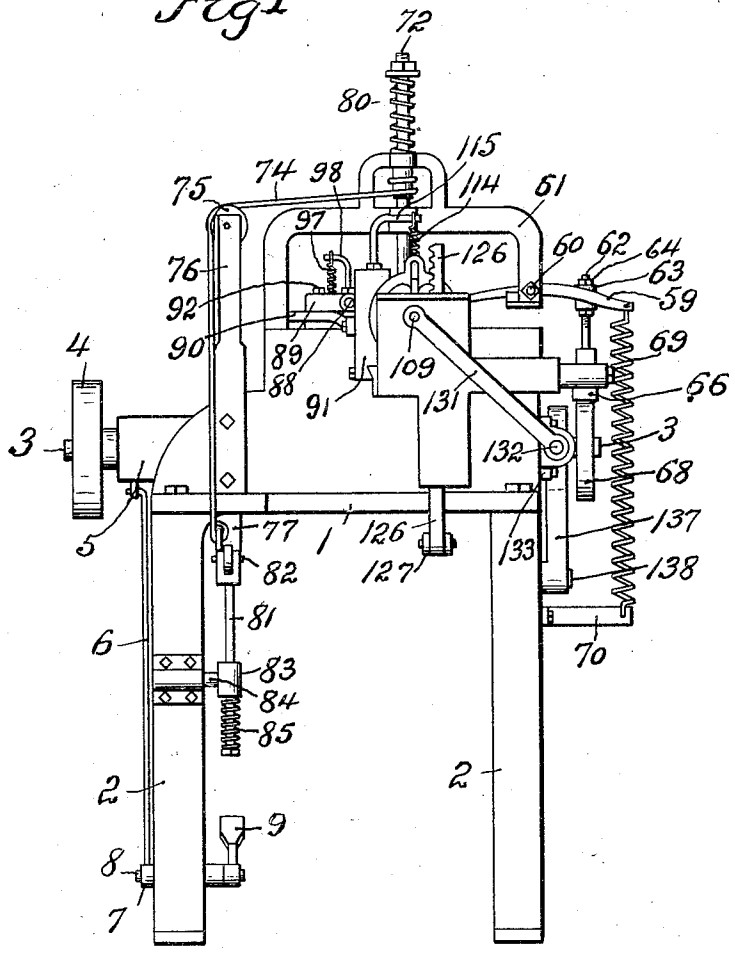
May 31, 1932. C. KIRCHNER 1,860,582

HOOK AND KNOT FORMING MACHINE

Filed July 11, 1931 6 Sheets-Sheet 1

Fig 1



Witness
H. Vernon Olson

INVENTOR
Carl Kirchner
BY
Warren D. House
His ATTORNEY

May 31, 1932. C. KIRCHNER 1,860,582

HOOK AND KNOT FORMING MACHINE

Filed July 11, 1931 6 Sheets-Sheet 2

Fig 2

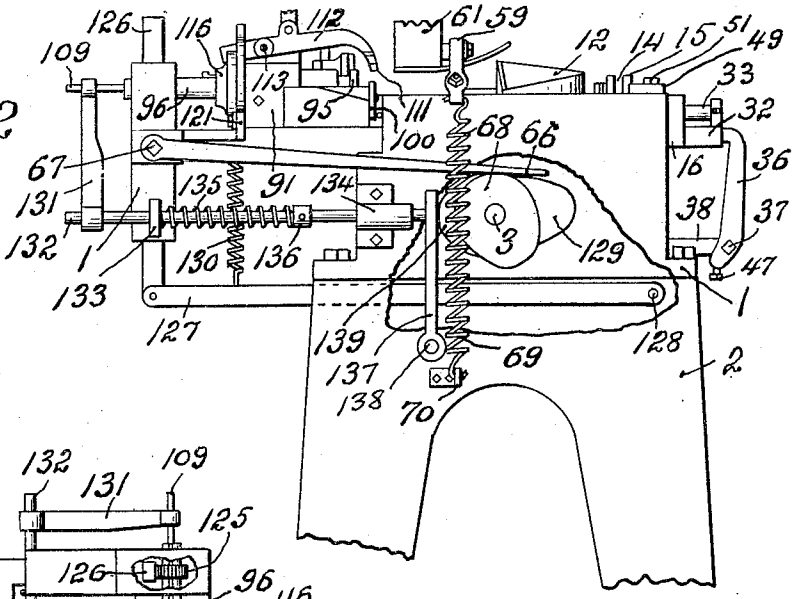
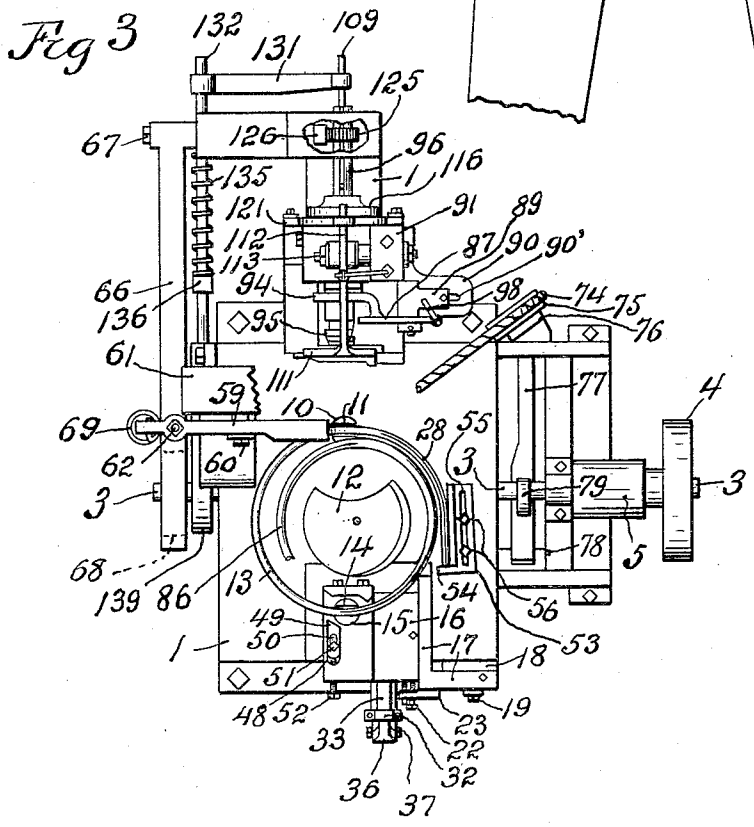


