March 10, 1925. 1,528,997

B. L. VAN ORMAN

SPRING COILING MACHINE

Filed Aug. 22, 1923 18 Sheets-Sheet 1

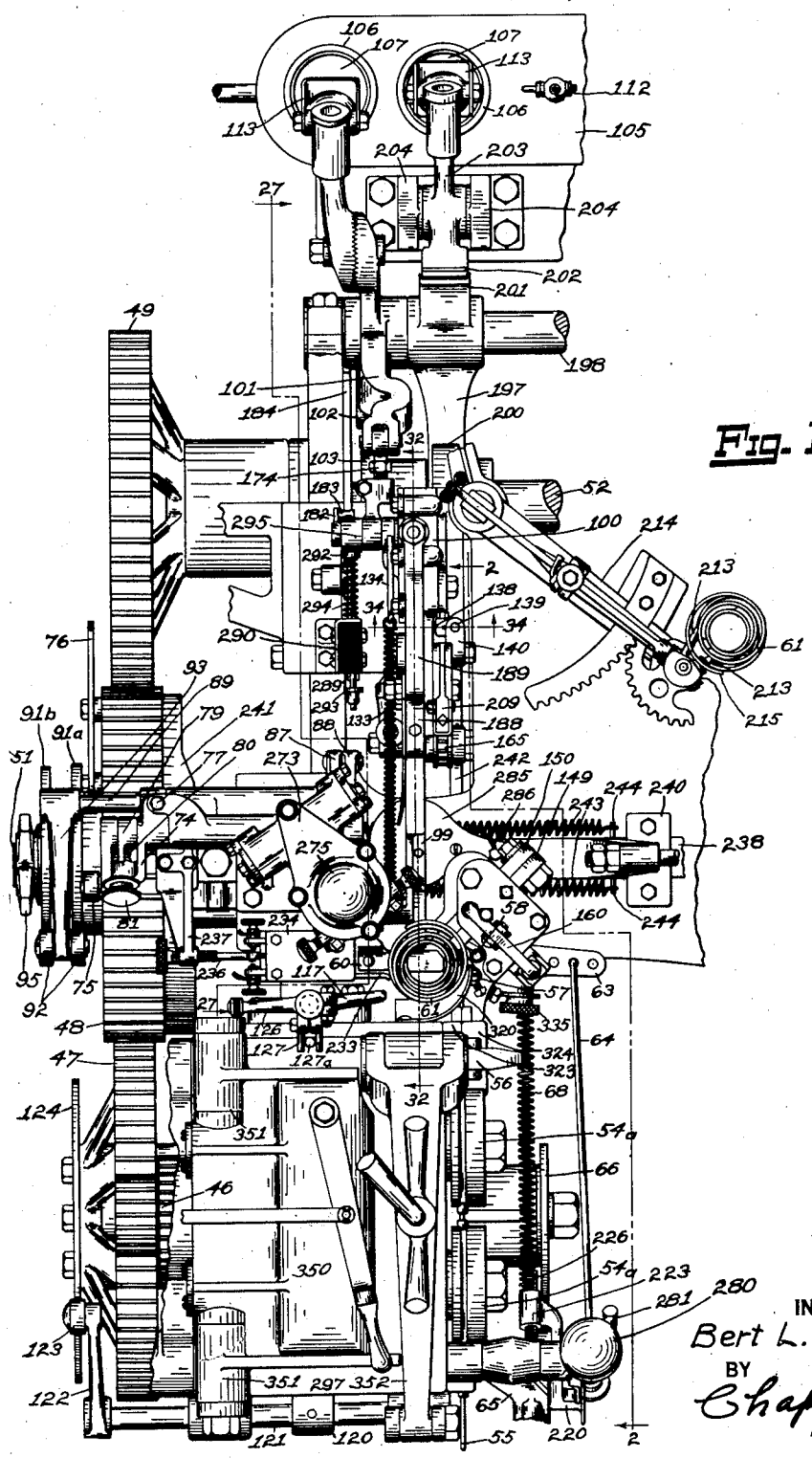


Fig. I

INVENTOR
Bert L. Van Orman
BY
Chappell Earl
ATTORNEYS

March 10, 1925. 1,528,997

B. L. VAN ORMAN

SPRING COILING MACHINE

Filed Aug. 22, 1923 18 Sheets-Sheet 2

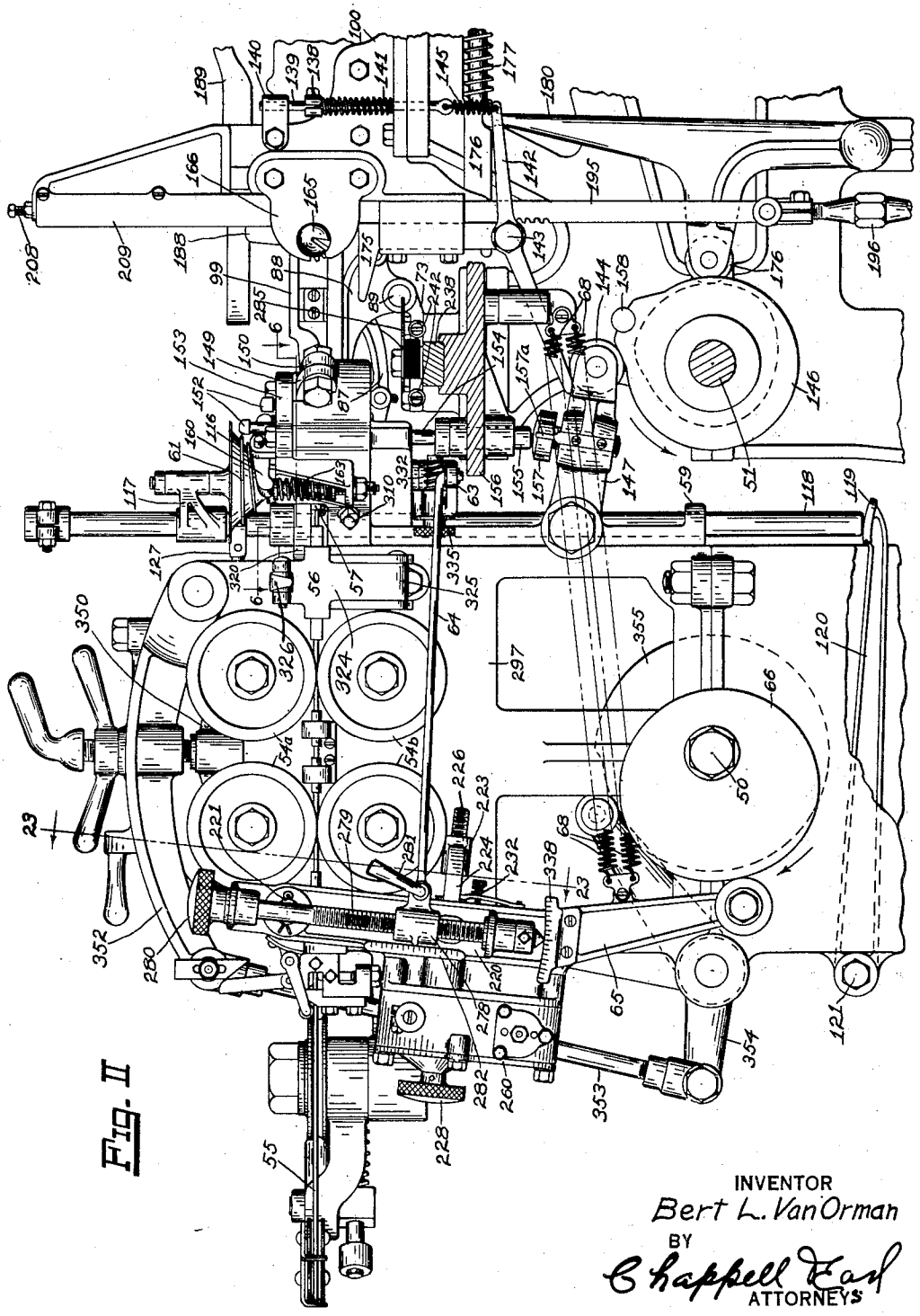


Fig. II

INVENTOR
Bert L. VanOrman
BY
Chappell Earl
ATTORNEYS

March 10, 1925. 1,528,997

B. L. VAN ORMAN

SPRING COILING MACHINE

Filed Aug. 22, 1923 18 Sheets-Sheet 3

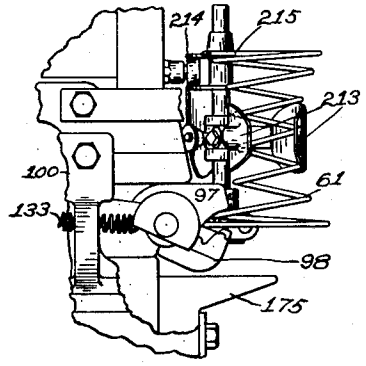


FIG. XXX

FIG. III

INVENTOR
Bert L. Van Orman
BY
Chappell & Earl
ATTORNEYS

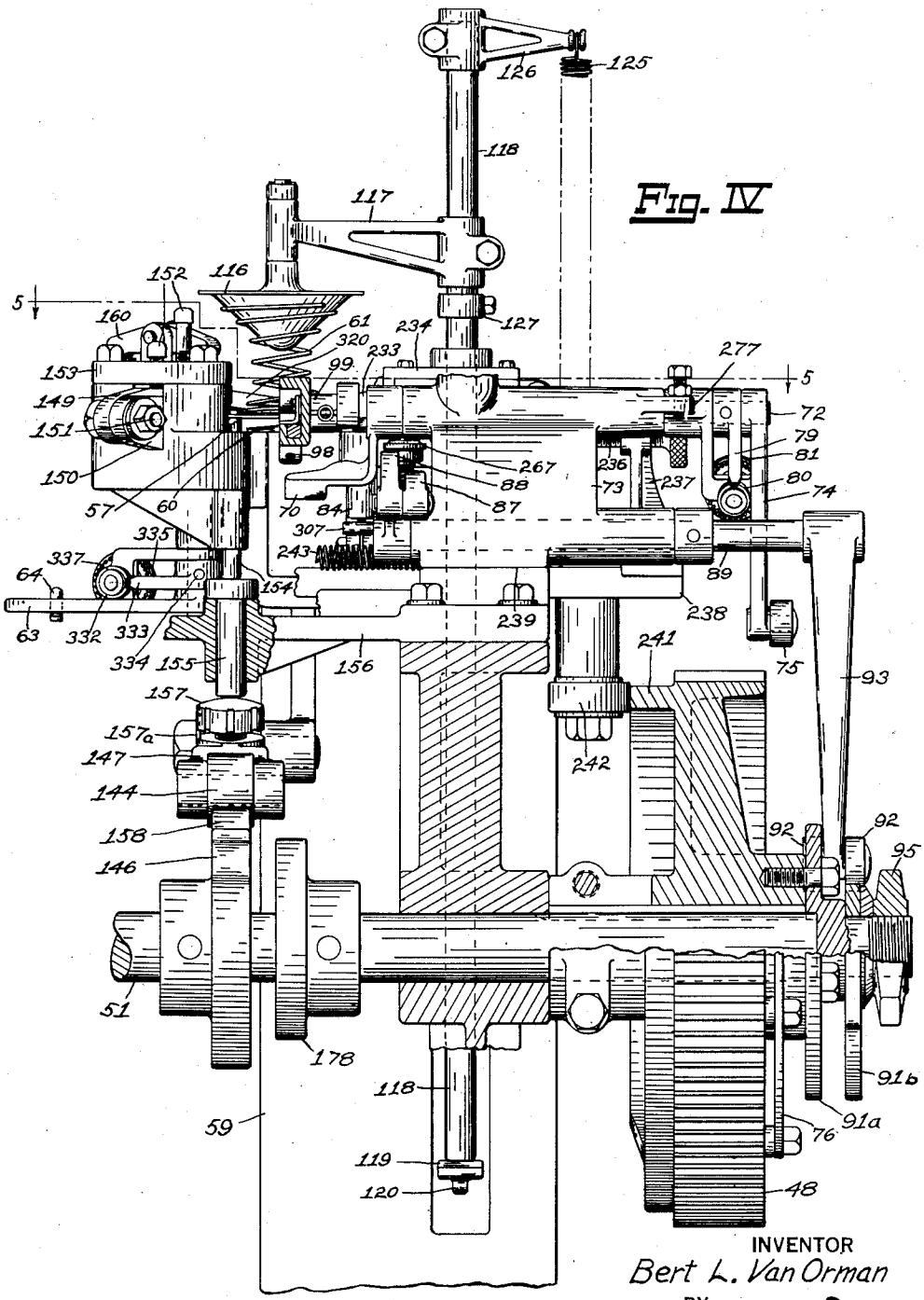
March 10, 1925. 1,528,997

B. L. VAN ORMAN

SPRING COILING MACHINE

Filed Aug. 22, 1923 18 Sheets-Sheet 4

Fig. IV



INVENTOR

Bert L. Van Orman

BY

Chappell & Earl

ATTORNEYS

March 10, 1925. 1,528,997

B. L. VAN ORMAN

SPRING COILING MACHINE

Filed Aug. 22, 1923 18 Sheets-Sheet 5

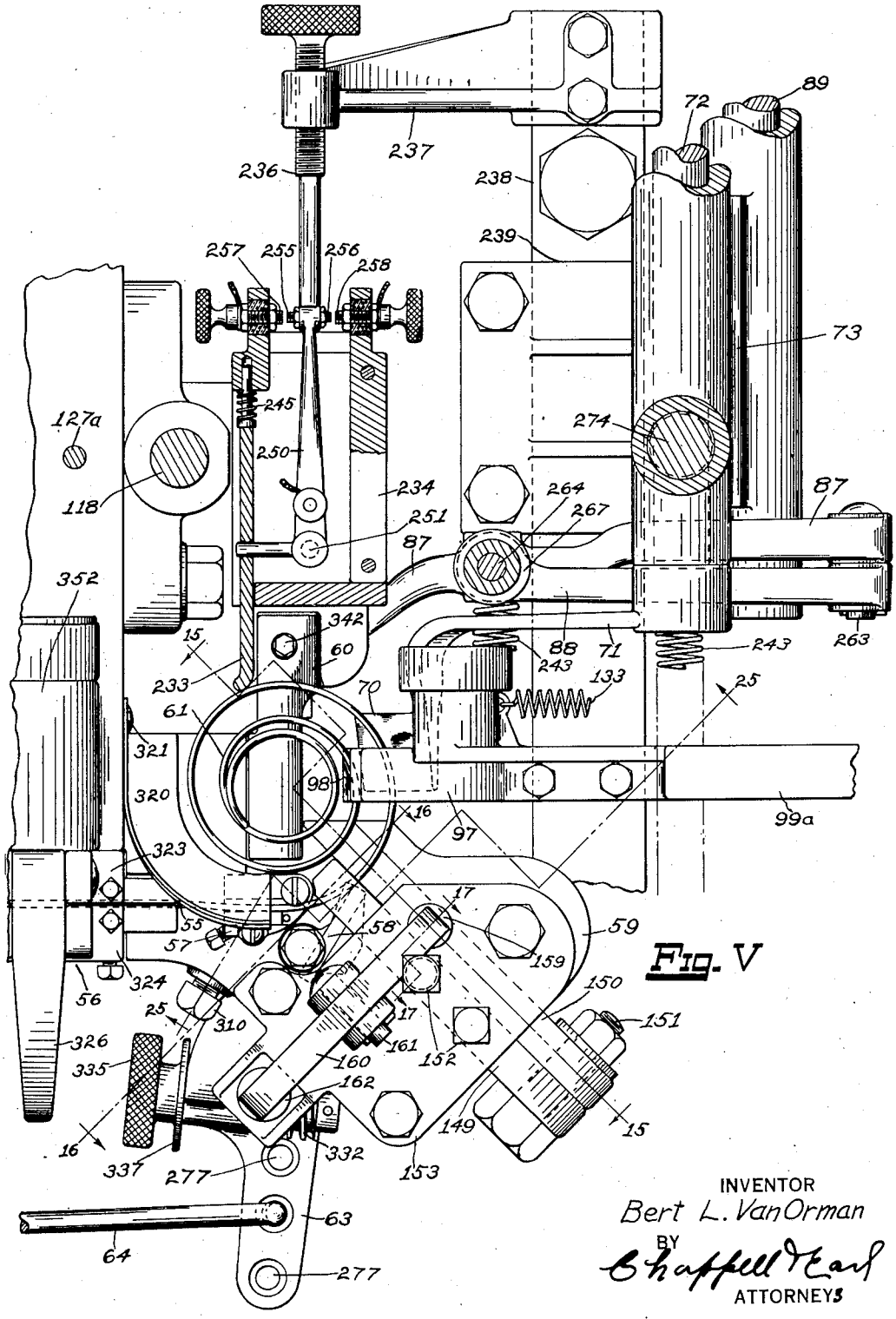


Fig. V

INVENTOR
Bert L. VanOrman
BY
Chappell & Earl
ATTORNEYS

March 10, 1925. 1,528,997

