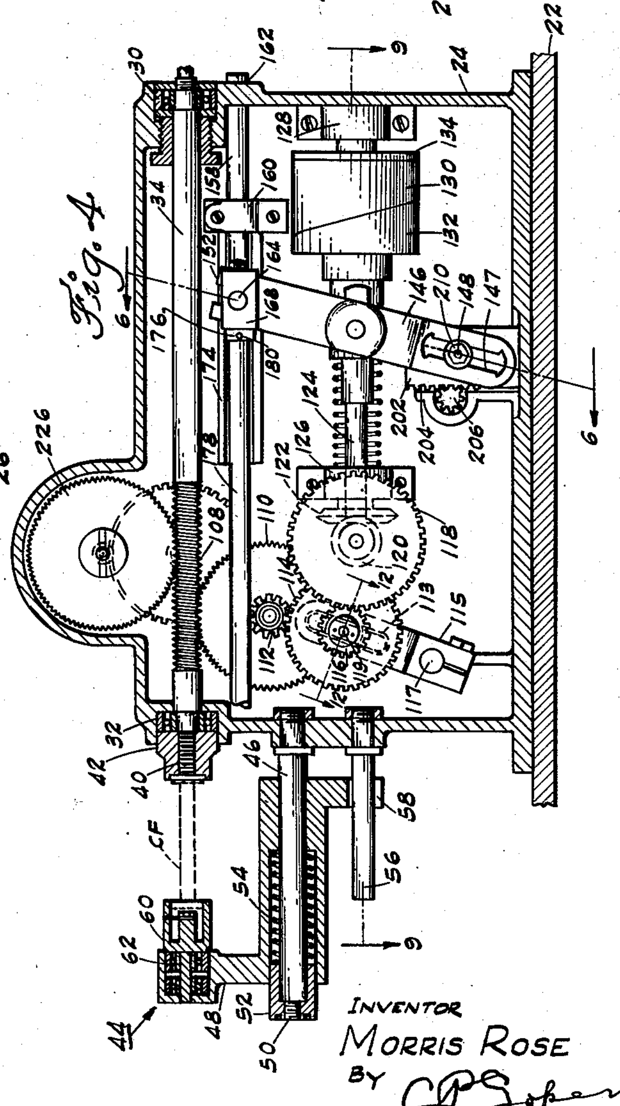

Fig. 4

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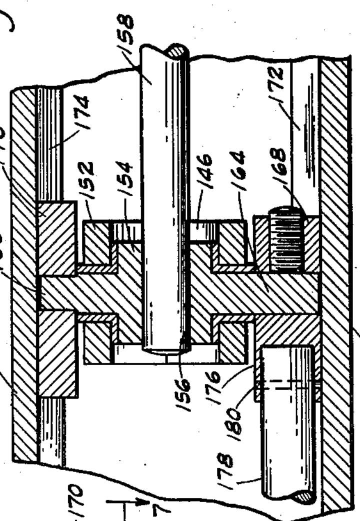