Fig 3



INVENTOR.

Carl Kirchner

BY Warren D. House

His ATTORNEY.

Witness

H. Vernon Olson

May 31, 1932. C. KIRCHNER 1,860,582

HOOK AND KNOT FORMING MACHINE

Filed July 11, 1931 6 Sheets-Sheet 3

Fig 4

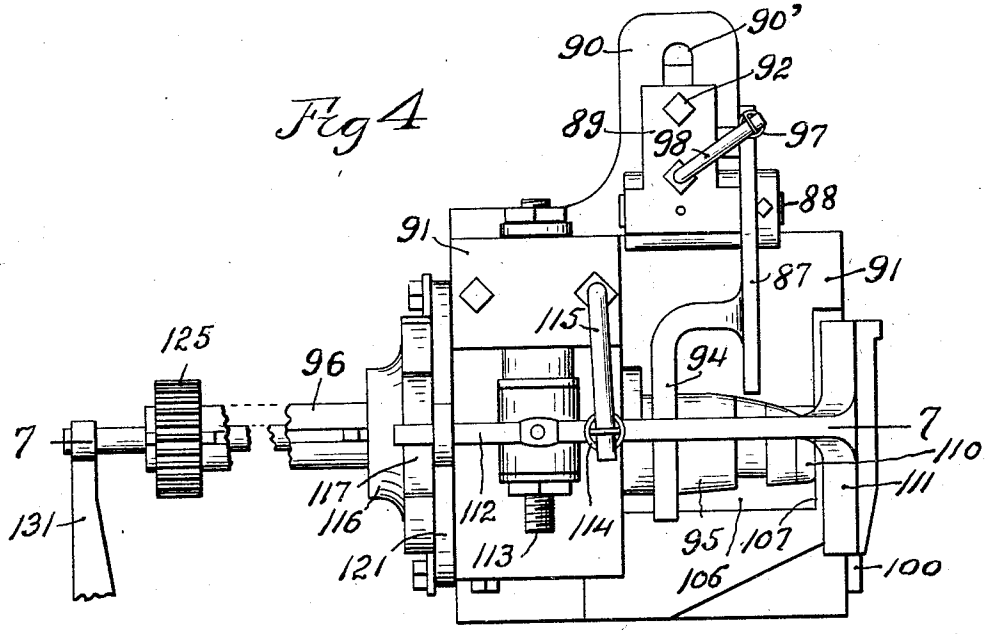


Fig 5

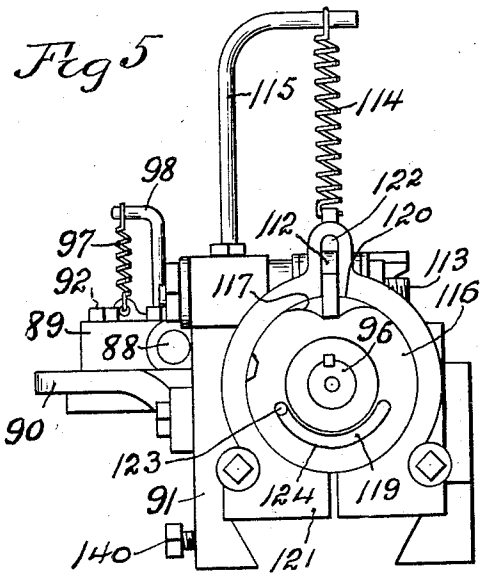
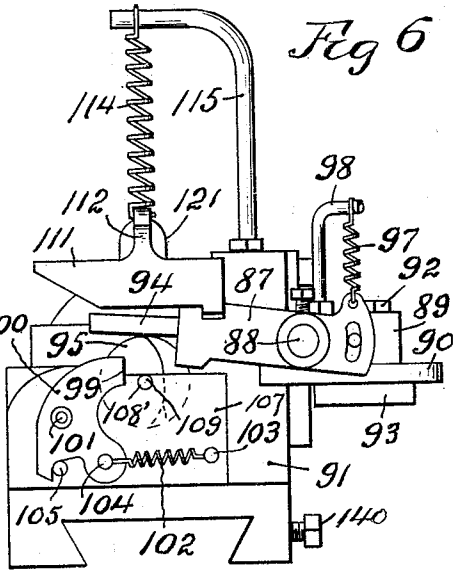