B. L. VAN ORMAN

SPRING COILING MACHINE

Filed Aug. 22, 1923 18 Sheets-Sheet 6

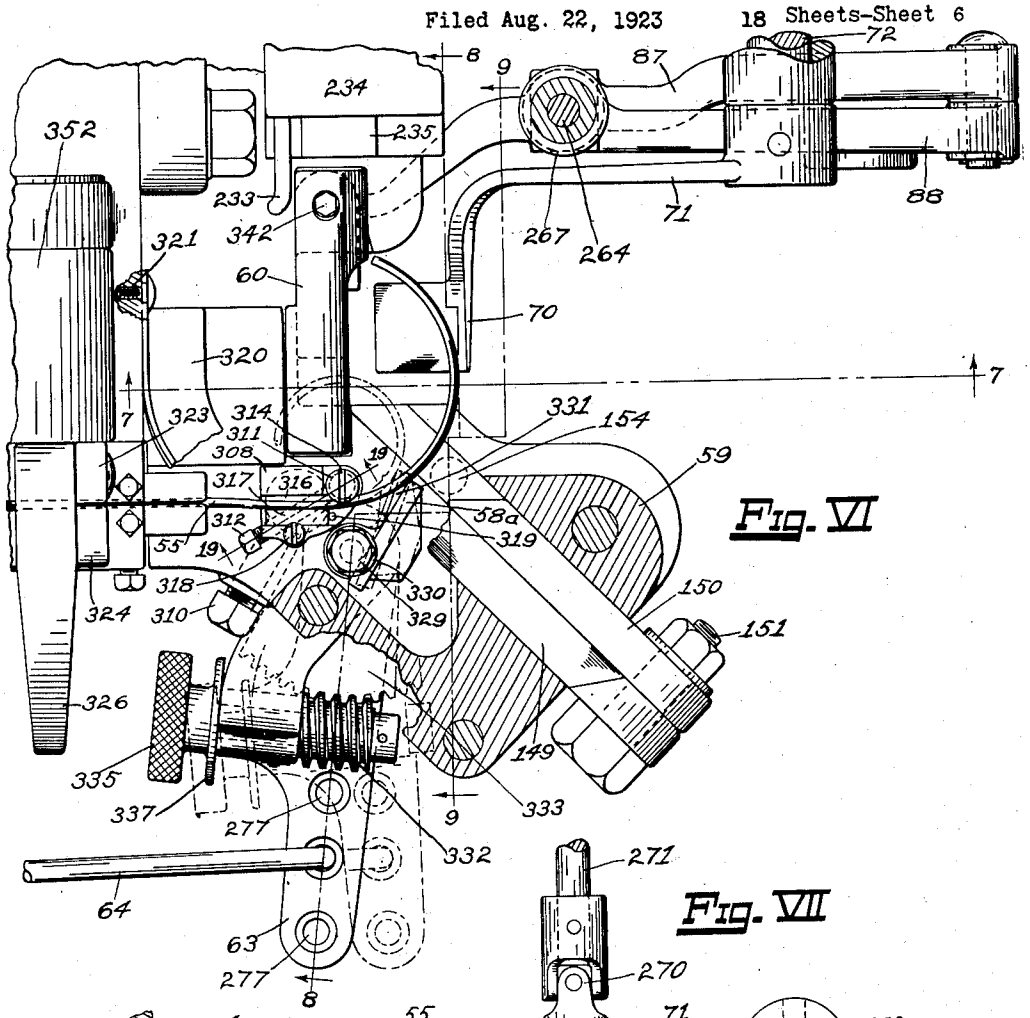


Fig. VI

Fig. VII

INVENTOR

Bert L. VanOrman

BY

Chappell Hearl

ATTORNEYS

March 10, 1925. 1,528,997

B. L. VAN ORMAN

SPRING COILING MACHINE

Filed Aug. 22, 1923 18 Sheets-Sheet 7

Fig. VIII

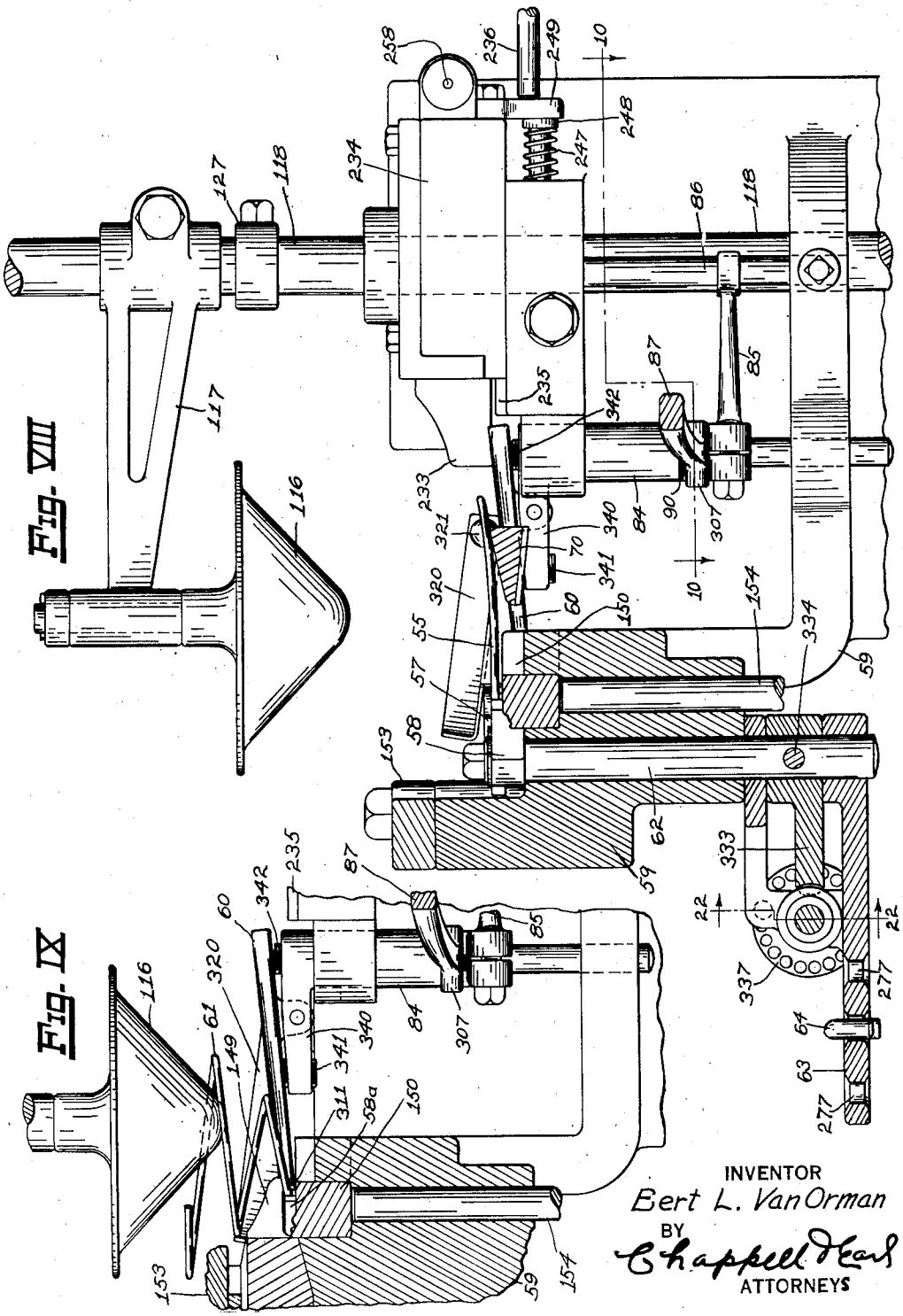


Fig. IX

INVENTOR
Bert L. Van Orman
BY
Chappell Hearn
ATTORNEYS

March 10, 1925. 1,528,997

B. L. VAN ORMAN

SPRING COILING MACHINE

Filed Aug. 22, 1923 18 Sheets-Sheet 8

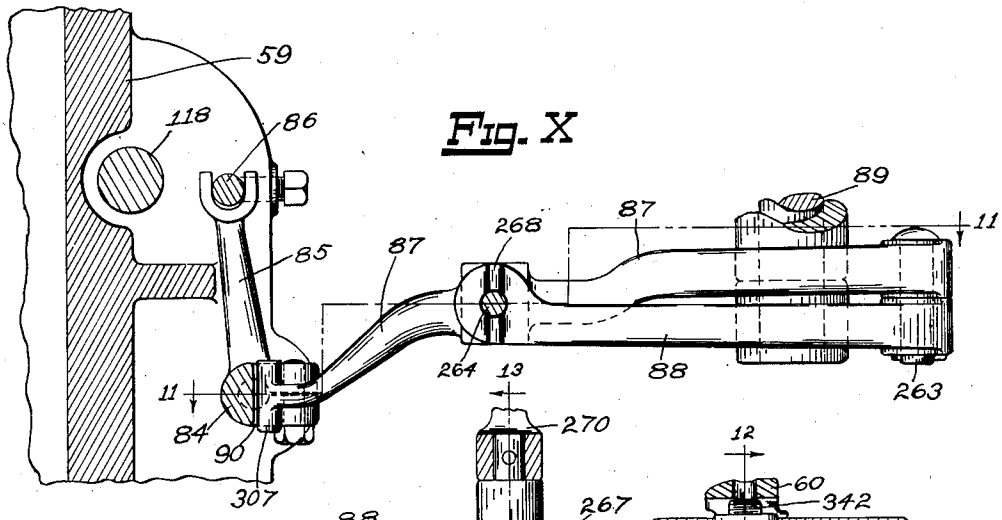


Fig. X

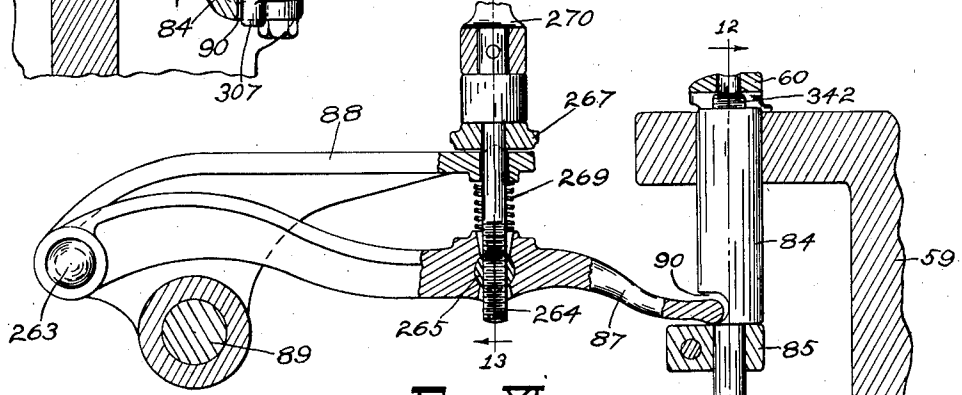


Fig. XI

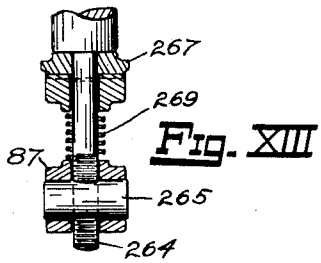


Fig. XIII

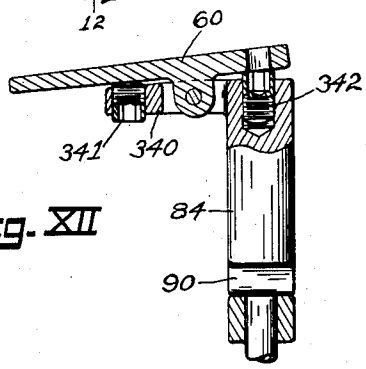


Fig. XII

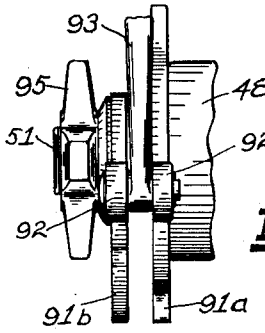


Fig. XIV

INVENTOR
Bert L. VanOrman
BY
Chappell & Earl
ATTORNEYS

March 10, 1925. 1,528,997

B. L. VAN ORMAN

SPRING COILING MACHINE

Filed Aug. 22, 1923 18 Sheets-Sheet 9

Fig. XV

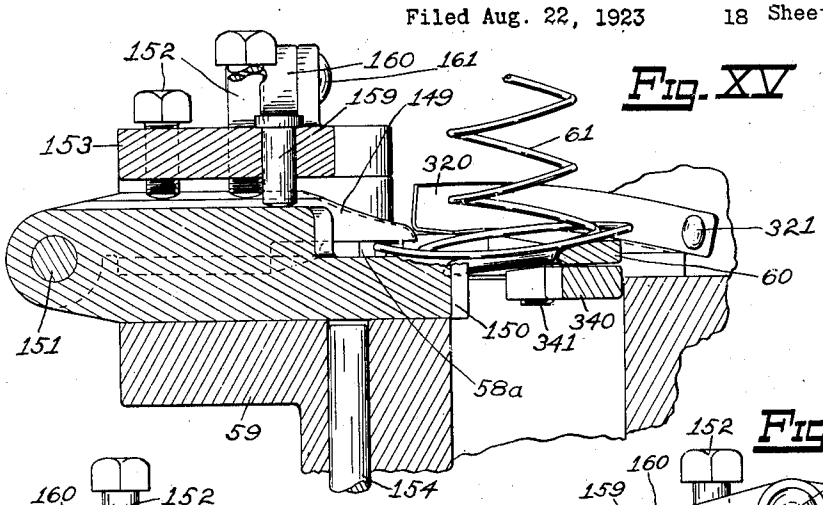


Fig. XVI

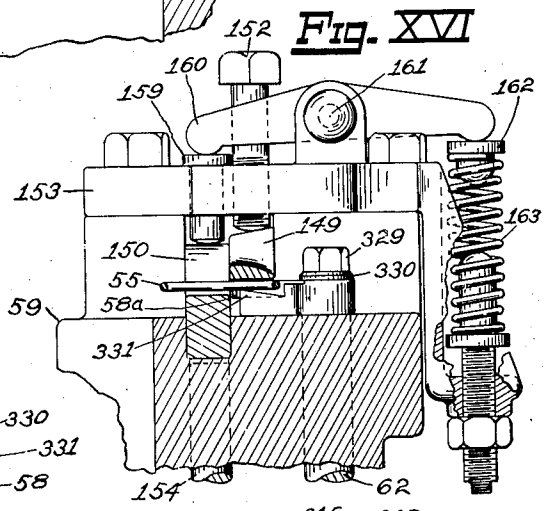
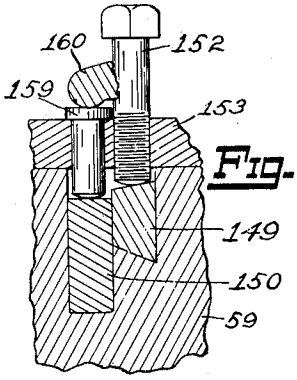