Fig. 7

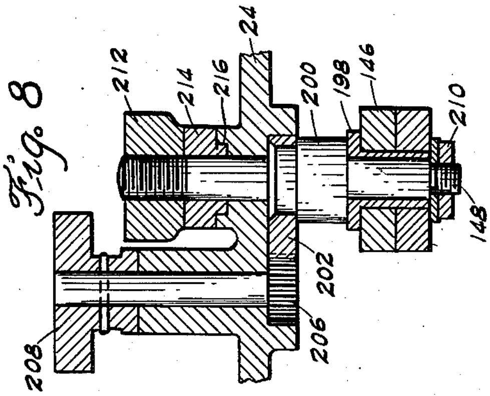

Fig. 8

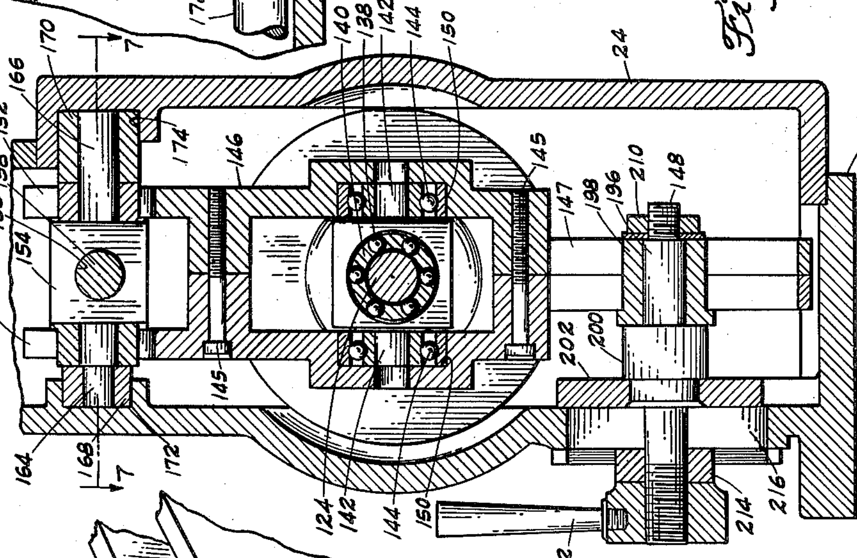

Fig. 6

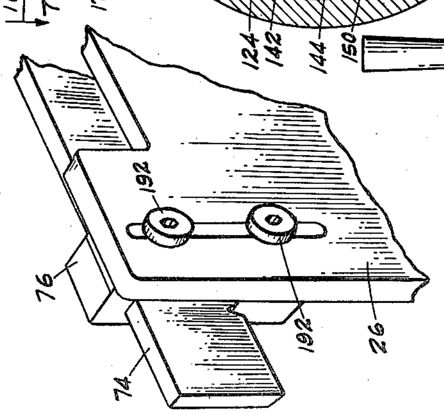

Fig. 13

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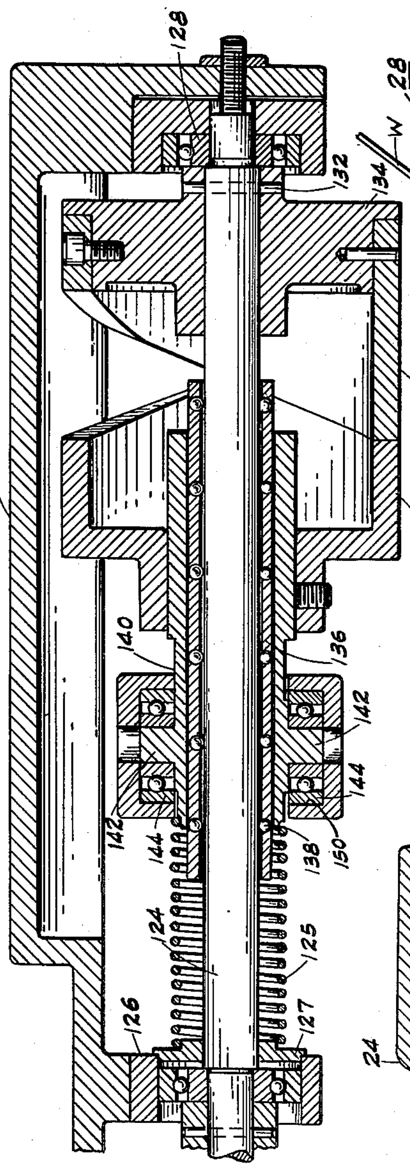

Fig. 9

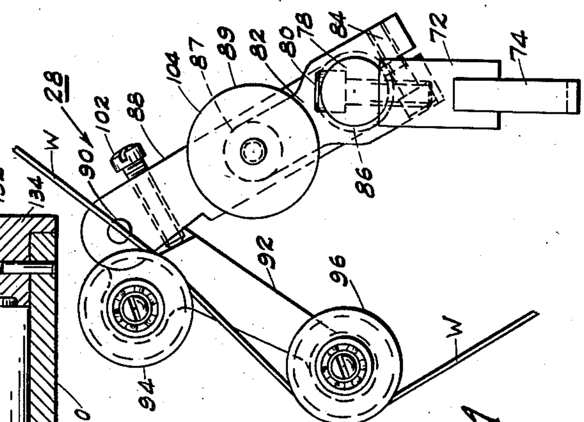

Fig. 11

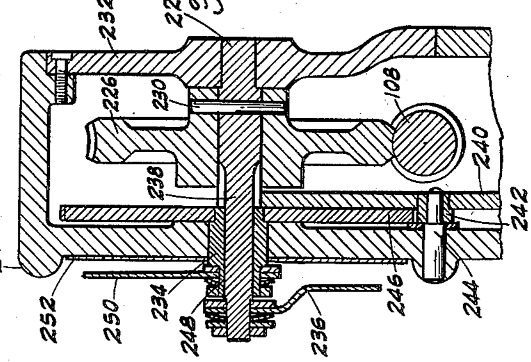

Fig. 10

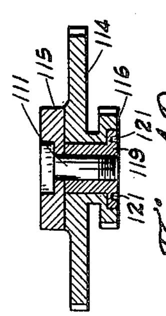

Fig. 12

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UNITED STATES PATENT OFFICE

2,569,618

WINDING MACHINE

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Application March 25, 1947, Serial No. 736,952

9 Claims. (Cl. 242—9)

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This invention relates in general to winding machines and has particular reference to machines of the type which are employed for making layer wound coils, such as may be found in the electrical arts.

Machines for making layer wound coils such as solenoid coils are generally of the type employing a spindle which drives a coil form upon which the coil is wound. By means of a gear train and a cam arrangement, reciprocal motion is imparted to a strand or wire guide, which enables the coil form to be wound with layers of wire. Means may be employed for varying the amplitude of movement of the wire guide a small amount to take care of minor differences in longitudinal dimension of the coil form, that the wire will not crowd or build up at the ends of the coil form.

The machines of the prior art, however, will not readily wind coils of greatly different lengths, only small changes in length being accommodated by the means for varying the amplitude of the wire guide. To change from coils of one length to a coil of a substantially larger length requires a great many changes, which cannot be made rapidly or easily.

With the foregoing considerations in mind, it is a principal object of this invention to provide an arrangement which will give a large amplitude of movement to the wire guide means when it is desired to wind coils of greater length.

A further object is to provide a pair of reciprocating members, one of which may be rapidly adjusted to allow for small variations in the length of the coil form, the second reciprocating member being connected to the first member in such a fashion that its amplitude of movement may be greater or less than the first reciprocating member.

A yet further object is to provide a pair of reciprocating members, one deriving its movement from a rotating driving spindle, the other deriving its movement from the first and supporting a wire or strand guide, the second being connected to the first and in such a fashion that its amplitude is some ratio of the amplitude of the first.

Still another object is to provide in a winding machine, a pair of reciprocating racks, the first rack deriving its motion from the rotation of a driving spindle which rotates a coil form, the second rack deriving its motion from the first and supporting a wire guide, the second rack deriving its motion by means of a cluster gear, and having an amplitude some ratio of the amplitude of the first rack bar.

Other objects and important features of the

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invention will be understood from a study of the description taken hereinafter, taken together with the drawings which illustrate a preferred embodiment which the invention may assume in practice. The embodiment shown is not intended to limit the scope of the invention, the scope being limited only by the terms of the claims appended.

In the drawings, Fig. 1 is a front elevation of the winding machine according to the present invention;

Fig. 2 is a top view of the winding machine shown in Fig. 1;

Fig. 3 is an end view of the winding machine shown in Fig. 1 from the right end thereof looking toward the left;

Fig. 4 is a section taken substantially along the lines 4—4 of Fig. 2, showing details of the mechanism for level winding and the coil form holding mechanism;

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

Fig. 6 is a section taken along the lines 6—6 of Fig. 4 in the direction of the arrows;

Fig. 7 is a section taken along the lines 7—7 of Fig. 6;

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 mechanism for giving reciprocating movement to the strand guide;

Fig. 10 is a sectional view showing the construction of the revolution counter;

Fig. 11 is an enlarged elevation view showing the details of the strand guide associated with the level winding means;

Fig. 12 is a sectional view along the line 12—12 of Fig. 4;

Fig. 13 is an enlarged isometric view showing details of the adjustable bearing supporting the rack for the strand guide.