Fig. XVII



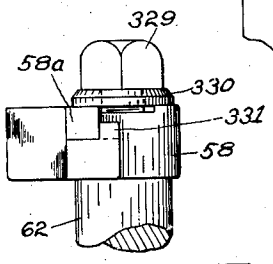


Fig. XXI

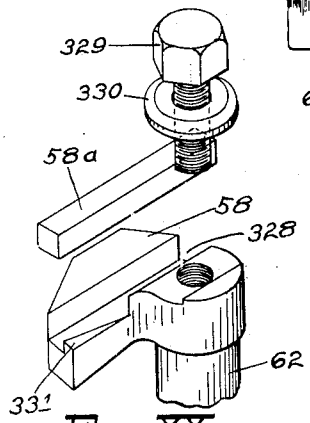


Fig. XX

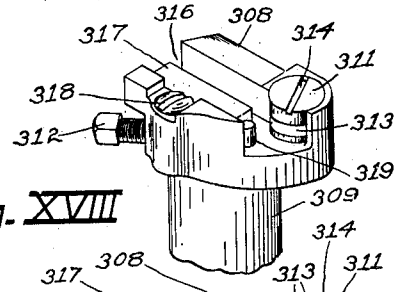


Fig. XVIII

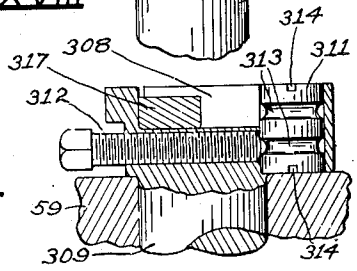


Fig. XIX

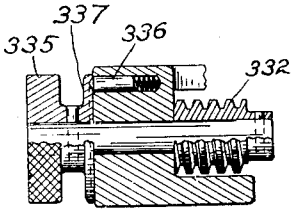


Fig. XXII

INVENTOR

Bert L. VanOrman

BY

Chappell Earl

ATTORNEYS

March 10, 1925. 1,528,997

B. L. VAN ORMAN

SPRING COILING MACHINE

Filed Aug. 22, 1923. 18 Sheets-Sheet 10

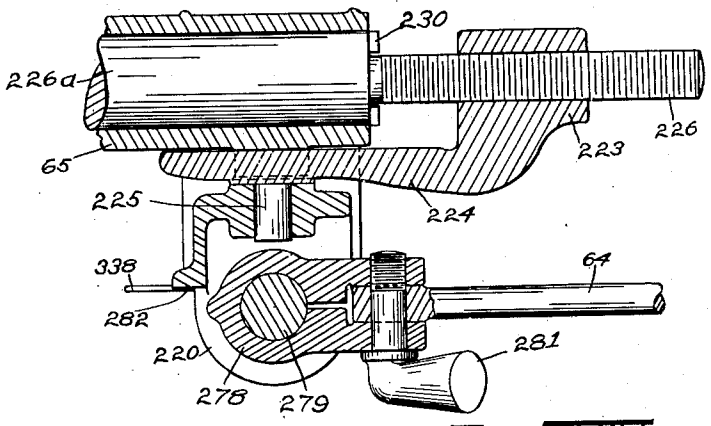


Fig. XXIV

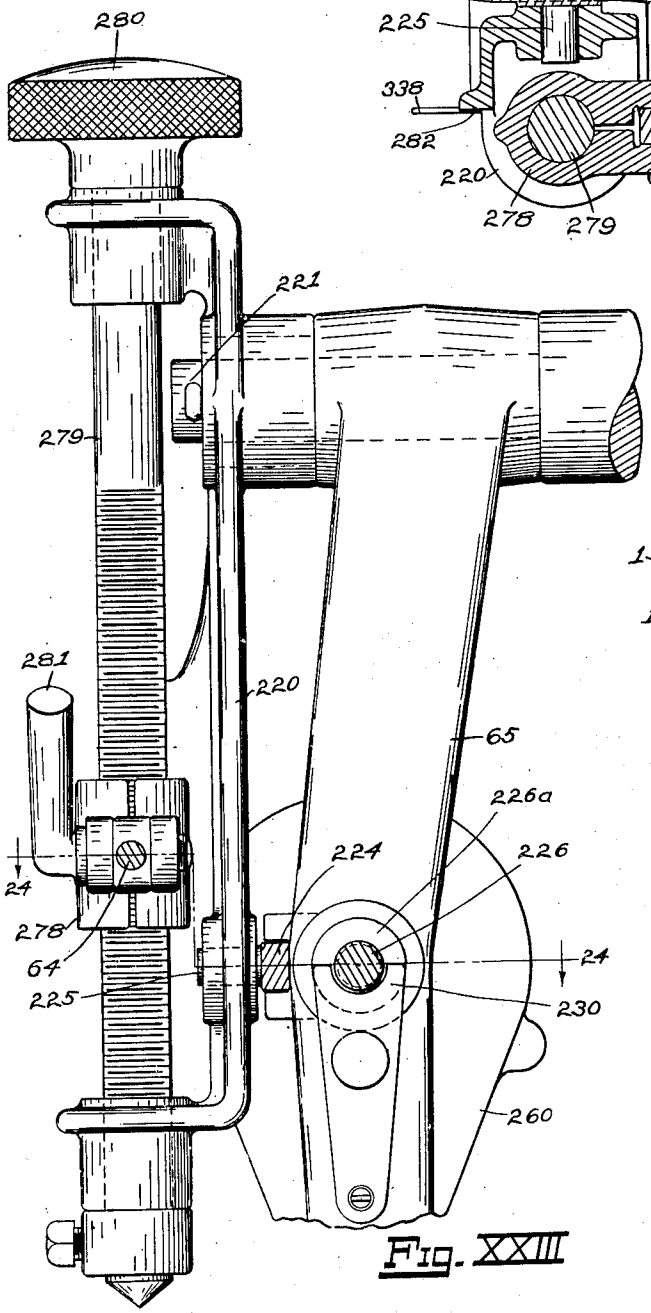


Fig. XXIII

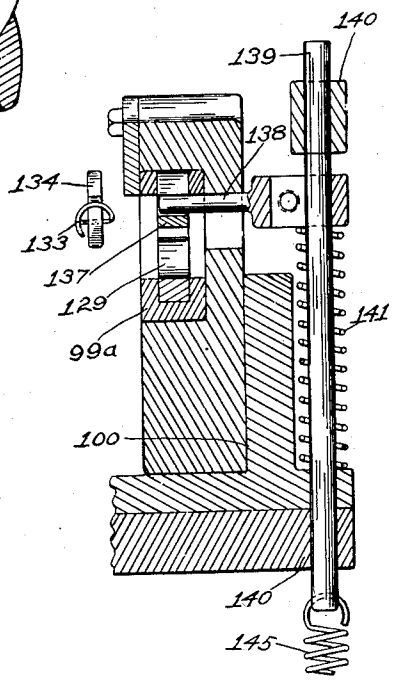


Fig. XXXIV

INVENTOR

Bert L. VanOrman

BY

Chappell Earl

ATTORNEYS

March 10, 1925. 1,528,997

B. L. VAN ORMAN

SPRING COILING MACHINE

Filed Aug. 22, 1923 18 Sheets-Sheet 11

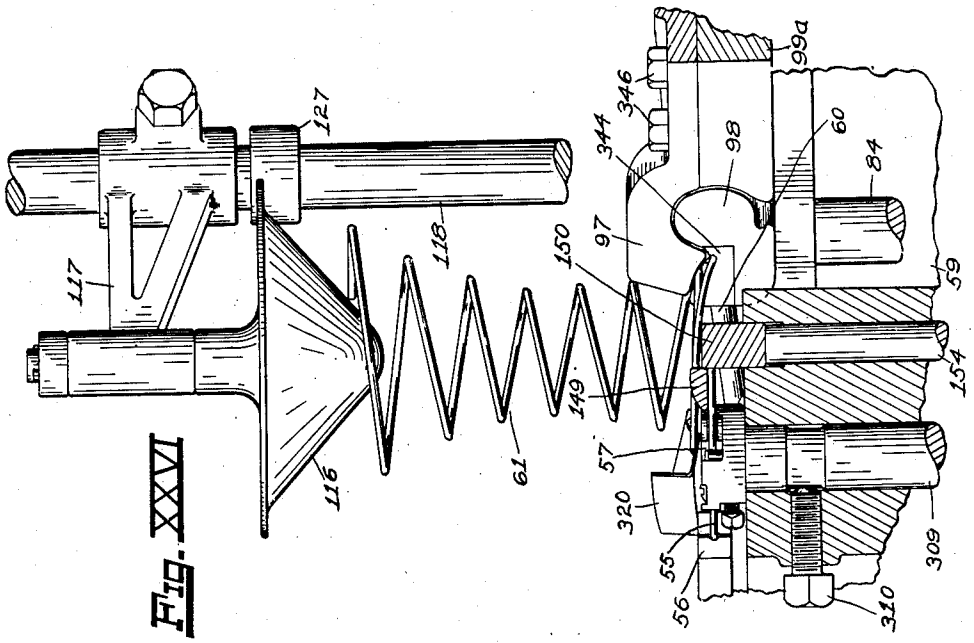


Fig. XXVI

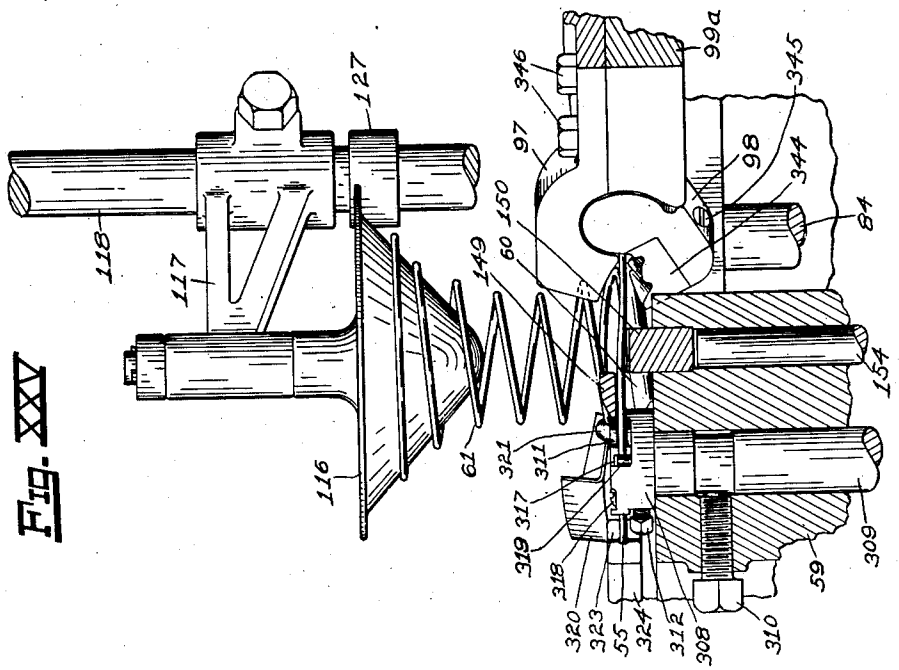


Fig. XXV

INVENTOR

Bert L. VanOrman

BY

Chappell Mark

ATTORNEYS

March 10, 1925. 1,528,997

B. L. VAN ORMAN

SPRING COILING MACHINE

Filed Aug. 22, 1923 18 Sheets-Sheet 12

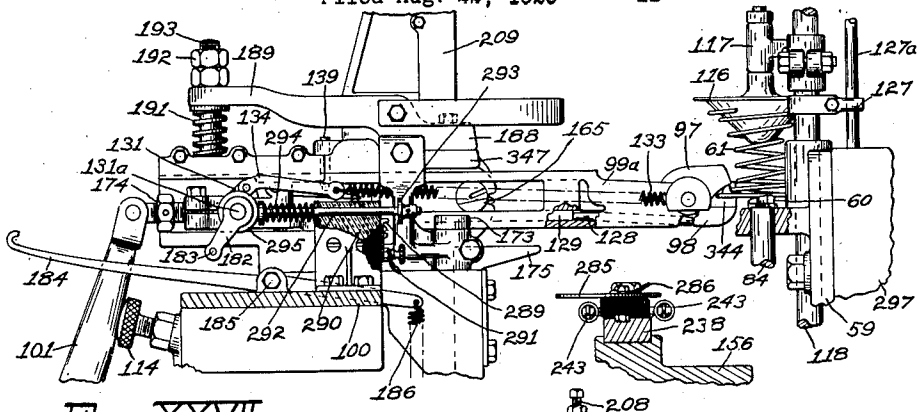


Fig. XXVII

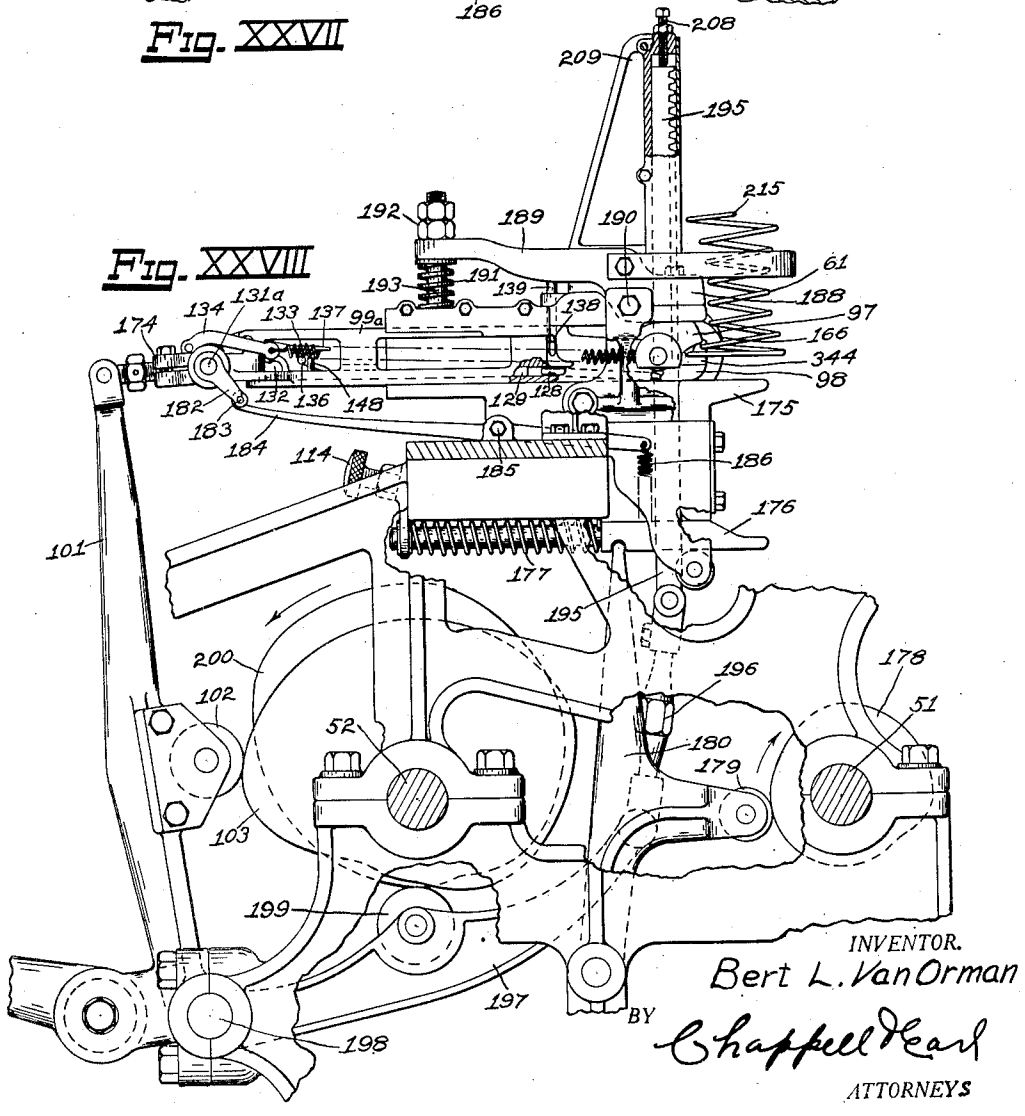


Fig. XXVIII

INVENTOR.
Bert L. Van Orman
BY
Chappell Pearl
ATTORNEYS

March 10, 1925. 1,528,997

B. L. VAN ORMAN

SPRING COILING MACHINE

Filed Aug. 22, 1923 18 Sheets-Sheet 13

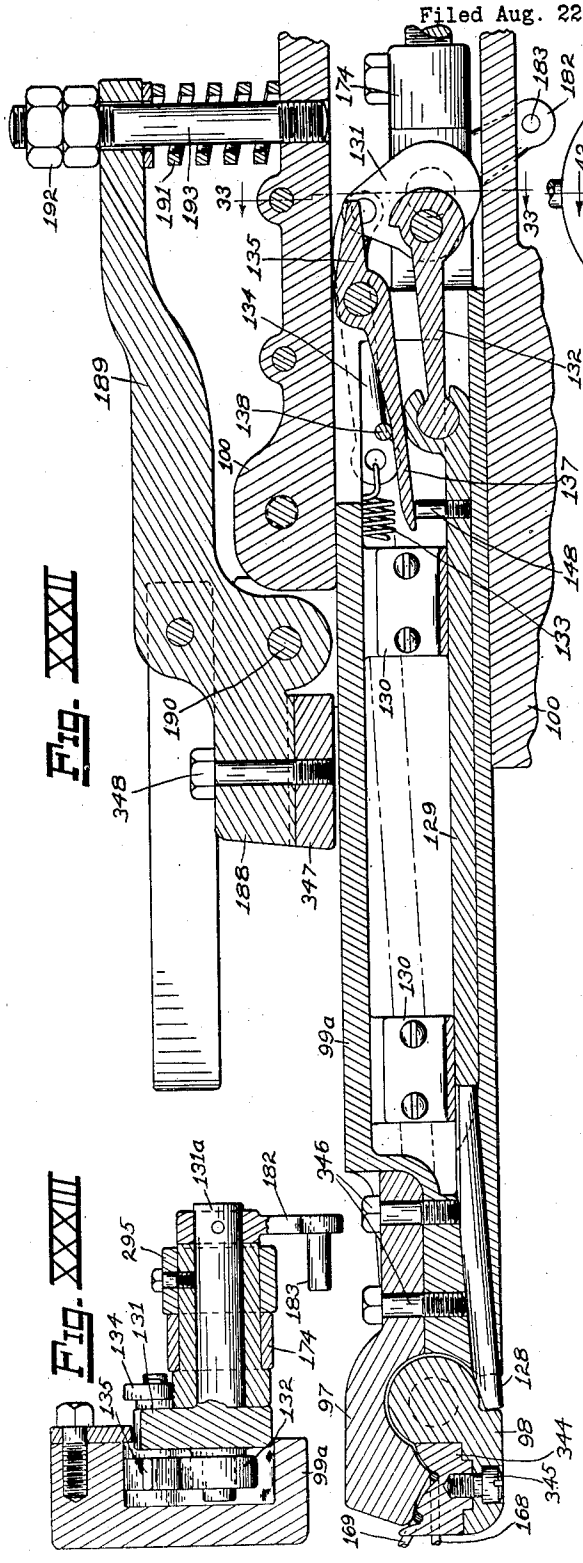


Fig. XXXII

Fig. XXXIII

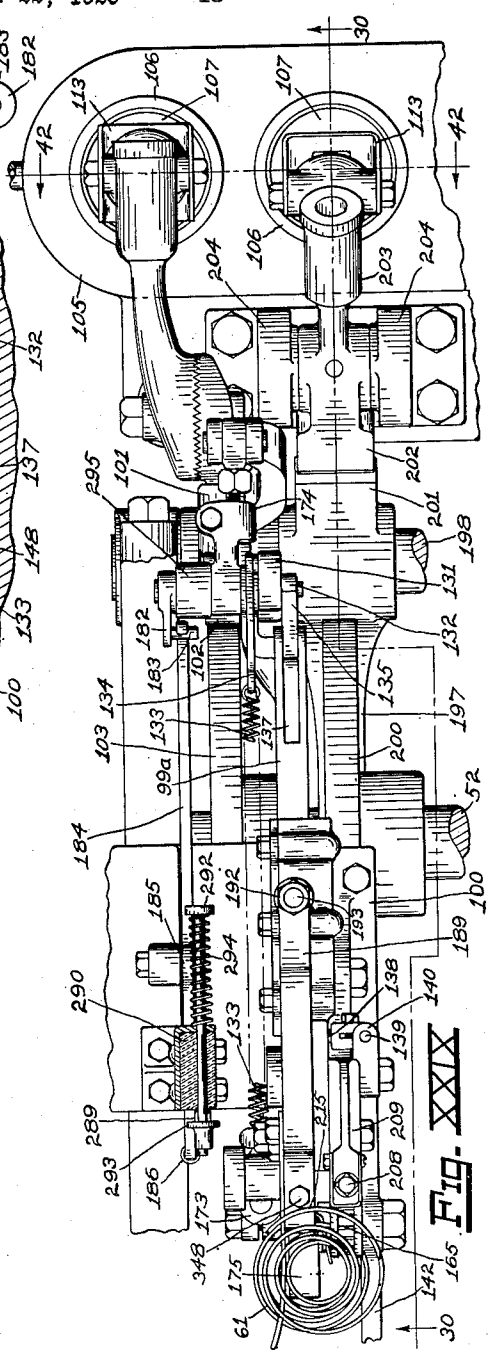


Fig. XXIX

INVENTOR

Bert L. VanOrman

BY

Chappell Teal

ATTORNEYS

March 10, 1925.