Referring now to the drawings, particularly Figs. 1 to 4, the winding machine according to the present invention is indicated generally by the ordinal 20, and comprises a base 22 which supports a casing 24. A standard 26 is suitably secured to the base 22 and has mounted thereon strand guide means indicated generally by the ordinal 28. The housing 24 has journaled therein, at 30 and 32, a rotating spindle 34 which is driven at a pulley 36, see Fig. 1, and a hand braking wheel 38 is secured to one end of the spindle 34 for braking or retarding the rotation of the spindle 34 when desired. The spindle 34 is threaded at 40 and has threaded thereat a headstock 42 for supporting one end of a coil form CF, shown in dotted outline. The other end of the coil form CF is held in a tailstock indicated generally by the ordinal 44, so arranged that the tailstock 44 is constantly biased toward the headstock 42 with the coil form CF held between.

Secured to the casing 24 is a stud and rack 46 which slidably supports a tailstock body member 48, the rack and stud 46 being threaded at 50 to receive a stop member 52, which also gives support to the tailstock body member 48. Encircling the stud and rack member 46 is a spring 54 which bottoms at one end against the stop member 52 and at the other end on the interior of the tailstock body member 48, thereby constantly urging the member 48 in a direction to hold the coil form CF between the tailstock and the headstock 42. The casing 24 also supports a stud 56 which forms a guide for the tailstock body member 48, which is slotted as at 58. The tailstock body member 48 supports a freely rotatable chuck 60 which is journaled in bearings 62.

Means are provided for moving the tailstock 44, shown in Fig. 4, to the left for a completed coil wound upon the coil form CF and for reinserting a new coil form CF between the headstock 42 and the tailstock 44. To this end, the stud and rack member 46 is provided with a rack 64, see Fig. 5, which cooperates with a pinion sector 66 suitably journaled at 68 in the tailstock body member 48, the pinion sector being provided with a handle 70, whereby upon counter clockwise rotation, as seen in Fig. 5, tailstock 44 is moved to the left as seen in Fig. 4.

The strand guide means 28, see Figs. 1, 3, and 11, which is adapted to move longitudinally of the axis of rotation of the coil form CF, layer winding a coil thereon, by means as will be presently described, comprises a pair of supports 72 which are press fitted to a rack bar 74, which is slidably supported in a pair of adjustable bearings 76, see also Fig. 2. The supports 72 are spanned by a member 78 which is held to the supports 72 by means of bolts 80 threaded into the supports 72. The member 78 supports a member 82 which is secured thereto by means of a bolt 84 threaded into one of the split ends thereof. An arm 88 is provided with a collar 86 surrounding the member 78. The arm 88 has hingedly connected thereto at 90, an arm 92 which supports a pair of freely turning sheaves 94 and 96 which guide a strand W. The pin 90 has a head 98 against which is bottomed against a spring 100, the other end of the spring 100 being bottomed against the arm 92 to provide some restraint of movement at the hinge at 90. The arm 88 is provided with an adjusting screw 102 which limits the amount of counterclockwise movement of the arm 92 with respect to the arm 88, a restrained amount of clockwise movement to the arm 92 with respect to the arm 88 being permitted by means of the spring 100.

An interiorly threaded boss 87 on the arm 88 cooperates with a knurled head screw 89, the boss 87 being encircled by a spring 91 bottomed at one end on the arm 82 and at the other end upon the knurled head of the screw 89, whereby the arm 88 may be adjusted in position with reference to the coil form CF at the start of a winding operation.