1,528,997

B. L. VAN ORMAN

SPRING COILING MACHINE

Filed Aug. 22, 1923 18 Sheets-Sheet 14

Fig. XXX

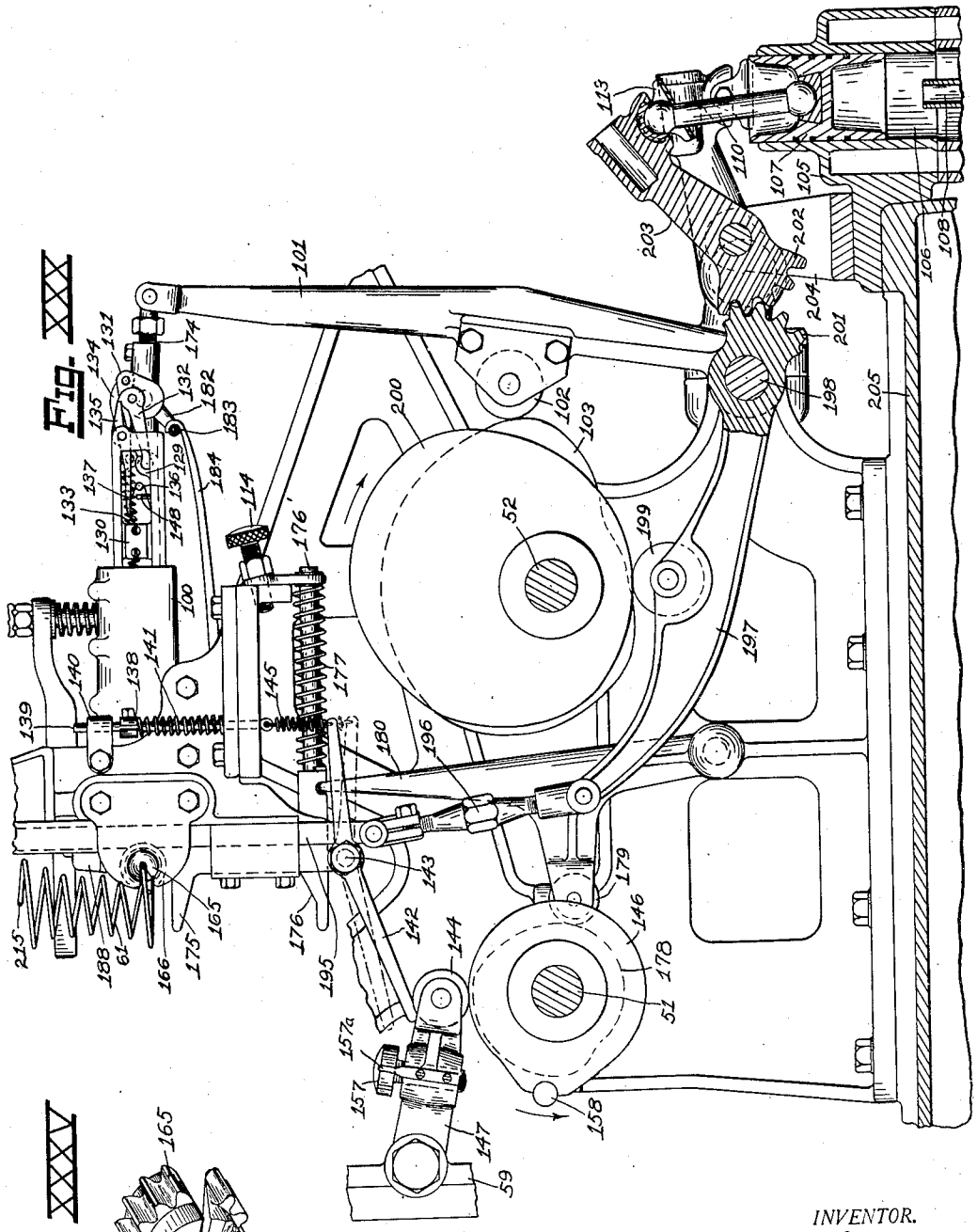
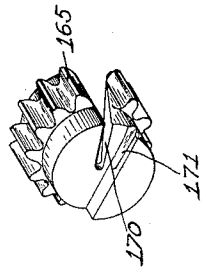


Fig. XXXV



INVENTOR.
Bert L. Van Orman
BY Chappell & Earl
ATTORNEYS

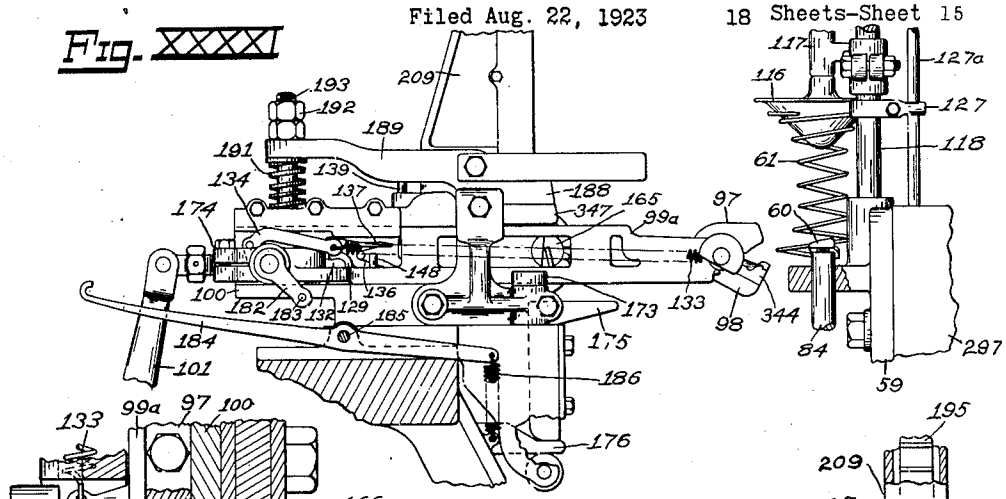
March 10, 1925. 1,528,997

B. L. VAN ORMAN

SPRING COILING MACHINE

Filed Aug. 22, 1923 18 Sheets-Sheet 15

Fig. XXXI



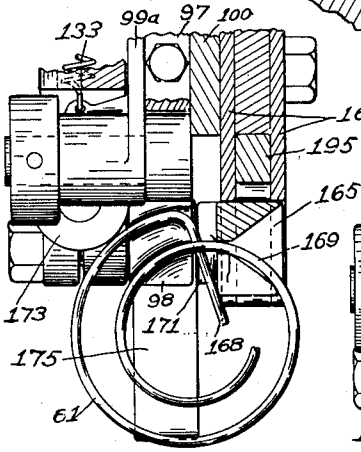


Fig. XXXVII

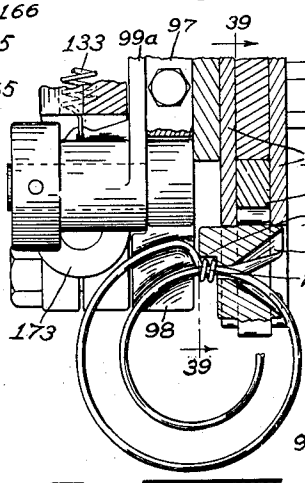


Fig. XXXVIII

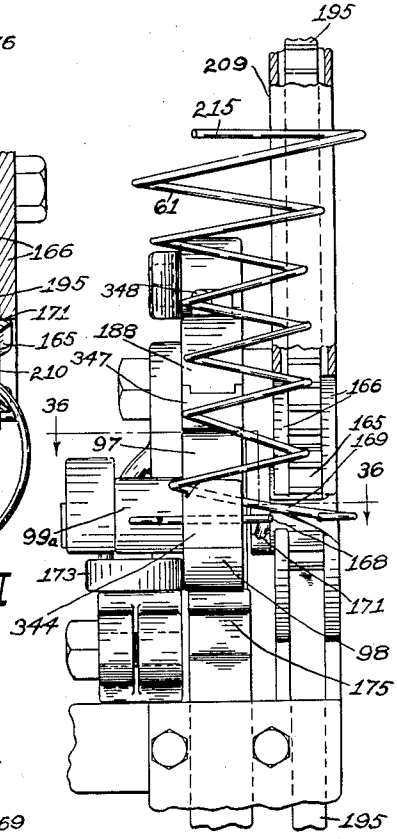


Fig. XXXI

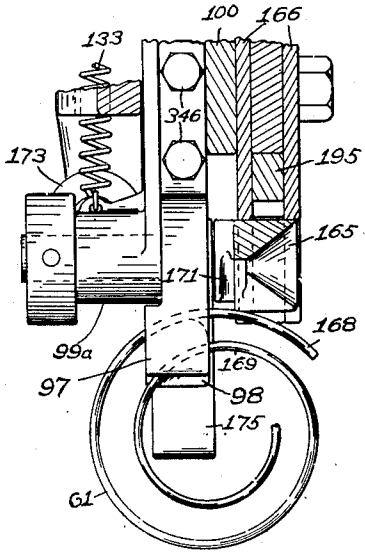


Fig. XXXVI

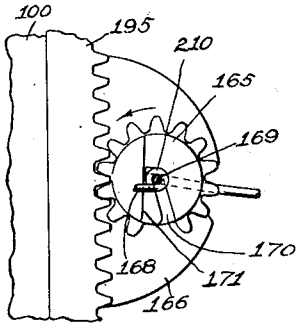


Fig. XXXIX

INVENTOR
Bert L. VanOrman
BY
C. Russell Kerr
ATTORNEYS

March 10, 1925. 1,528,997

B. L. VAN ORMAN

SPRING COILING MACHINE

Filed Aug. 22, 1923 18 Sheets-Sheet 16

Fig. XXXXIII

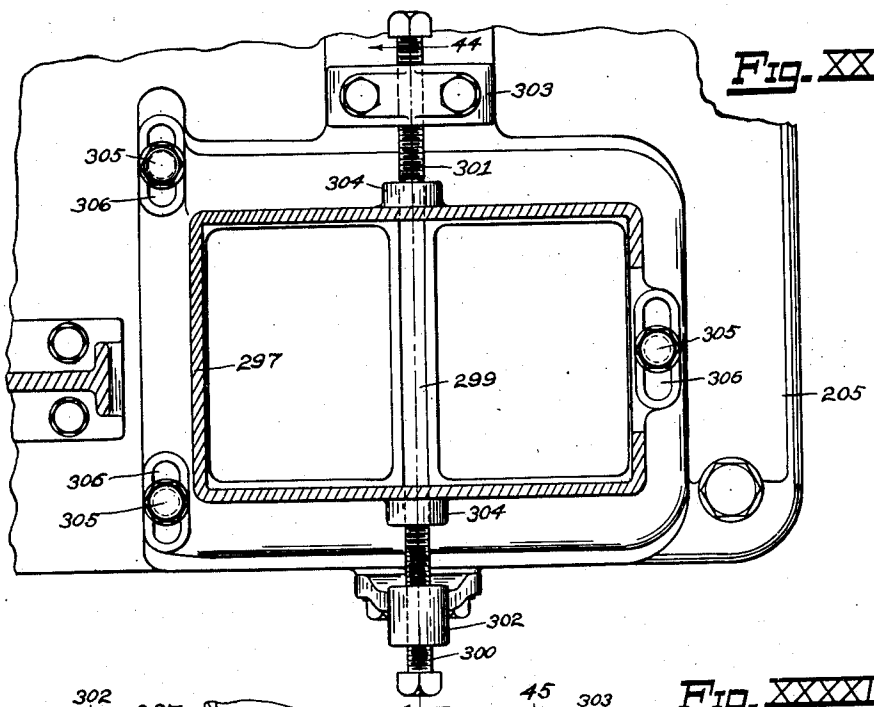


Fig. XXXXIV

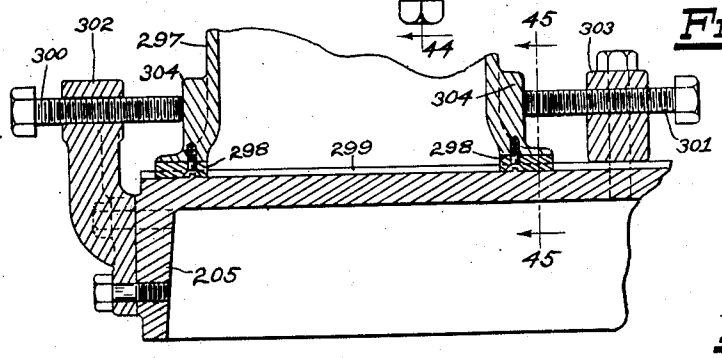
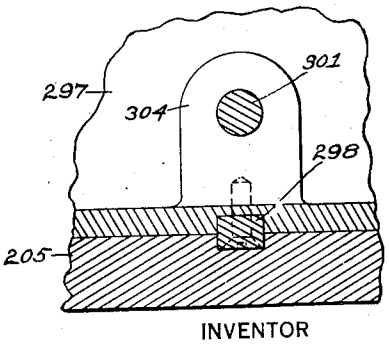


Fig. XXXXV



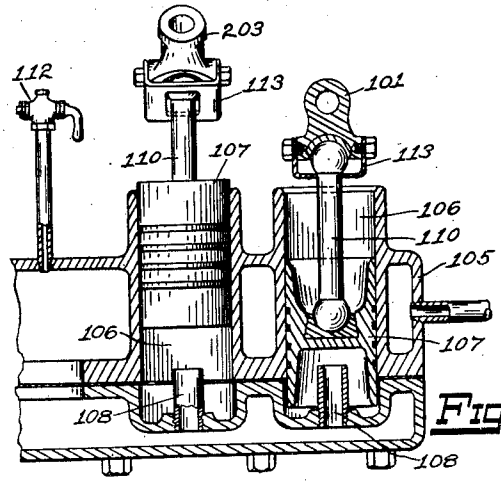


Fig. XXXXII

INVENTOR

Bert L. Van Orman

BY

Chappell & Earl

ATTORNEYS

March 10, 1925. 1,528,997

B. L. VAN ORMAN

SPRING COILING MACHINE

Filed Aug. 22, 1923 18 Sheets-Sheet 17

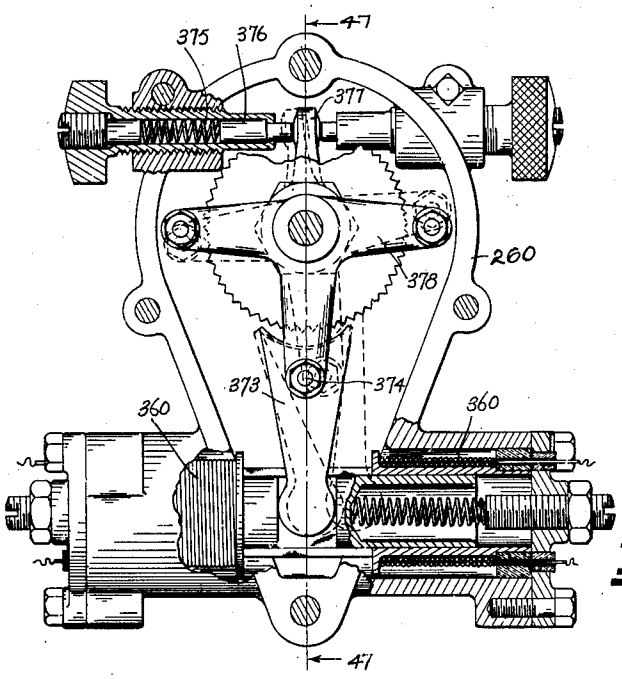


Fig. XLVI.

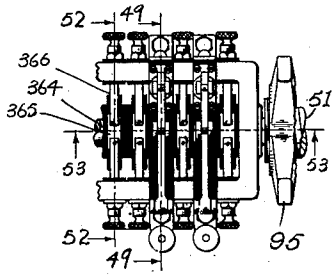


Fig. XLVIII.