Means are provided for reciprocating the rack bar 74 longitudinally of the axis of the coil form CF, whereby upon rotation of the coil form CF between the headstock 42 and the tailstock 44, the strand guide means 28 supported on the rack bar 74 will layer wind the coil form CF. To this end, see Figs. 1 and 4, the spindle 34 is provided with a worm portion 108 which engages a worm wheel 110. Fast to the worm wheel 110 is a pinion 112 which, through a gear train comprising gears and pinions, 114, 116, 118 imparts rotation to a bevel gear 120. The bevel gear 120 meshes with a beveled gear 122 fast on a shaft 124 supported in bearing 126 and 128. The gear 114 which meshes with pinion 112 and the attendant pinion 116 of the gear 116 are journaled, see Fig. 12, on a stub shaft 111 which may be adjustably positioned in a slot 113 of an arm 115 mounted near its split end on a stud 117 in the casing 24. The pinion 116 and gear 114 are held to the arm by a member 119 threaded to the stub 111 with the pinion 116 and gear 114 between and locked by means of a spanner adapted to engage holes 121 therein. By the arrangement just described, the gear 114 and pinion can be brought into proper engagement, respectively, with pinion 112 and gear 118.

The shaft 124 has fast thereon a cylindrical cam 130, which is secured to the shaft by means of a pin 132, see Fig. 9, passing through its hub 134 and the shaft 124. The cam 130 cooperates with a follower 132 which is slidable with respect to the shaft 124 and mounted upon a bushing 136 which provides a ball race for ball bearings 138 to minimize the friction between the shaft 124 and the cam follower 132.

The cam follower 132 has secured thereto a member 140 which is provided with a pair of bosses 142 which support bearings 144. The cam follower is constantly urged to the right as seen in Fig. 9 by means of a spring 125 which bottoms at one end against the bearing 126 and a disk 127, the other end of the spring 125 abutting the member 140. A toggle arm 146, comprising two matching portions secured together by machine screws 145, is slotted at 147 and is adjustably pivoted at 148, and is provided with a cylindrical recess 150 adapted to engage the outer races of the bearings 144. The upper end of the toggle arm 146 is formed with a clevis 152 which straddles a block 154, see also Figs. 6 and 7. The block 154 is bored as at 156, and the block 154 is slidable on a stud 158 which is fixedly supported at 160, one end of the stud being supported in the casing 24 by means of a bore or a hole therein at 162.

The block 154 is formed with a pair of stub shafts 164 and 166, the stub shafts 164 and 166 being respectively fitted with shoes 168 and 170 which respectively ride on channels 172 and 174 formed in the casing 24. The shoe 168 has integrally therewith an extension 176 which is bored to receive a reciprocating member 178, which is connected to the extension 176 by means of a pin 180. The reciprocating member 178 passes through an opening in the casing 24 and exteriorly of the casing 24 is provided with a rack member 182 mounted thereon in any convenient manner, see Fig. 1. The rack member 182 meshes with a pinion 184 of a cluster gear 186 mounted on a stub shaft 188 supported by the standard 26.

The cluster gear 186 also includes a larger pinion 190 which is engaged by the rack 74, the ends of which are supported in the sliding bearing 76 which may be adjusted to proper position by means of set screws 192, see Fig. 13, according to the diameter of the pinion 190 of the cluster gear 186.

It will thus be seen that upon rotation of the spindle 34 that rotating motion will be imparted to the shaft 124 through the gear train comprising gear elements 110, 112, 114, 116, 118, 120, and 122, which will rotate the cylinder cam 130. The cam follower 132 which is constantly urged to the right as seen in Fig. 9 by means of the spring 125 will be alternately moved to the left and then to the right by the rotation of the cylinder cam 130, thereby imparting rotative movement in one direction and then in the other direction of the cluster gear 186. The pinion 190 which engages the rack 74 will then cause the rack 74 to have reciprocal movement, the amplitude of which, as compared to the amplitude of movement of the rack 182, will be in the same ratio as the ratio of number of teeth of the pinion 190 to the number of the teeth on the pinion 184. The strand guide 28 which is mounted to move with the rack 74 will thus have the same ratio of amplitude of movement to the rack 182.

It will be seen also that by a suitable selection of the teeth ratio in the cluster gear 186 that almost any desired ratio of amplitude of movement to the rack bar 182 can be maintained.