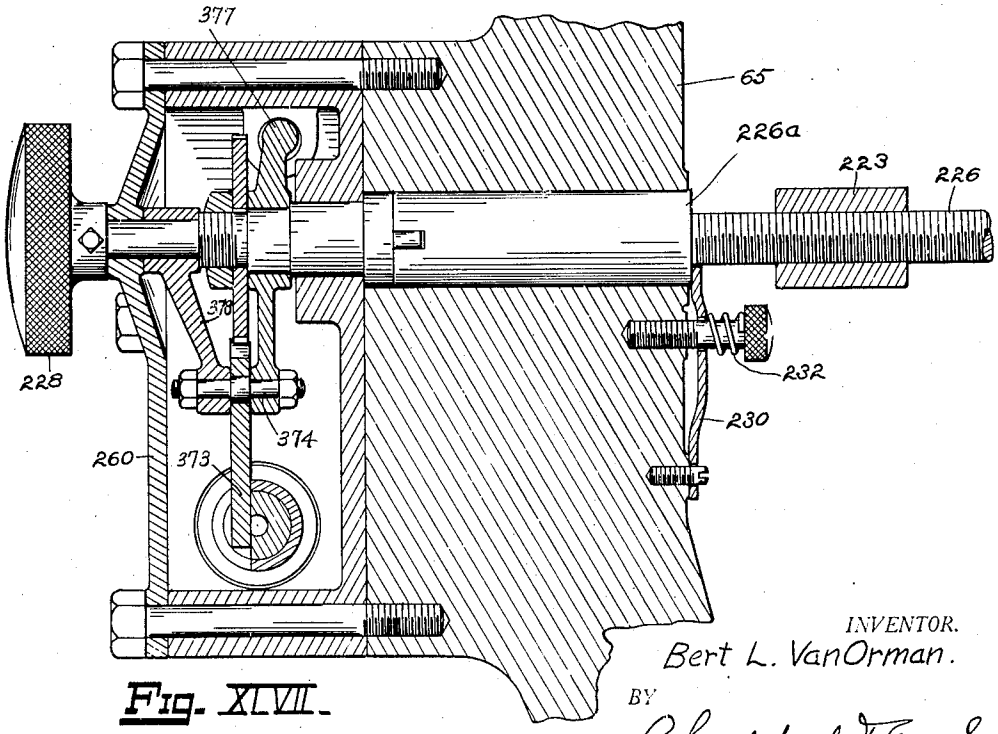


Fig. XLVII.

INVENTOR.
Bert L. VanOrman.
BY
Chappell Teare
ATTORNEYS

March 10, 1925. 1,528,997

B. L. VAN ORMAN

SPRING COILING MACHINE

Filed Aug. 22, 1923 18 Sheets-Sheet 18

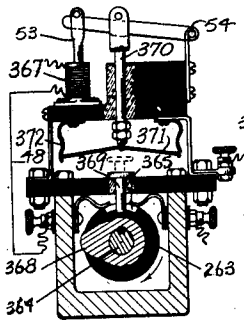


Fig. XLIX.

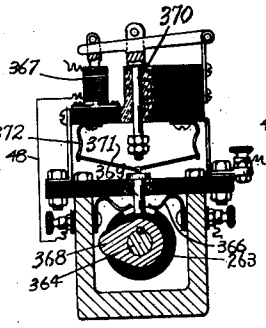


Fig. L.

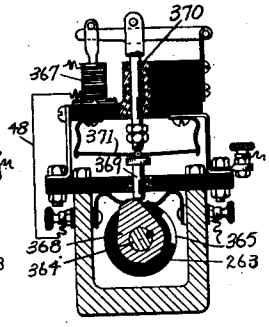


Fig. LI.

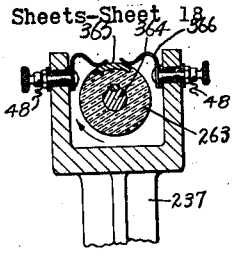


Fig. LII.

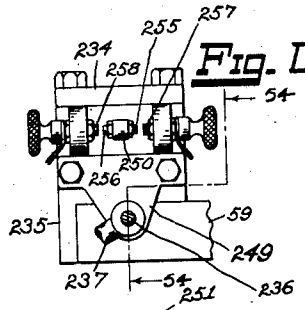


Fig. LV.

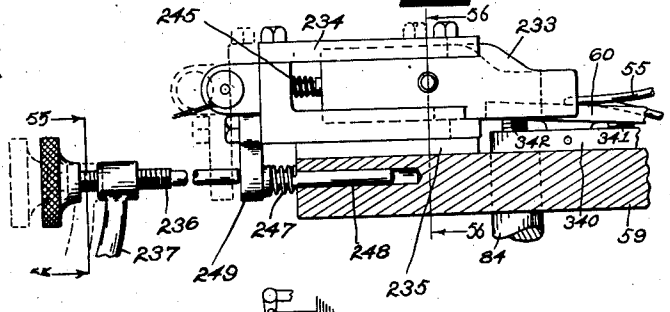


Fig. LIV.

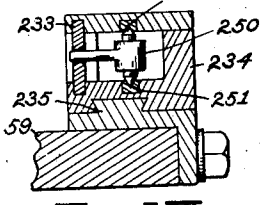


Fig. LVI.

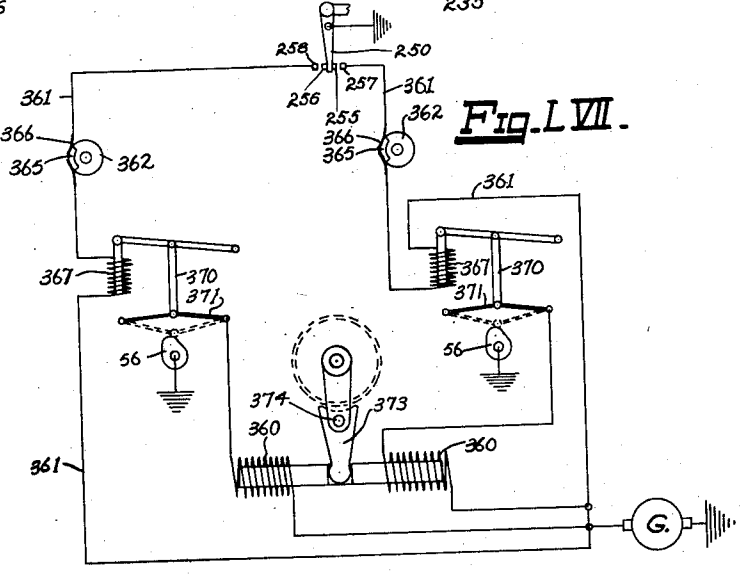


Fig. LVII.

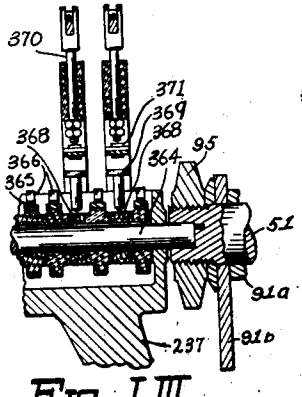


Fig. LIII.

INVENTOR.
Bert L. VanOrman

BY
Chappell & Earl
ATTORNEYS

Patented Mar. 10, 1925. 1,528,997

UNITED STATES PATENT OFFICE.

BERT L. VAN ORMAN, OF HIGHLAND PARK, MICHIGAN, ASSIGNOR TO L. A. YOUNG INDUSTRIES, INC., OF DETROIT, MICHIGAN.

SPRING-COILING MACHINE.

Application filed August 22, 1923. Serial No. 658,726.

To all whom it may concern:

Be it known that I, BERT L. VAN ORMAN, a citizen of the United States, residing at Highland Park, county of Wayne, State of Michigan, have invented certain new and useful Improvements in Spring-Coiling Machines, of which the following is a specification.

This invention relates to improvements in spring coiling machines.

My present improvements are especially designed by me for use or embodiment in machines for the manufacture of coiled springs such as are used in beds, furniture, vehicle seats and the like shown in my Letters Patent No. 1,480,796 issued January 15, 1924. Certain features of my improvements are, however, desirable and readily adapted for use in other relations.

The main objects of this invention are:—

First, to provide in a wire spring making machine an improved coiling mechanism.

Second, to provide in a wire spring making machine an improved means for adjusting the coiling mechanism to change the size and shape of the spring.

Third, to provide in a spring coiling machine an improved cut-off mechanism for the formed spring.

Fourth, to provide in a spring coiling machine an improved means for supporting the formed spring while being cut-off or severed from the stock and transferring it to and holding it securely during the knotting operation.

Further objects, and objects relating to structural details, will definitely appear from the detailed description to follow.

I accomplish the objects of my invention by the devices and means described in the following specification. The invention is clearly defined and pointed out in the claims.

A structure which is a preferred embodiment of my invention is clearly illustrated in the accompanying drawing, forming a part of this application, in which:

Fig. I, Sheet 1, is a partial plan view.

Fig. II, Sheet 2, is a view partially in elevation and partially in section on a line corresponding to line 2—2 of Fig. I.

Fig. III, Sheet 3, is a detail side elevation taken from the left of Fig. I.

Fig. IV, Sheet 4, is a detail view partially in detail section on a line corresponding to line 4—4 of Fig. III.

Fig. V, Sheet 5, is a detail view partially in horizontal section on a line corresponding to line 5—5 of Fig. IV, illustrating coiler details and a part of the transfer member.

Fig. VI, Sheet 6, is a detail view partially in horizontal section on a line corresponding to line 6—6 of Fig. II, showing further details of the coiler at another stage of the coiling operation.

Fig. VII, Sheet 6, is a detail view partially in vertical section on a line corresponding to line 7—7 of Fig. VI.

Fig. VIII, Sheet 7, is a detail view partially in vertical section on a line corresponding to line 8—8 of Fig. VI.

Fig. IX, Sheet 7, is a detail view partially in vertical section on a line corresponding to line 9—9 of Fig. VI, showing still another stage of the coiling operation.

Fig. X, Sheet 8, is a detail view partially in horizontal section on a line corresponding to line 10—10 of Fig. VIII illustrating details of pitch block controlling means.

Fig. XI, Sheet 8, is a detail view partially in vertical section on a line corresponding to line 11—11 of Fig. X, showing further detail of the pitch control means.

Fig. XII, Sheet 8, is a detail view partially in section on a line corresponding to line 12—12 of Fig. XI, showing details of the pitch block.

Fig. XIII, Sheet 8, is a detail view partially in section on a line corresponding to line 13—13 of Fig. XI, illustrating details of pitch control adjusting means.

Fig. XIV, Sheet 8, is an enlarged detail view of an adjustable cam and cam lever for controlling the pitch bar, the view being taken from a line corresponding to line 14—14 of Fig. III.

Fig. XV, Sheet 9, is a detail view mainly in vertical section on a line corresponding to line 15—15 of Fig. V, illustrating details of coiler and cut-off mechanism.

Fig. XVI, Sheet 9, is a detail view partially in vertical section on a line corresponding to line 16—16 of Fig. V, showing further coiler and cut-off details.

Fig. XVII, Sheet 9, is a detail view of cut-off parts partially in section on a line corresponding to line 17—17 of Fig. V.

Fig. XVIII, Sheet 9, is an enlarged detail perspective of the final wire guide.

Fig. XIX, Sheet 9, is a detail view of the

final wire guide partially in section on a line corresponding to line 19—19 of Fig. VI.

Fig. XX, Sheet 9, is a detail perspective of a coiler block with parts disassembled.

Fig. XXI, Sheet 9, is an elevation of the assembled coiler block viewed from the left of Fig. XX.

Fig. XXII, Sheet 9, is a detail view partially in section on a line corresponding to line 22—22 of Fig. VIII, illustrating details of coiler-block adjusting means.

Fig. XXIII, Sheet 10, is an enlarged detail view sectioned on a line corresponding to line 23—23 of Fig. II, showing further details of other coiler block adjusting means.

Fig. XXIV, Sheet 10, is a detail view partially in section on a line corresponding to line 24—24 of Fig. XXIII.

Fig. XXV, Sheet 11, is a detail view partially in section on a line corresponding to line 25—25 of Fig. V, showing a coiled spring in position in the coiler and the transfer member jaws in position to grasp the spring.

Fig. XXVI, Sheet 11, is a detail sectional view similar to Fig. XXV, showing the spring held by the transfer jaws, severed from the stock wire and free to be removed from the coiler.

Fig. XXVII, Sheet 12, is a detail view partially in vertical section on a line corresponding to line 27—27 of Fig. I, illustrating further details of the coiler, transfer member and knotter.

Fig. XXVIII, Sheet 12, is a detail view similar to Fig. XXVII, showing further transfer and knotter details with a coiled spring in operative position in the knotter.

Fig. XXIX, Sheet 13, is a plan view of the parts shown in Fig. XXVIII.

Fig. XXX, Sheet 14, is a detail view partially in vertical section on a line corresponding to line 30—30 of Fig. XXIX.

Fig. XXXI, Sheet 15, is a detail elevation viewed from the right of Fig. XXVIII.

Fig. XXXII, Sheet 13, is a detail section on a line corresponding to line 32—32 of Fig. I, showing further details of the transfer mechanism, the transfer member jaws being shown in closed position.

Fig. XXXIII, Sheet 13, is a detail section on a line corresponding to line 33—33 of Fig. XXXII.

Fig. XXXIV, Sheet 10, is an enlarged detail section on a line corresponding to line 34—34 of Fig. I illustrating details of transfer jaw tripping mechanism.

Fig. XXXV, Sheet 14, is a detail perspective view of a knotter gear.

Fig. XXXVI, Sheet 15, is a fragmentary view partially in section on a line corresponding to line 36—36 of Fig. XXXI, showing a coil spring about to enter the knotter gear.

Fig. XXXVII, Sheet 15, is a fragmentary sectional view similar to Fig. XXXVI showing a spring drawn into operative position in the knotter gear.

Fig. XXXVIII, Sheet 15, is a fragmentary sectional view similar to Fig. XXXVII, showing the knotting operation completed by the knotter gear.

Fig. XXXIX, Sheet 15, is a detail view in section on a line corresponding to line 39—39 of Fig. XXXVIII, illustrating the knotter gear with its actuating rack.

Fig. XXXX, Sheet 3, is a detail view similar to a portion of Fig. XXVIII, showing a spring ejected from the knotter with lower end knotted and in the grasp of a second transfer member.

Fig. XXXXI, Sheet 15, is a fragmentary view similar to Fig. XXVII, showing the transfer jaws approaching a spring in the coiler.

Fig. XXXXII, Sheet 16, is a detail view in section on a line corresponding to line 42—42 of Fig. XXIX, illustrating details of transfer and knotter actuating means.

Fig. XXXXIII, Sheet 16, is a detail view in section on a line corresponding to line 43—43 of Fig. III, illustrating means of shifting the position of the coiler.

Fig. XXXXIV, Sheet 16, is a detail view in section on a line corresponding to line 44—44 of Fig. XXXXIII.

Fig. XXXXV, Sheet 16, is a detail view in section on a line corresponding to line 45—45 of Fig. XXXXIV.

Fig. XLVI, Sheet 17, is a detail view partially in section showing details of the coiler adjusting and governing mechanism.

Fig. XLVII, Sheet 17, is a fragmentary section on a line corresponding to line 47—47 of Fig. XLVI.

Fig. XLVIII, Sheet 17, is a fragmentary plan view showing further details of the electric control mechanism.

Fig. XLIX, Sheet 18, is a detail section on a line corresponding to line 49—49 of Fig. XLVIII showing details of the governor actuating relays.

Figs. L and LI, Sheet 18, are detail sections corresponding to that of Fig. XI showing the parts in different positions.

Fig. LII, Sheet 18, is a detail section on a line corresponding to line 52—52 of Fig. XLVIII showing further details of the governor control mechanism.

Fig. LIII, Sheet 18, is a fragmentary section on a line corresponding to line 53—53 of Fig. XLVIII.

Fig. LIV, Sheet 18, is a detail section on a line corresponding to the broken line 54—54 of Fig. LV showing details of the testing mechanism of the electric control.

Fig. LV, Sheet 18, is a fragmentary section on a line corresponding to line 55—55 of Fig. LIV.

Fig. LVI, Sheet 18, is a detail section on

a line corresponding to line 56—56 of Fig. LIV.

Fig. LVII is a diagrammatic view of the wiring for the electrically controlled governing mechanism.

In the drawing similar reference characters refer to similar parts throughout the several views, and the sectional views are taken looking in the direction of the little arrows at the ends of the section lines.

Referring to the drawings, the machine is driven from any suitable source of power through reduction gears 46, power being imparted to the various mechanisms by counter gears 47, 48 and 49, which drive the counter shafts 50, 51 and 52 respectively (see Figs. I and III). Wire feed rollers 54^a and 54^b which are driven by a gear train operatively connected with the gears 46, draw wire 55 from a source of supply and project it, through guides 56 and 57, against a deflecting block 58 which forces the moving wire 55 to bend into a coil as shown in Fig. V. After being deflected by the coiler block 58, the wire overruns a pitch bar 60 which causes successive coils to rise above one another to form a coil spring. The height at which the pitch bar 60 is located, determines the pitch of the spiral or space between coils.

A preferred means of feeding wire to the coiling mechanism is disclosed in detail in my co-pending application filed February 3, 1923, Serial No. 616,652 and I deem it sufficient in my present embodiment to illustrate and describe only those parts which are quite directly associated with the coiling mechanism.

The upper feed rollers 54^a are rotatably mounted in a bearing member 350 which is pivoted at 351 to the main gear housing 297. All of the feed rollers revolve constantly while the machine is in operation, but the wire 55 is in motion only when the upper rollers are held tightly against the wire on the lower rollers 54^b by a pressure lever 352 which is connected by a link 353 to one end of a cam lever 354 which is actuated by a cam 355 (see Fig. II). The cam 355 thereby controls the movement of the wire 55 which is intermittently projected against the coiler block 58 in accordance with the requirements of the coiling mechanism.

If the coiler block 58 remains stationary during the coiling operation, a spring purely cylindrical in shape is formed, that is, the coils will be of uniform diameter. However, it usually is desirable to vary the radius of successive coils to allow greater freedom of compression and to procure a spring of the desired length from less material. A common hour glass shape or type of spring is shown in the accompanying drawings and designated by the numeral 61.