It will also be apparent that by a suitable selection of gearing in the gear train comprising gears and pinions 110, 112, 114, 116, 118, 120, and 122 that the speed of rotation of the cam 130 may be increased or decreased. If the speed of the cam 130 is increased, it will be seen that the speed of reciprocation of the member 178 will also be increased, and that the wire guide 28 will also increase in reciprocal speed that wires of larger diameter may be layer wound on the coil form CF. For smaller diameter wires, the gear train is so close in that a smaller speed is given to the cam 130 and consequently a lower speed to the wire guide 28.

Referring now to Figs. 1, 4, and 6, means are provided for giving a small amount of adjustment to the amplitude of movement to the rack 182 and the strand guide 28. To this end, the pivot point 148 of the toggle arm 146 may be suitably lowered or raised. The pivot point 148 comprises a shaft 196 journaled in a bushing 198 which rides in the slot 147 of the toggle arm 146, the shaft 196 being enlarged at 200 and adapted to be shouldered against a member 202 provided with a rack 204 whereby it may be raised or lowered by means of a pinion 206 journaled in the casing 24, and turned by means of a knurled hand wheel 208. The right end of the shaft 196 is provided with a nut and washer assembly 210, and the left end has threaded thereto a handle 212 which bears against the collar 214 which is slidable upon an elongated slot 216 in the housing 24. The collar 214 carries a pointer 218 cooperating with a suitable index scale 220 which will indicate to the operator whether to raise or lower the pivot point 148 to take care of minor changes in length of the coil form CF.

In operating the adjusting means just described, the operator turns the handle 212 to the left unlocking the shaft 196 which is in firm engagement with the rack member 202. By suitably turning the knurled wheel 208, the pointer 218 is raised or lowered a desired amount according to the longitudinal dimensions of the coil form CF and then locked into position by turning the handle 212 a small amount to the right thereby bringing the shouldered portion of the shaft 196 into firm engagement with rack member 202.

It will thus be seen by lowering or raising the pivot point 148 that the amplitude of movement of the reciprocating member 178 will be suitably increased or diminished, and that the amplitude of movement of wire or strand guide will be correspondingly increased or diminished.

Referring now to Fig. 4, means are provided for indicating the total number of turns wound upon the coil form CF. To this end, the housing 24 is provided with a substantially semicircular extension 222 for housing a revolution counter generally indicated by the ordinal 224. Referring now to Figs. 4 and 10, the worm 108 of the spindle 34 cooperates with a worm wheel 226 secured to a shaft 228 by means of a pin 230, the right end of the shaft 228 being journaled in a cover plate 232 which encloses the revolution counter 224. The left end of the shaft 228 is journaled in a bushing 234 in the casing 24, and has secured thereto in any suitable manner, as shown, an indicator 236.

The shaft 228 is suitably enlarged at 238 and has pinion teeth cut therein which mesh with a large gear 240 having a pinion 242 fast therewith, the large gear 240 and the pinion 242 being suitably journaled at 244 in the casing 24. The pinion 242 meshes with a gear 246 which is fast to the bushing 234 and rotates therewith, the bushing 234 having a reduced portion 248 which supports in any suitable manner an indicator 250. Referring now to Fig. 1, the revolution counter 224 has a suitable calibrated dial 252, the outer scale which may read from 1,000 to 10,000, and the other scale which may read from 1 to 100, said readings corresponding to the turns made by the spindle 34 and the coil form CF. For each revolution of the worm wheel 226, the pinion 238 on the shaft 228 will rotate one revolution and will cause the gear 240 to make one-tenth of a revolution, and since the pinion 242 is secured to gear 240, it also makes one-tenth of a revolution. Since gear 246 is in mesh with the pinion 242, it will make one-tenth of a revolution as the pinion 242 makes one revolution, thereby making a ratio of movement of the worm wheel 226 (and the indicator 250) to the indicator 236 of one hundred to one.

In operating the winding machine according to the present invention, the operator inserts a coil form CF between the headstock 42 and the tailstock 44 by operating the handle 70. A strand W is started on the coil form CF and the indicator set at zero. Power is applied to the spindle 34 at the pulley 38, and the strand guide 28 is caused to move reciprocally of the axis of the coil form CF. By selecting a suitable cluster gear 186, which cooperates with the rack 182 and the rack 74, any desired amplitude of movement of the rack 74 with respect to the rack 182 may be had, and the winding machine is thus not limited by the amplitude of movement of the rack 182 alone. By suitable selection of the ratio of pinion 192 to pinion 184, the wire guide 28 and its rack 74 may have larger or smaller total movement than the rack 182.

By suitably manipulating the adjustment 208 and the handle 212, see Fig. 1, the amount of travel of the strand guide 28 may be suitably adjusted to allow for small variations in length of the coil form CF.

When the indicator 224 shows that a desired number of turns has been wound upon the coil form CF, the winding machine may be stopped, the wound coil removed from between the headstock 42 and the tailstock 44 by operation of the handle 70 and a new coil form CF inserted between the tailstock 44 and the headstock 42.

The winding machine, according to the present invention, provides for the winding of coils on forms of greatly varying longitudinal dimension. The machines of the prior art would accommodate coil forms having small differences in longitudinal dimension. With the present machine, by selecting a suitable cluster gear for varying the total amount of travel of the strand guide, the longitudinal dimensions of the coil forms may be between wide limits, at the same time permitting of adjustment for minor variations in length of the coil form.

While the invention has been described in terms of a preferable embodiment thereof, its scope is not limited in terms of the embodiment shown nor otherwise than by the terms of the claims here appended.

I claim:

1. A winding machine comprising a rotating spindle for driving a coil form, wire guide means moving reciprocally of the axis of rotation of said coil form, a rack bar adapted to move reciprocally upon rotation of said spindle, a second rack bar supporting the wire guide means, a support for said second rack bar, a shaft journaled in said support, a cluster gear mounted on said shaft and connecting the rack bars for changing the amount of amplitude of movement of the wire guide means with respect to said first rack bar, and an adjustable bearing for said second rack bar mounted on said support, whereby the second rack bar may be raised or lowered according to the diameter of the cluster gear.

2. A winding machine comprising a rotating spindle for driving a coil form, wire guide means moving reciprocally of the axis of rotation of said coil form, a rack bar adapted to move reciprocally upon rotation of said spindle, a second rack bar supporting the wire guide means, a support for said second rack bar, a shaft journaled in said support, a cluster gear mounted on said shaft comprising a pair of pinions, the smaller being in engagement with the first said rack bar, the larger pinion being in engagement with the second rack bar, whereby the amplitude of movement of the wire guide means is increased, and an adjustable bearing for said second rack bar mounted on said support, whereby the second rack bar may be raised or lowered according to the diameter of the larger pinion.

3. A winding machine comprising a rotating spindle for driving a coil form, wire guide means moving reciprocally of the axis of said coil form, a shaft driven by said spindle and having a rotating cam mounted thereon, a reciprocating member following the contour of said cam, a second reciprocating member, a toggle connection between said last mentioned reciprocating members, means for adjusting the position of the pivot point of said toggle for adjusting the amplitude of movement of said second reciprocating member, a driving rack bar attached to said second reciprocating member, a driven second rack bar supporting the wire guide means, and means connecting the rack bars affording adjustment facilities for selecting a desired ratio between distances moved by said driving rack bar and corresponding distances moved by said wire guide means, said connecting means including a pair of replaceable gears of relative size determined by said ratio, and a rotatable shaft to which said gears are fixedly secured, one of said rack bars being adjustably positionable according to the size of its associated gear.

4. A winding machine comprising a rotating spindle for driving a coil form, wire guide means moving reciprocally of the axis of said coil form, a shaft driven by said spindle and having a rotating cam mounted thereon, a reciprocating member following the contour of said cam, a second reciprocating member, a toggle connection between said last mentioned reciprocating members, means for adjusting hte position of the pivot point of said toggle for adjusting the amplitude of movement of said second reciprocating member, a rack bar attached to said second reciprocating member, a second rack bar supporting the wire guide means, a support for said second rack bar, a shaft journaled in said support, a cluster gear mounted on said shaft and connecting the rack bars for changing the amplitude of movement of the wire guide means with respect to the said first rack bar, and means for adjusting the position of one of said rack bars according to the diameter of the cluster gear.