For the purpose of varying the diameter of the coils, the coiler block 58 is secured to a shaft 62, which is rotatable in the coiler bracket 59, in order that the coiler block may be oscillated to change the amount of deflection of the wire 55 (see Fig. VIII). The shaft 62 is oscillated by a rock arm 63 which is connected by a rod 64 to a coiler actuating lever 65, the latter being moved in one direction by a cam 66 which is secured to the counter shaft 50. The lever is swung in the opposite direction by tension springs 68. When the coiler lever 65 is swung to its extreme outward position relative to the cam 66 (see Fig. III) the coiler block 58 is in position to form the largest coil of the spring (see full lines in Fig. VI). When the coiler lever swings to the opposite limit, the coiler block is caused to deflect the wire more abruptly thereby forming the small coils of the spring (see broken outline in Fig. VI). It is desirable that the coiler block be moved toward the wire 55 by action of the springs 68 or other yielding force rather than by any positive driving means in order to prevent breakage of parts in case the coiler block meets undue resistance from misdirected wire or other abnormal conditions.

At the commencement of the coiling of each spring, the end of the wire after describing an arc of the first coil, approaches the pitch bar 60 (see Fig. VI). To insure overrunning of the pitch bar by the wire 55, the latter is lifted just before reaching the bar, by a beveled block 70 carried by an arm 71 which is secured to a rock shaft 72 journaled in a bearing bracket 73 (see Figs. VII and VIII) the shaft 72 being actuated by a rock arm 74 carrying a cam roller 75 which is in range of a cam member 76 secured to the counter gear 48 (see Figs. I, III and IV). The downward movement of the arm 71 is limited by a stop 77 and the height to which the wire 55 is lifted is determined by adjustment of the rock arm 74 in relation to the rock shaft 72. The adjusting means shown consists of a worm wheel segment 79 which is secured to the shaft 72, the rock arm 74 being pivoted on the shaft and carrying a worm 80 in mesh with the segment 79. A hand wheel 81 secured to the worm shaft 82 provides means of rotating the worm when adjustment is desired (see Fig. III).

After the advance end of the wire 55 has passed over the top of the pitch bar 60, the latter is lifted to a higher position thereby giving an upward bend to the wire as it is being coiled. This upward bending takes place between the pitch bar and a stationary cutter bar 149 under which the wire passes after leaving the final guide 57 (see Figs. IX and XV).

The pitch bar is mounted upon a post 84 which is reciprocable in the frame bracket

59, rotation of the post 84 being prevented by an arm 85 having a forked end embracing a guide post 86 (see Fig. X). The pitch bar is lifted by an adjustable arm 87 carried by a rock arm 88 on a rock shaft 89 which is journaled in the bracket 73. The end of the arm 87 engages a notch 90 in the post 84 to lift the pitch bar. The rock arm 88 is actuated by a cam 91 which is carried by the counter shaft 51, the cam engaging rollers 92 on an arm 93 which is secured to the rock shaft 89 (see Figs. III, IV and XIV). Since the length of time that the pitch bar is held in lifted position varies for different sizes or types of spring, the working period of the cam 91 must be changed accordingly whenever a different kind of spring is produced. To meet this requirement I have made the cam 91 in two sections consisting of a fixed section 91^a and a movable section 91^b. The movable section is normally held clamped to the fixed section by a nut 95. Since each of the cam sections engages one of the rollers 92, the pitch bar 60 is held in lifted position from the time that the arm 93 is raised by section 91^a until released by section 91^b. By loosening the nut 95, the section 91^b may be moved to change the dwell of the cam as desired, thereby determining the length of time that the pitch bar is actuated.

After the spring 61 is formed, the two lower turns or coils are grasped by gripper jaws 97 and 98, carried by a reciprocating transfer member 99 which conveys the spring from the coiling mechanism to a knotter mechanism (see Figs. XXVII and XXVIII). The transfer member, consisting of a hollow bar 99^a, is reciprocatingly supported in a bracket 100 which supports the knotter parts. The transfer member is moved away from the coiler by a cam actuated lever 101 which has a roller 102 engaging a cam 103 carried by the counter shaft 52.

It is preferable that the transfer member jaws be moved toward the coiler by a yielding force to eliminate the possibility of breakage due to abnormal conditions of operation. A preferred means of holding the lever 101 and certain other levers of the machine in contact with their respective cams, consists of a cylinder block 105 having cylinders 106 in which are pistons 107 (see Figs. XXIX, XXX and XXXXII). A passage 108 connects each of the cylinders with space within the cylinder block. Air admitted to the interior of the cylinder block and maintained at a high pressure, tends to force the pistons upward in the cylinders. Each piston is connected with a cam lever by a connecting rod 110 preferably formed with spherical ends which engage appropriate sockets in the piston and on the lever. The cam rollers are held in contact with the cams by pressure against the pistons, elasticity of the air permitting the pistons to be pushed downward whenever actuated by the cams. A relief valve 112 allows pressure to be removed from the levers when desired, the connecting rod 110 being held in assembly with the lever by a retaining clip 113. An adjustable stop 114 for the lever 101 limits the movement of the transfer member toward the coiler (see Fig. XXVII).

As the transfer jaws 97 and 98 approach the coiled spring 61, the latter is compressed to force the two bottom coils into range of the open jaws (see Figs. XXV and XXVII). At this time one of the rollers 92 is in contact with a stepped portion 115 of the cam section 91^b (see Fig. III) which holds the pitch bar 60 at the correct height to hold the two lower coils of the spring in position to be enclosed by the open transfer jaws. The spring is compressed by a cone 116 which is rotatably mounted on an arm 117 carried by a vertical post 118 reciprocable in the frame bracket 59 (see Figs. IV and VIII). The lower end of the post 118 rests on a suitable pad 119 on an arm 120 which is secured to a rock shaft 121, another arm 122 being fastened to the same shaft and having a roller 123 engaging a cam 124 on the counter gear 47 (see Fig. III). A tension spring 125 attached to an arm 126, on the upper end of the post 118 and anchored to the frame of the machine, pulls the cone 116 downward whenever the position of the cam 124 permits. An arm 127 which is clamped to the post 118 has a forked end engaging a guide post 127^a to prevent the post 118 from rotating and swinging the cone 116 out of position. The cone 116 is brought down into engagement with the top coils of the spring 61 at an early stage in the coiling operation and follows them upward as the spring is formed (see Fig. IX).

The lower transfer jaw 98 is pivoted to the hollow bar 99^a, the upper jaw 97 being fixed to the bar (see Fig. XXXII). A push rod 128, reciprocable in the member 99^a is arranged to engage the heel of the lower jaw 98 for the purpose of closing the jaws. The push rod is reciprocated by a slide member 129 which is retained in a groove in the member 99^a by guide brackets 130, the slide 129 being actuated by a rock lever 131 through the medium of a connecting link 132. The rock lever which is pivoted in the member 99^a is actuated by a tension spring 133 which is suitably anchored to the member 99^a and connected to the rock lever by a link 134. To allow the jaw 98 to open, the push rod 128 and slide 129 are held in retracted position by a catch or trigger 135 which drops into interlocking position with the link 132, the trigger being urged to this

position by a spring 136 engaging the inwardly extending arm 137 of the trigger (see Fig. XXX).

As the transfer jaws 97 and 98 advance to engage the spring 61 in the coiler, the arm 137 of the trigger 135 underruns a releasing pin 138 which is secured to a rod 139 vertically reciprocable in guides 140 in the knotter bracket 100, the releasing pin being urged upward by a compression spring 141 (see Fig. XXXIV). Means for pulling the rod 139 downward are provided by a lever 142 which is pivoted at 143 and has one end lying on a cam roller 144, the other end of the lever being connected with the rod 139 by a spring 145 (see Figs. II and XXX).

After the transfer jaws 97 and 98 have enclosed the two lower coils of the spring and the movement of wire against the coiler block has stopped (see Fig. XXV) a cam 146 which is carried by the counter shaft 51 engages the roller 144, carried by a lever 147, and actuates the lever 142 thereby pulling the releasing pin 138 downward (see Fig. II). The downward movement of the releasing pin depresses the trigger arm 137 and releases the rock lever 131, allowing the spring 133 to slide the push rod 128 toward the lower jaw 98 and close the latter upon the lower coils of the spring 61 (see Figs. XXXII, XXVI and XXVII). A post 148 on the slide 129 serves as a stop for the trigger arm 137; continued movement of the lever 142 being permitted by the spring connection 145.

After leaving the final wire guide 57, the wire underruns the fixed cutter bar 149 and over-runs a movable cutter bar 150 which is pivoted on a bolt 151 which holds the two cutter bars together at their outer ends (see Figs. V, VI, IX and XVI). The fixed bar 149 is held rigidly in place in the bracket 59 by set screws 152 in the cover plate 153. The cutter 150 is free to be rocked in a groove in the bracket 59, such action causing the cutter bars to shear or sever the wire (see Fig. XXVI). The top and bottom faces of the fixed bar 84 are beveled at such an angle that the pressure of the set screws 152 prevents the fixed bar from crowding or binding the movable bar 150 see Figs. XVI and XVII). The movable cutter bar is actuated by a push rod 154 which is lifted by a tappet 155 reciprocable in a frame cross member 156, (see Figs. II and IV). The tappet 155 is lifted by the head of a thrust screw 157 carried by the cam lever 147, a spring locking finger 157ª engaging coacting slots in the screw to hold it in its adjusted positions.

The spring 61 is severed from the wire 55 when the cam roller 144 is encountered by an abrupt rise 158 on the cam 146. The transfer jaw 98 has already been tripped by the gradual rise, leading up to the rise 158, it being important that the parts be so adjusted that the jaw tripping action precedes the cut-off action. This co-ordination of operation between the transfer mechanism and the cutoff mechanism insures that the spring 61 is grasped by the transfer jaws before being released from the coiler.

When the cam lever 147 is released by the cam 146, the cutter bar 150 is returned to open position by a presser bolt 159 which is vertically reciprocable in the cover plate 153 and is urged downward by one end of a rock lever 160 which is pivoted at 161, the other end of the lever being in contact with a thrust block 162 carried by a compression spring 163 which is adjustably mounted on the cover plate 153 (see Fig. XVI).

While the spring 61 is being gripped by the transfer jaws 97 and 98 and severed from the wire 55, the cone 116 is lifted to clear the spring and allow it to be removed from the coiler (see Fig. XXVI).

The transfer member carries the spring 61 from the coiler into position to be operated upon by a knotter gear 165 which is rotatably mounted in between the plates 166 supported by the bracket 100 (see Figs. XXX, XXXI and XXXV). As the spring 61 approaches the knotter gear, the lower free end portion 168 of the spring comes into contact with a shoulder on the gear, (see Fig. XXXVI). Further retrograde movement of the transfer jaws bends the spring end 168 into a position substantially radial to the spring coils, while the second coil 169 moves into a radial slot 170 in the knotter gear and comes to rest in the center of the gear (see Fig. XXXVII). The end portion 168 over-runs a ledge 171 which projects from the side of the gear. A guide roller 173 bears the side thrust of the transfer jaw 98. The transfer jaws are appropriately shaped to insure correct presentation of the lower spring coils to the knotter gear. An adjustable link 174 connects the transfer member 99 with the cam lever 101 and provides means of closely fixing the limit of movement of the transfer jaws toward the knotter.

While the spring 61 is moving into operative relation with the knotter gear, a rest block 175 is thrust up against the lower jaw 98 by a wedge 176 which is projected by a spring 177 on the stem 176′ of the wedge (see Fig. XXVIII). The movements of the wedge 176 are controlled by a cam 178 which is secured to the shaft 51 and engages a roller 179 on a lever 180, the upper end of the latter engaging a slot in the wedge (see Fig. XXX). The block 175 holds the transfer jaws firmly closed on the spring 61 during the knotting operation.

An arm 182 secured to a rock shaft 131ª forming a part of the rock lever 131 has a laterally extending pin 183 in range of the hook end of a reset lever 184 which is piv-

oted to the frame at 185, the hook end of the lever being yieldingly held upward by a spring 186 (see Figs. XXXIII and XXXXI). Whenever the rock lever 131 is released or in position to close the transfer jaw 98, the arm 182 holds the pin 183 toward the rear of the transfer bar 99a (see Fig. XXVII). As the transfer member reaches the limit of its retrograde movement and the block 175 has engaged the jaw 98, the pin 183 encounters the hook end of the reset lever 184 and swings the rock lever 131 back into locked position with the trigger 135 (see Figs. XXVIII and XXX).

The upper jaw 97 passes under a guide 188 on one end of a lever 189 which is pivoted at 190, the other end of the lever being held between a spring 191 and adjusting nuts 192 on the spring keeper 193. The spring 191 is strong enough to hold the transfer jaws in proper position under normal conditions but yields to any undue stress as, for instance, that caused by the jaws failing to close completely on account of misplaced wire between them (see Fig. XXXII).

The knotter gear 165 is rotated by a rack 195 which is vertically reciprocable in suitable guides in the bracket 100 (see Fig. XXVIII). The rack is connected by an adjustable link 196 to a cam lever 197 which is pivoted on a rod 198, the lever carrying a roller 199 engaging a cam 200 on the shaft 52. A gear segment 201 on the lever 197 meshes with a companion segment 202 on a rock lever 203 which is pivoted to brackets 204 supported by the machine base 205 (see Figs. XXIX and XXX). The roller 199 is held against the cam 200 by air pressure against the piston 107 to which the lever 203 is connected by a rod 110. The rack 195 is at its highest position when the radial slot 170 in the knotter gear 165 is in position to receive the second coil 169 of the spring 61. This position is accurately determined by a screw 208 which is threaded into the rack housing 209 to form an adjustable stop for the rack (see Fig. XXVIII).

After the second coil 169 of the spring 61 has entered the slot in the knotter gear 165 and the spring end 168 is bent to the position shown in Fig. XXXVII, the gear is rotated in the direction indicated by the arrow in Fig. XXXIX. Rotation of the knotter gear causes the ledge 171 to wind the end of the spring around the second coil, the latter being held within the center of the gear. This operation forms the knot 210, (see Fig. XXXVIII). After the knot has been formed, the gear 165 continues to rotate in the same direction until the slot 170 is in the original or open position, leaving the spring 61 free to be removed from the gear.

After the lower end of the spring has been knotted and the slot 170 in the knotter gear is in position to allow removal of the spring, the transfer member 99 starts advancing toward the coiler and carries the spring out of the knotter. The block 175 is allowed to drop away from the lower jaw 98, permitting the latter to swing to open position as it leaves the guides in the bracket 100, thereby releasing the spring from the transfer member (see Fig. XXXX).

As a preferred means of removing the spring 61 from the transfer member 99, the spring is seized, just before being released from the jaws 97 and 98, by grippers 213 of a member 214 (see Figs. I and XXXX). This member 214 may discharge the spring or deliver it to a positioning means as shown in my said application, Serial No. 474,399, where it is positioned for transfer to a second knotter which ties the other free end 215.

After the spring 61 has been removed from the transfer member 99, the latter continues advancing toward the coiler, with the jaw 98 in open position, to repeat the cycle of operations (see Fig. XXXXI). The rack 195 returns to highest position, rotating the knotter gear 165 in reverse direction back to receiving position before the next spring is brought to the knotter.

It has been found in practice that the degree of hardness in the stock wire varies considerably so that springs of uniform diameter cannot be formed without frequently changing the range of oscillation of the coiler block 58. As a means of changing the position of the coiler block relative to the position of the coiler lever 65, the connecting rod 64 is hinged to a swinging arm 220 which is pivoted at 221 on the coiler lever (see Figs. II and XXIII). The swinging of the arm on the pivot 221 is controlled by an adjusting nut 223 which has an arm 224 with a pin 225 engaging a slot in the arm 220 (see Fig. XXIV). The nut 223 and arm 220 are moved either to the right or to the left by turning an adjusting screw 226 which is rotatably mounted in the coiler lever. If the arm 220 is swung to the right on the coiler lever, the rock arm 63 is pushed farther from the coiler lever and the coiler block 58 is turned farther toward the wire 55, thereby decreasing the diameter of the coils. Conversely, swinging the arm 220 to the left increases the diameter of the coils. The nut 223 may be adjusted manually by a hand wheel 228 which is secured to the shaft-like extension 226a of the adjusting screw 226. A brake 230 which is held against a shoulder of the shaft 226a by a spring 232, holds the screw 226 in adjustment.

It is unsatisfactory as well as expensive to depend upon manual means to test the coiled springs and make the necessary adjustments to the coiling mechanism. To insure the minimum amount of variation from the re-

quired size of springs, it is desirable that the range of movement of the coiler block be controlled automatically by mechanism affected by each coiled spring. A satisfactory type of automatic governing means is disclosed in detail in my co-pending application, Serial No. 574,846, filed July 13, 1922. As my present invention does not relate to any particular form of governor, I deem it unnecessary to illustrate and describe such details further than to show their direct connection with the coiling mechanism.

Each spring is tested for diameter by a testing finger 233 which is mounted in a carriage 234, the latter being intermittently moved toward the coiler on a track 235 by a tappet 236 which is adjustably mounted in an arm 237 secured to a slide bar 238 (see Fig. V). The slide bar is reciprocable in guides 239 and 240 on the frame member 156 and is actuated by a cam 241 which is carried by the counter gear 48, a cam roller 242 on the slide 238 being held against the cam by tension springs 243 which are attached to the slide by pins 244 and anchored to the bracket 73 (see Figs. I, II and IV). The testing finger 233 is reciprocable in guides in the carriage 234 so that a spring 245 tends to push the finger toward the coiler. As the coiling operation is nearing completion, the carriage 234 is advanced toward the coiler until the testing finger 233 comes into contact with the lower coil of the spring 61, the extent of this forward movement being accurately determined by the threaded adjustment of the tappet 236 in the arm 237. The carriage is held in contact with the tappet 236 by a spring 247 which acts upon a push rod 248 reciprocable in the frame member 59, both the tappet and the push rod engaging a downwardly extending lug 249 on the carriage 234 (see Fig. VIII). The tappet 236 is adjusted whenever the coiler is reset to produce a different sized spring.

The testing finger 233 is operatively connected to a bell crank lever 250 which is pivoted at 251 in the carriage 234. A pair of contact points 255 and 256, on one arm of the bell crank, lie between contact points 257 and 258 on the carriage 234. If the testing finger engages a coil spring of the correct diameter, while the carriage 234 is in testing position, both of the contact points 255 and 256 are held away from the points 257 and 258 (see Fig. V). If the spring 61 is too small, the point 255 makes contact with the point 257 thereby closing an electrical circuit in which is included a solenoid magnet of electrically actuated mechanism for turning the adjusting screw 226 in the coiler lever 65. This adjusting mechanism is carried in a housing 260 on the coiler lever 65 (see Fig. II). Contact of the points 255 and 257 causes the screw 226 to be turned in a certain direction to swing the arm 220 to the left on the coiler lever and swing the coiler block 58 farther away from the wire 55 thereby increasing the diameter of the next spring. If the spring 61 is too large, the point 256 makes contact with the point 258 and energizes another solenoid magnet causing the screw 226 to be turned in the opposite direction to rock the coiler block farther toward the wire 55 so that the next spring is coiled smaller.

The solenoid magnets are generally designated by the numeral 360, see Figs. XLVI and LVII, the connections being made through the relays shown in Figs. XLIX, L and LI, the main function of the relays being to maintain the current on the actuating governor solenoids 360 for a sufficient period to effectively energize the same and a further advantage is to provide for the actuation of the solenoid during the period of idleness, the parts being under considerable stress during the working period or while the wire is being projected against the coiler block.

It will be understood that these relays are used in pairs, each of the contacts 257 and 258 being connected to a relay through the wires 361. A timer 362 is interposed in each of the circuits. These timers prevent the magnets being energized while the testing carriage is in its retracted position.

The timers comprise a disk 363 of insulating material mounted on the shaft 364 and provided with a contact 365 with which the brushes 366 coact, these brushes being connected in the circuit 361. The solenoid coil 367 of the relay is also connected with this circuit. The shaft 364 is provided with cams 368 which coact with the insulated pins 369, the cams being grounded. When the solenoid is actuated the plunger 370 throws the contact 371 down to position to be engaged by the pin contact 369 as shown in Fig. L.

This contact 371 is formed of a pair of members hinged together and supported at their outer ends by the springs 372 to secure a snap action. With the parts in the position shown in Fig. XLIX the circuit is broken. When the contact 371 is actuated by the solenoid 367 it is engaged with the contact 369 and when that is raised by means of the cam, see Fig. LI, the circuit to one of the actuating governor solenoids 360 is closed.

These governor solenoids actuate the pawl 373 which is pivoted at 374 to coact with the ratchet wheel 375 connected to the screw 226 so that on the actuation of the pawl in either direction the screw is turned, thereby adjusting the coiler block. The springs 375 acting upon the pins 376 coact with an arm

377 on the spider 378 carrying the pawl 373 to return the pawl to its initial normally disengaged position.

Each coiled spring is also tested for length and the pitch bar 60 controlled by automatic governing means. Since I prefer to test the spring for length after it leaves the first knotter, the testing means is not directly associated with the parts of the machine made the subject matter of this application and therefore such testing means is not shown in the accompanying drawings. Satisfactory height testing means are disclosed in detail in the said application, Serial No. 574,846.

For the purpose of adjusting the pitch bar 60 to maintain a uniform length of spring, the arm 87 which lifts the pitch bar, is pivoted to the rock arm 88 at 263 and connected to the other end of the rock arm by an adjusting screw 264 (see Figs. XI and XIII). The screw 264 passes through a slot in the arm 88 and is threaded into a cross piece 265 which is pivoted in the arm 87 to permit change in angularity between the two arms. A collar 267 on the adjusting screw has a groove in its under face engaging a laterally disposed ridge 268 on the top of the rock arm 88, the collar being free to rock slightly and permit variation in the relative positions of the parts. The collar 267 is held in contact with the arm 88 by a spring 269 on the screw 264. The rock arm 88 is oscillated by the cam 91 through a fixed range but the arm 87 may be raised or lowered relative to the arm 88 by turning the adjusting screw 264, thereby changing the height to which the pitch bar 60 is lifted. If a spring is tested and found to be too short, the screw 264 may be turned in a certain direction to cause the pitch bar to be lifted higher and increase the pitch of the next spring. When a spring is found to be too long, the screw 264 may be turned in the opposite direction to decrease the lift of the pitch bar and consequently shorten the next spring.

The adjusting screw 264 is connected by a universal joint 270, shaft 271, and telescopic connection 272 to electrically actuated mechanism like the automatic means used to control the adjusting screw 226 on the coiler lever 65 (see Figs. I and III). The housing 273 which holds the mechanism is supported by a post 274 secured to the bracket 73. A hand wheel 275 which is secured to the governor shaft 276 and extends above the governor housing 273, provides means of turning the adjusting screw 264 manually. The universal and telescopic connections on the shaft 271 permit turning of the screw 264 while the rock arm 88 is being oscillated. Electrical circuits connecting solenoid magnets of the governor mechanism with circuit closing means associated with spring length testing means, such as hereinbefore referred to, are provided for controlling the screw 264 automatically.

As previously stated herein, the variations in diameter of the coils in each spring are caused by oscillation of the coiler block 58. The extent of oscillation or length of stroke of the rock arm 63 determines the amount of difference between the largest and the smallest coils of the spring. If the length of stroke of the rock arm is decreased, the outline of the spring approaches nearer to a cylindrical form. If the stroke is increased in length a greater variation in the diameter of the coils is caused.

To provide means of changing the amount of oscillation of the coiler block 58 without changing the cam 66, the rock arm 63 is provided with a plurality of holes 277 for the connecting rod 64 (see Fig. VI). If the rod 64 engages the arm 63 at a point nearer to the end of the arm, the coiler block is oscillated through a shorter range of distance. If the rod engages the arm at a point nearer to the shaft 62, the coiler block is oscillated through a greater distance.

As an auxiliary to the above described means of changing the length of stroke of the coiler block, the connecting rod 64 is hinged to a nut 278 on an adjusting screw 279 which is rotatable in the swinging arm 220 on the coiler lever 65 (see Fig. II). A hand wheel 280 provides means of turning the screw 279. The nut 278 is designed to be clamped tightly on the screw 279 by a clamping screw 281 (see Figs. XXIII and XXIV), tightening of the nut preventing the adjusting screw from moving the nut out of the desired position. If the nut 278 is raised to a higher position on the arm 220, the stroke of the arm 63 is decreased. If the nut is lowered the stroke is increased. A graduated scale 282 on the arm 220 provides means of locating the nut 278 in any desired position. The connecting rod 64 is shifted to a different hole in the arm 63 only when a change of considerable extent is to be made, the adjusting screw 279 being used for minute and accurate adjustments.

Means are provided for automatically stopping the machine in case the spring 61 fails to follow the course prescribed for it, or certain parts of the machine fail to operate at the right time. A satisfactory type of automatic machine control means is completely disclosed in my co-pending application, Serial No. 595,995 filed October 21, 1922, and I have illustrated only such parts as have a direct application to my present invention and such as seems necesary to give a general understanding of the operation.

This automatic control means consists of clutch control mechanism for disengaging

the main drive clutch of the machine, the mechanism being arranged to be released by the action of a solenoid magnet whenever the latter is energized by an electrical current. Circuit closing means located at various points on the machine are designed to close a circuit connecting the solenoid magnet with a source of electricity, whenever certain parts fail to function, or some other interruption in the operation of the machine occurs.

One of the circuit closing means consists of a contact plate 285 which is mounted on the slide bar 238 in insulated relation thereto (see Figs. I, II and XXVII) and which is connected by a conductor 286 to the circuit in which the clutch control solenoid magnet is included. When the transfer jaws 97 and 98 convey a spring from the coiler to the knotter, they must pass over the contact plate 285. If a spring falls from the coiler or transfer jaws it strikes the plate 285 and acts as a conductor connecting the plate with whatever other part of the machine that the spring may be touching at that time. The machine acts as a ground for the circuit which is thereby closed causing the solenoid magnet to be energized and the machine to be stopped. In case a spring becomes lodged in the knotter, the machine is stopped by failure of the transfer member 99 to advance to the coiler at the right time. A contact point 289 supported by a block 290 of insulating material is connected to the clutch control circuit by a conductor 291 (see Figs. I, III, XXVII and XXIX). A plunger 292 which is reciprocable in the block 290 and electrically connected to the frame of the machine has a contact 293 which is held against the contact 289 by a spring 294 except when pushed ahead by a collar 295 on a lateral extension of the transfer member 99. The contact 293 is held away from the contact point 289 whenever the transfer jaws have advanced into position to grasp a spring in the coiler. A timer which is included in the circuit with this circuit closing means, holds the circuit open at another point except at the time when the contacts 289 and 293 are normally held apart. If the transfer member 99 fails to advance and open the circuit closing means at this time, the complete circuit is closed causing the machine to be stopped. This automatic control means insures correct action of the transfer member while the machine is running.

Since the transfer jaws must grasp the spring 61 at a certain point in order to present the spring correctly to the knotter, it is impossible for the coiler and the knotter to maintain the same positions relative to each other, for springs of considerable difference in diameter. In order to change the relative positions of the coiler and knotter, to place a spring of any size in correct relation to the knotter, I have mounted the frame member or supporting bracket 297 in such a way that it may be moved transversely on the frame base 205. The bracket 297 supports the feed rollers 54 and the coiler bracket 59 on which the spring is coiled. Guide blocks 298, secured to the bottom of the bracket 297 lie in a channel 299 in the frame base 205, thereby holding the bracket 297 in alignment (see Figs. XXXXIII XXXXIV and XXXXV.) The bracket is moved along the channel 299 by means of screws 300 and 301 which are threaded into arms 302 and 303 secured to the base 205. The screws bear against bosses 304 on the bracket 297, movement of the latter being effected by loosening one of the screws and turning up the other screw. After being placed in the desired position, the bracket 297 is held securely to the base 205 by cap screws 305 which pass through slots 306 in a bottom flange of the bracket. The counter gear 48 is provided with extra width of face to permit axial shifting of the gear 47 carried by the bracket (see Fig. I).

The end 307 of the arm 87 which lifts the pitch block 60 is wide enough to maintain operative relation between the parts (see Fig. X). Also, the contact faces of the cut-off actuating mechanism are of sufficient width to permit the required amount of shifting of the parts (see Fig. IV). The tappet 236 which determines the positions of the spring diameter testing means must be readjusted whenever the bracket 297 is moved.

In order that the machine may continue in operation with the minimum amount of interruption, certain parts which are subject to considerable wear, are provided with removable wearing surfaces that may be easily and quickly renewed. Certain adjustments also compensate for wear, and aid in maintaining correct working of the parts. Also, the parts are so designed as to facilitate re-threading of wire when a bale of wire has become exhausted.

A preferred form of final wire guide 57 consists of a head 308 supported by a stud 309 which is held in place in the coiler bracket 59 by a set screw 310 (see Figs. XVIII and XIX. The coiler block 58 bends the wire 55 around a hardened guide post 311 which is secured in the head 308 by a set screw 312. The post 311 is provided with annular grooves 313 to receive the wire, and with slots 314 by means of which the post may be rotated in the head 308. By loosening the set screw 312 the post 311 may be turned until a new wearing surface is presented to the wire, only the upper groove being in contact with the wire. When one of the grooves 313 has become worn all around, the post 311 may be removed from

the head 308 and replaced in inverted position, thereby bringing the other annular groove into use. The position of the post 311 relative to the coiler block may be adjusted by loosening the set screw 310 and turning the stud 309.

When the coiler block bends the wire 55 around the post 311, the reaction causes the wire to bear against the opposite side of a channel 316 in the head 308, which forms a passage for the wire. The wear at this point is borne by a hardened bar 317 which is square in cross section. The bar is held in place in the channel 316 by a set screw 318 and stop 319 which one end of the bar abuts. The bar 317 may be turned and reversed until all four faces have been used.

The coils of the spring are kept out of the channel 316 of the final guide 57 during the coiling process by a guard plate 320 which partially covers the head 308. The plate is pivoted at 321 to permit it to be raised and give access to the final guide (see Fig. V).

The guide 56, which directs the wire to the guide 57, consists of two sections 323 and 324, the section 324 being pivoted at 325 (see Figs. II and V) and normally held in closed position by a latch 326. By lifting the latch 326, the section 324 is allowed to drop to open position, releasing the wire 55. When a bale of wire is exhausted, the guide 56 may be opened. the plate 320 raised and the wire readily lifted from the guide 57. The distance from the guide 56 to the upper cutter bar 84 is so short that there is no danger of the wire 55 rising out of the guide 57 while the machine is in operation with the guide 56 closed.

To provide a renewable wearing surface for the coiler block 58, a bar 58ª of hardened material is held in place in a groove 328 in the block 58 by a set screw 329 and washer 330 (see Figs. XX and XXI). The wire 55 bears against the bar 58ª near the outer end of the latter. Any one of the four surfaces of the bar may be presented to the wire with either end of the bar extended, thereby providing eight wearing surfaces on each bar. A ledge 331 on the block 58 prevents the wire from dropping out of range of the bar 58ª.

The coiler rock arm 63 is adjustable to provide means of changing the angularity of the coiler block 58, and means of compensating for wear in the bar 58ª. The rock arm 63 is pivoted on the shaft 62 and carries a worm 332 which meshes with a worm segment 333 which is secured to the shaft 62 as by the pin 334 (see Figs. VI and VIII). The worm 332 is rotatable in a bearing on the rock arm, by means of a hand wheel 335, the worm being normally held in adjustment by a spring projected plunger 336 which engages depressions in a flange 337 of the wheel 335 (see Fig. XXII). By turning the worm 332, the coiler block 58 may be adjusted to produce springs of different diameters without changing the range of movement of the rock arm 63. The arm 220 may be kept at substantially a central position on the coiler lever 65, a graduated scale 338 on the lever marking the location of this position.

The pitch bar 60, which is made of wear resisting material, is pivoted to an arm 340 extending from the post 84 (see Figs. VIII, IX and XII). The bar 60 is held rigid by set screws 341 and 342 which provide means of tilting the bar to any desired angle. The edge of the bar approached by the wire is rounded to facilitate over-running of the bar by the wire.

The lower transfer jaw 98 is provided with a removable insert 344 which is held in place by a set screw 345 (see Fig. XXXII). The insert may be renewed when worn, or replaced by another insert formed to fit a spring of different size. The upper jaw 97 is also detachable, being held to the member 992 by cap screws 346.

The upper guide 188, under which the upper transfer jaw 97 runs, has a detachable wearing block 347 which is held in correct position by a dove-tailed joint and secured by a cap screw 348 (see Figs. XXXI and XXXII).

With this arrangement of parts, I am enabled to adjust the machine to manufacture springs of different dimensions and sizes. The machine is of very large capacity; the parts may be run at high speed; it is not likely to get out of repair or broken in use, the parts particularly subject to wear being readily renewable.

I have illustrated and described an embodiment of my invention which I have found very practical. I have not attempted to illustrate and describe various adaptations and modifications which I contemplate as I believe the disclosure made will enable those skilled in the art to embody or adapt my improvements as may be desired.

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

1. The combination with a wire feed means, of a coiler, a spring compressing means operative to compress the formed spring while in the coiler, a knotter gear slotted to receive a coil of a spring and shouldered to engage the end thereof, a reciprocating transfer member disposed at the side of said knotter gear and provided with an upper fixed jaw and a lower pivoted jaw adapted to close upon the two bottom coils of a spring while in said coiler, a support member adapted to coact with the upper jaw when in knotting position, said support member being yieldable under undue strains, a coacting movable support member adapted

to engage the pivoted jaw when in knotting position, means for moving said movable support to and from jaw engaging position, a jaw actuating slide arranged within said transfer member, an actuating means for said slide comprising a rock shaft carried by said transfer member, a link connecting said rock shaft to said slide, an actuating spring for said rock shaft, a trigger for holding said rock shaft in initial position, means for releasing said trigger when said jaws are in spring-engaging position, means for returning said rock shaft to initial position to be engaged by said trigger after said jaws have been engaged by said support members, a cutoff means for severing the formed spring from the stock after the spring has been engaged by said jaws and while engaged by said compressor, an actuating rack for said knotter gear, and an actuating means for said transfer member and rack.

2. The combination with a wire feed means, of a coiler, a knotter gear slotted to receive a coil of a spring and shouldered to engage the end thereof, a reciprocating transfer member disposed at the side of said knotter gear and provided with an upper fixed jaw and a lower pivoted jaw adapted to close upon the two bottom coils of a spring while in said coiler, a support member adapted to coact with the upper jaw when in knotting position, said support member being yieldable under undue strains, a coacting movable support member adapted to engage the pivoted jaw when in knotting position, means for moving said movable support to and from jaw-engaging position, a jaw actuating slide arranged within said transfer member, an actuating means for said slide comprising a rock shaft carried by said transfer member, a link connecting said rock shaft to said slide, an actuating spring for said rock shaft, a trigger for holding said rock shaft in initial position, means for releasing said trigger when said jaws are in spring engaging position, means for returning said rock shaft to initial position to be engaged by said trigger after said jaws have been engaged by said support members, a cutoff means for severing the formed spring from the stock after the spring has been engaged by said jaws, an actuating rack for said knotter gear, and an actuating means for said transfer member and rack.