5. A winding machine comprising a rotating spindle for driving a coil form, wire guide means moving reciprocally of the axis of said coil form, a shaft driven by said spindle and having a rotating cam mounted thereon, a reciprocating member adapted to follow the contour of said cam, a rack bar attached to said reciprocating member, a second rack bar supporting the wire guide means, a support for said second rack bar, a shaft journaled in said support, and a cluster gear mounted on said shaft and connecting the rack bars for changing the amplitude of movement of the wire guide means with respect to the first said rack bar, and an adjustable bearing for said second rack bar mounted on said support, whereby the second rack bar may be raised or lowered according to the diameter of the cluster gear.

6. A winding machine comprising a rotating spindle for driving a coil form, wire guide means moving reciprocally of the axis of said coil form, a shaft driven by said spindle and having a rotating cam mounted thereon, a reciprocating member adapted to follow the contour of said cam, a rack bar attached to said reciprocating member, a second rack bar supporting the wire guide means, a support for said second rack bar, a shaft journaled in said support, a cluster gear mounted on said shaft comprising a pair of pinions, the smaller being in engagement with the first said rack bar, the larger pinion being in engagement with the second rack bar for increasing the amplitude of movement of the second rack bar, and an adjustable bearing for said second rack bar mounted on said support, whereby the second rack bar may be raised or lowered according to the diameter of the larger pinion.

7. A winding machine comprising a rotating spindle for driving a coil form, wire guide means moving reciprocably of the axis of said coil form, a shaft driven by said spindle and having a rotating cam mounted thereon, a reciprocating member following the contour of said cam, a second reciprocating member, a toggle connection between said last mentioned reciprocating member, means for adjusting the position of the pivot point of said toggle for adjusting the amplitude of movement of said second reciprocating member, a rack bar attached to said second reciprocating member, a second rack bar supporting the wire guide means, a support for said second rack bar, a shaft journaled in said support, a cluster gear mounted on said shaft comprising a pair of pinions, the smaller being in engagement with the first said rack, the larger being in engagement with the second rack bar, and adjustable positioning means associated with one of said rack bars affording

facilities for positioning such bar according to the size of its respective pinion, whereby said cluster gear may be replaced by one having pinions of different relative size to effect a change in the amplitude of movement of the wire guide means.

8. A winding machine comprising a rotating spindle for driving a coil form, wire guide means moving reciprocably of the axis of said coil form, a shaft driven by said spindle and having a rotating cam mounted thereon, a reciprocating member following the contour of said cam, a second reciprocating member, a toggle connection between said last mentioned reciprocating members, means for adjusting the position of the pivot point of said toggle for adjusting the amplitude of movement of said second reciprocating member, a rack bar attached to said second reciprocating member, a second rack bar supporting the wire guide means, a support for said second rack bar, a shaft journaled in said support, a cluster gear mounted on said shaft and connecting the rack bars for changing the amplitude of movement of the wire guide means, and an adjustable bearing for said second rack bar mounted on said support, whereby the second rack bar may be raised or lowered according to the diameter of the cluster gear.

9. A winding machine comprising a rotating spindle for driving a coil form, wire guide means moving reciprocably of the axis of said coil form, a shaft driven by said spindle and having a rotating cam mounted thereon, a reciprocating member following the contour of said cam, a second reciprocating member, a toggle connection between said last mentioned reciprocating members, means for adjusting the position of the pivot point of said toggle for adjusting the amplitude of movement of said second reciprocating member, a rack bar attached to said second reciprocating member, a second rack bar supporting the wire guide means, a support for said second rack bar, a shaft journaled in said support, a cluster gear mounted on said shaft comprising a pair of pinions, one of pinions being in engagement with the first said rack bar, the other pinion being in engagement with the second rack bar, and an adjustable bearing for said second rack bar mounted on said support, whereby the second rack bar may be raised or lowered according to the diameter of the larger pinion.

MORRIS ROSE.

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