3. The combination with a wire feed means, of a coiler, a spring compressing means operative to compress the formed spring while in the coiler, a knotter gear slotted to receive a coil of a spring and shoulder to engage the end thereof, a reciprocating transfer member disposed at the side of said knotter gear and provided with an upper fixed jaw and a lower pivoted jaw adapted to close upon the two bottom coils of a spring while in said coiler, a jaw actuating slide arranged within said transfer member, an actuating means for said slide comprising a rock shaft carried by said transfer member, a link connecting said rock shaft to said slide, an actuating spring for said rock shaft, a trigger for holding said rock shaft in initial position, means for releasing said trigger when said jaws are in spring engaging position, means for returning said rock shaft to initial position, a cutoff means for severing the formed spring from the stock after the spring has been engaged by said jaws and while engaged by said compressor, an actuating rack for said knotter gear, and an actuating means for said transfer member and rack.

4. The combination with a wire feed means, of a coiler, a knotter gear slotted to receive a coil of a spring and shoulder to engage the end thereof, a reciprocating transfer member disposed at the side of said knotter gear and provided with an upper fixed jaw and a lower pivoted jaw adapted to close upon the two bottom coils of a spring while in said coiler, a jaw actuating slide arranged within said transfer member, an actuating means for said slide comprising a rock shaft carried by said transfer member, a link connecting said rock shaft to said slide, an actuating spring for said rock shaft, a trigger for holding said rock shaft in initial position, means for releasing said trigger when said jaws are in spring engaging position, means for returning said rock shaft to initial position, a cut-off means for severing the formed spring from the stock after the spring has been engaged by said jaws, an actuating rack for said knotter gear, and an actuating means for said transfer member and rack.

5. The combination with a wire feed means, of a coiler, a spring compressing means operative to compress the formed spring while in the coiler, a rotatable knotter member slotted to receive a coil of a spring and shouldered to engage the end thereof, a reciprocating transfer member disposed at the side of said knotter gear and provided with an upper fixed jaw and a lower pivoted jaw adapted to close upon the two bottom coils of a spring while in said coiler, a support member adapted to coact with the upper jaw when in knotting position, a coacting movable support member adapted to engage the pivoted jaw when in knotting position, means for moving said movable support to and from jaw engaging position, a jaw actuating means carried by said transfer member, means for holding said pivoted jaw in open position, means for releasing said pivoted jaw when said jaws are in spring engaging position, and a cut-off means for severing the formed spring

from the stock after the spring has been engaged by said jaws and while engaged by said compressor.

6. The combination of a coiler, a rotatable knotter member slotted to receive a coil of a spring and shouldered to engage the end thereof, a reciprocating transfer member disposed at the side of said knotter gear and provided with an upper fixed jaw and a lower pivoted jaw adapted to close upon the two bottom coils of a spring while in said coiler, a support member adapted to coact with the upper jaw when in knotting position, a coacting movable support member adapted to engage the pivoted jaw when in knotting position, means for moving said movable support to and from jaw engaging position, a jaw actuating means carried by said transfer member, means for holding said pivoted jaw in open position, and means for releasing said pivoted jaw when said jaws are in spring engaging position.

7. The combination with a wire feed means, of a coiler, a spring compressing means operative to compress the formed spring while in the coiler, a rotatable knotter member slotted to receive a coil of a spring and shouldered to engage the end thereof, a reciprocating transfer member disposed at the side of said knotter gear and provided with an upper fixed jaw and a lower pivoted jaw adapted to close upon the two bottom coils of a spring while in said coiler, a jaw actuating means carried by said transfer member, means for holding said pivoted jaw in open position, means for releasing said pivoted jaw when said jaws are in spring engaging position, and a cut-off means for severing the formed spring from the stock after the spring has been engaged by said compressor.

8. The combination of a coiler, a rotatable knotter member slotted to receive a coil of a spring and shouldered to engage the end thereof, a reciprocating transfer member disposed at the side of said knotter gear and provided with an upper fixed jaw and a lower pivoted jaw adapted to close upon the two bottom coils of a spring while in said coiler, a jaw actuating means carried by said transfer member, means for holding said pivoted jaw in open position, and means for releasing said pivoted jaw when said jaws are in spring engaging position.

9. The combination with a wire feed means, of a coiler, a spring compressing means operative to compress the formed spring while in the coiler, a knotter, a reciprocating transfer member provided with coacting spring engaging jaws, support members coacting with said jaws when in knotting position, a jaw actuating slide arranged within said transfer member, an actuating means for said slide comprising a rock shaft carried by said transfer member, a link connecting said rock shaft to said slide, an actuating spring for said rock shaft, a trigger for holding said rock shaft in initial position, means for releasing said trigger when said jaws are in spring engaging position, means for returning said rock shaft to initial position to be engaged by said trigger after said jaws have been engaged by said support members, and a cut-off means for severing the formed spring from the stock after the spring has been engaged by said jaws and while engaged by said compressor.

10. The combination with a wire feed means, of a coiler, a knotter, a reciprocating transfer member provided with coacting spring engaging jaws, support members coacting with said jaws when in knotting position, a jaw actuating slide arranged within said transfer member, an actuating means for said slide comprising a rock shaft carried by said transfer member, a link connecting said rock shaft to said slide, an actuating spring for said rock shaft, a trigger for holding said rock shaft in initial position, means for releasing said trigger when said jaws are in spring engaging position, means for returning said rock shaft to initial position to be engaged by said trigger after said jaws have been engaged by said support members, and a cut-off means for severing the formed spring from the stock after the spring has been engaged by said jaws.

11. The combination with a wire feed means, of a coiler, a spring compressing means operative to compress the formed spring while in the coiler, a knotter, a reciprocating transfer member provided with coacting spring engaging jaws, a jaw actuating slide arranged within said transfer member, an actuating means for said slide comprising a rock shaft carried by said transfer member, a link connecting said rock shaft to said slide, an actuating spring for said rock shaft, a trigger for holding said rock shaft in initial position, means for releasing said trigger when said jaws are in spring engaging position, means for returning said rock shaft to initial position to be engaged by said trigger and a cut-off means for severing the formed spring from the stock after the spring has been engaged by said jaws and while engaged by said compressor.

12. The combination with a wire feed means, of a coiler, a knotter, a reciprocating transfer member provided with coacting spring engaging jaws, a jaw actuating slide arranged within said transfer member, an actuating means for said slide comprising a rock shaft carried by said transfer member, a link connecting said rock shaft to said slide, an actuating spring for said rock shaft, a trigger for holding said rock

shaft in initial position, means for releasing said trigger when said jaws are in spring engaging position, means for returning said rock shaft to initial position to be engaged by said trigger, and a cut-off means for severing the formed spring from the stock after the spring has been engaged by said jaws.

13. The combination with a wire feed means, of a coiler, a spring compressing means operative to compress the formed spring while in the coiler, a knotter, a reciprocating transfer member provided with coacting spring engaging jaws, support members coacting with said jaws when in knotting position, a spring actuated means for closing said jaws, a trigger for holding said jaw closing means in jaw releasing position, means for releasing said trigger when said jaws have been engaged by said support members, and a cut-off means for severing the formed spring from the stock after the spring has been engaged by said jaws and while engaged by said compressor.

14. The combination with a wire feed means, of a coiler, a knotter, a reciprocating transfer member provided with coacting spring engaging jaws, support members coacting with said jaws when in knotting position, a spring actuated means for closing said jaws, a trigger for holding said jaw closing means in jaw releasing position, means for releasing said trigger when said jaws are in spring engaging position, means for engaging said trigger after said jaws have been engaged by said support members, and a cut-off means for severing the formed spring from the stock after the spring has been engaged by said jaws.

15. The combination of a coiler, a knotter, a reciprocating transfer member provided with coacting spring engaging jaws, support members coacting with said jaws when in knotting position, a spring actuated means for closing said jaws, a trigger for holding said jaw closing means in jaw releasing position, means for releasing said trigger when said jaws are in spring engaging position, and means for engaging said trigger after said jaws have been engaged by said support members.

16. The combination with a wire feed means, of a coiler, a spring compressing means operative to compress the formed spring while in the coiler, a knotter, a reciprocating transfer member provided with coacting spring engaging jaws, support members coacting with said jaws when in knotting position, one of said support members being yieldable under undue strains, and a cut-off means for severing the formed spring from the stock after the spring has been engaged by said jaws and while engaged by said compressor.

17. The combination with a wire feed means, of a coiler, a knotter, a reciprocating transfer member provided with coacting spring engaging jaws, support members coacting with said jaws when in knotting position, one of said support members being yieldable under undue strains, and a cut-off means for severing the formed spring from the stock after the spring has been engaged by said jaws.

18. The combination of a coiler, a knotter, a reciprocating transfer member provided with coacting spring engaging jaws, and support members coacting with said jaws when in knotting position, one of said support members being yieldable under undue strains.

19. The combination of a coiler, a knotter, a reciprocating transfer member provided with coacting spring engaging jaws, a spring actuated means for closing said jaws, a trigger for holding said jaw closing means in jaw releasing position, means for releasing said trigger when said jaws are in spring engaging position, means for engaging said trigger when said transfer member is in retracted position, an actuating means for said transfer member comprising a cam and coacting lever, and pneumatic means for holding said lever in engagement with said cam.

20. The combination of a coiler, a knotter, a reciprocating transfer member provided with coacting spring engaging jaws, a spring actuated means for closing said jaws, a trigger for holding said jaw closing means in jaw releasing position, means for releasing said trigger when said jaws are in spring engaging position and means for engaging said trigger when said transfer member is in retracted position.

21. The combination of a coiler, a rotatable knotter member slotted to receive a coil of a spring and shouldered to engage the end thereof, a transfer member disposed at the side of said knotter and provided with jaws adapted to close upon the two bottom coils of a spring while in said coiler, a cut-off means for severing the formed spring from the stock after the spring has been engaged by said jaws, and support members adapted to coact with said jaws when in knotting position, one of said support members being yieldable under undue strains.

22. The combination of a coiler, a rotatable knotter member slotted to receive a coil of a spring and shouldered to engage the end thereof, a transfer member disposed at the side of said knotter and provided with jaws adapted to close upon the two bottom coils of a spring while in said coiler, and a cut-off means for severing the formed spring from the stock after the spring has been engaged by said jaws.

23. The combination of a coiler, a rotatable knotter member slotted to receive a coil of a spring and shouldered to engage the

end thereof, a transfer member disposed at the side of said knotter and provided with jaws adapted to close upon the two bottom coils of a spring while in said coiler, and support members adapted to coact with said jaws when in knotting position, one of said support members being yieldable under undue strains.

24. The combination of a coiler, a transfer member provided with spring engaging jaws, a cut-off means for severing the formed spring from the stock after the spring has been engaged by said jaws, and support members adapted to coact with said jaws when in knotting position.

25. The combination of a coiler, a transfer member provided with spring-engaging jaws, and support members adapted to coact with said jaws when in knotting position.

26. The combination with a coiler, a knotter, a reciprocating transfer member, spring engaging jaws, a spring means for closing said jaws, a trigger for holding said jaw closing means in initial position, a trip therefor comprising a reciprocating rod, a spring for holding said rod in initial position, an actuating lever, a spring connecting said actuating lever to said rod, and an actuating cam for said lever, timed to trip the trigger when the jaws are in spring engaging position.

27. The combination with a coiler, a knotter, a reciprocating transfer member, spring engaging jaws, a spring means for closing said jaws, a trigger for holding said jaw closing means in initial position, a trip therefor, and means for actuating said trip when the jaws are in spring engaging position.

28. The combination with a knotter, of a spring holding member operatively associated with said knotter and provided with a relatively fixed and a pivoted jaw, a pivoted support member with which said fixed jaw coacts when said transfer member is in knotting position, a spring tension means for said support, a support member mounted for reciprocating movement transversely of said jaws, a wedge for actuating said sliding support, a spring for projecting said wedge to engaging position, and a cam for retracting said wedge.

29. The combination with a knotter, of a spring holding member operatively associated with said knotter and provided with a relatively fixed and a pivoted jaw, a support member with which said fixed jaw coacts when said transfer member is in knotting position, a support member mounted for reciprocating movement transversely of said jaws, a wedge for actuating said sliding support, a spring for projecting said wedge to engaging position, and a cam for retracting said wedge.

30. The combination with a knotter, of a spring supporting member operatively associated with said knotter and provided with jaws, a pivoted support member with which one of said jaws coacts when said transfer member is in knotting position, a spring tension means for said support, a support member mounted for reciprocating movement transversely of said jaws, and means for actuating said reciprocating support.

31. The combination with a knotter, of a spring supporting member operatively associated with said knotter and provided with jaws, a support member with which one of said jaws coacts when said transfer member is in knotting position, a support member mounted for reciprocating movement transversely of said jaws, and means for actuating said reciprocating support.

32. The combination of a coiler, a knotter, means for transferring springs from said coiler to said knotter, said coiler being adjustable to vary the springs coiled thereby, and an adjustable support for said coiler whereby it may be adjusted to position the springs formed by the coiler relative to said transfer means and knotter.

33. The combination with a coiler, a knotter, a reciprocating transfer member for transferring the coiled springs from said coiler to said knotter, a rack for actuating said knotter, an actuating means for said transfer member and rack comprising cams, cam levers coacting with said cams and operatively connected to said knotter and transfer member, and pneumatic means for holding said levers in engagement with their respective cams and actuating the parts in one direction.

34. The combination with a coiler, a knotter, a reciprocating transfer member for transferring the coiled springs from said coiler to said knotter, a rack for actuating said knotter, an actuating means for said transfer member and rack comprising cams, cam levers coacting with said cams and operatively connected to said knotter and transfer member, and yielding means for holding said levers in engagement with their respective cams and actuating the parts in one direction.

35. The combination with a coiler, a reciprocating transfer member for the coiled springs, an actuating means for said transfer member comprising a cam, a cam lever coacting with said cam and operatively connected to said transfer member, and pneumatic means for holding said lever in engagement with its respective cam and for actuating said transfer member to spring engaging position.

36. The combination with a coiler, a reciprocating transfer member for the coiled springs, an actuating means for said transfer member comprising a cam, a cam lever coacting with said cam and operatively con-

nected to said transfer member, and means for holding said lever in engagement with its respective cam and for actuating said transfer member to spring engaging position.

37. The combination of a knotter gear, a reciprocating driving rack therefor, a driving cam, a lever coacting with said cam and having an adjustable link connection to said driving rack, an adjustable stop for said rack, said lever being provided with a segment, a fluid cylinder and coacting piston, and a second lever connected to said piston and provided with a segment coacting with said segment on said cam lever.

38. The combination of a knotter gear, a reciprocating driving rack therefor, a driving cam, a lever coacting with said cam, said lever being provided with a segment, a fluid cylinder and coacting piston, and a second lever connected to said piston and provided with a segment coacting with said segment on said cam lever.

39. The combination with a coiler, a knotter, a rack for actuating said knotter, an actuating means for said transfer member and rack comprising cams, a cam lever coacting with said cam and operatively connected to said rack, and yielding means for holding said lever in engagement with its cam.

40. The combination of a coiler member having a slot-like groove in the top thereof with a lug at one end and a cylindrical recess at one side of said groove, a wear block disposed in said groove against said lug, a screw disposed with its head over-hanging said block securing it in said groove, a cylindrical guide block disposed in said cylindrical recess and provided with a pair of peripheral grooves, and a set screw disposed to engage the lower of said grooves whereby said guide block is adjustably secured within said recess, the upper groove constituting a wire guide.

41. The combination of a coiler member having a slot-like groove in the top thereof with a lug at one end and a cylindrical recess at one side of said groove, a wear block disposed in said groove against said lug and a screw disposed with its head over-hanging said block securing it in said groove.

42. The combination with a coiler member having a cylindrical recess therein, a cylindrical guide block disposed in said cylindrical recess and provided with a pair of peripheral grooves, and a set screw disposed to engage the lower of said grooves whereby said guide block is adjustably secured within said recess.

43. The combination with a coiler member having a cylindrical recess therein, a cylindrical guide block disposed in said cylindrical recess, and a set-screw disposed to engage said guide block whereby said guide block is adjustably secured within said recess.

44. The combination with a coiler member having a cylindrical recess therein, a cylindrical guide block disposed in said cylindrical recess and provided with a pair of peripheral grooves, and a set-screw disposed to engage said block whereby said guide block is adjustably secured within said recess.

45. The combination with a wire feed means, of a coiler block having a groove in the face thereof adapted to receive a wear bar, a wear bar disposed in said groove, means for clamping said bar in said groove, and a guide for directing the wire to be coiled against said bar.

46. The combination with an adjustable coiler block, of a vertically reciprocating rod having an arm at its upper end, a pitch bar pivotally connected to said arm, adjusting screws disposed at opposite sides of the pivot whereby the angle of said pitch bar may be varied, an actuating lever for said rod, an arm pivoted on said lever and engaging said rod, and an adjusting screw connecting said arm and lever.

47. The combination with an adjustable coiler block, of a vertically reciprocating rod having an arm at its upper end, a pitch bar pivotally connected to said arm, and adjusting screws disposed at opposite sides of the pivot whereby the angle of said pitch bar may be varied.

48. The combination with an adjustable coiler block, of a vertically reciprocating rod, a pitch bar mounted in said rod, an actuating lever for said rod, an arm pivoted on said lever and engaging said rod, and an adjusting screw connecting said arm and lever.

49. The combination with a coiler, a knotter, a reciprocating transfer member adapted to transfer the formed springs from the coiler to the knotter, driving means for said transfer member, a control means therefor including a reciprocating electric contact member, and a tappet on said transfer member adapted to engage said contact member on the forward stroke of the transfer member.

In witness whereof, I have hereunto set my hand.

BERT L. VAN ORMAN. [L. S.]