Fig 6



INVENTOR.

Carl Kirchner

BY Warren D. House

His ATTORNEY

Witness

H. Vernon Olson

May 31, 1932. C. KIRCHNER 1,860,582

HOOK AND KNOT FORMING MACHINE

Filed July 11, 1931 6 Sheets-Sheet 4

Fig 7

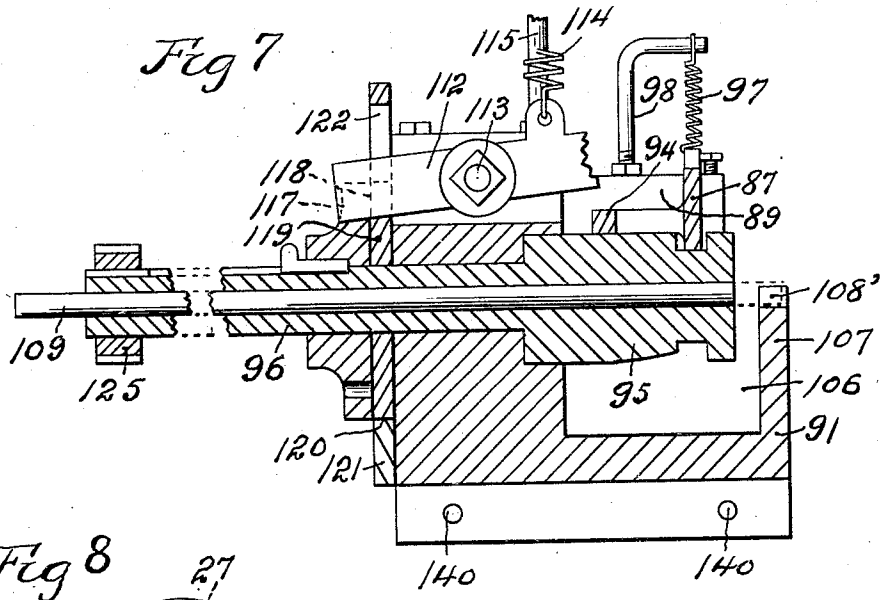


Fig 8

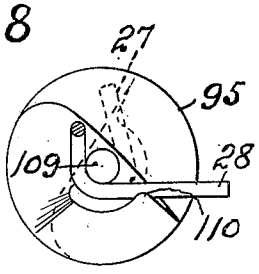


Fig 11

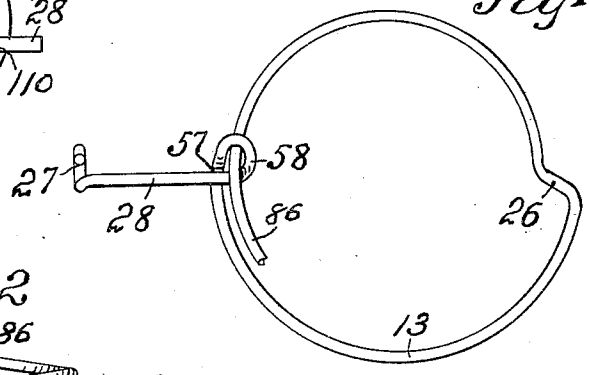


Fig 12

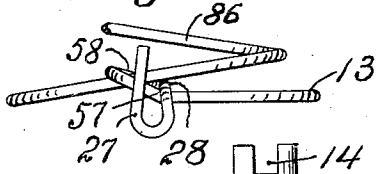


Fig 9

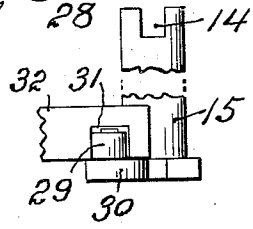
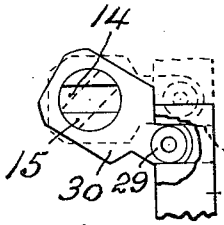


Fig 10



Witness
H. Werner Olsen

INVENTOR
Carl Kirchner
BY
Warren D. House
His ATTORNEY

May 31, 1932. C. KIRCHNER 1,860,582

HOOK AND KNOT FORMING MACHINE

Filed July 11, 1931 6 Sheets-Sheet 5

Fig 13

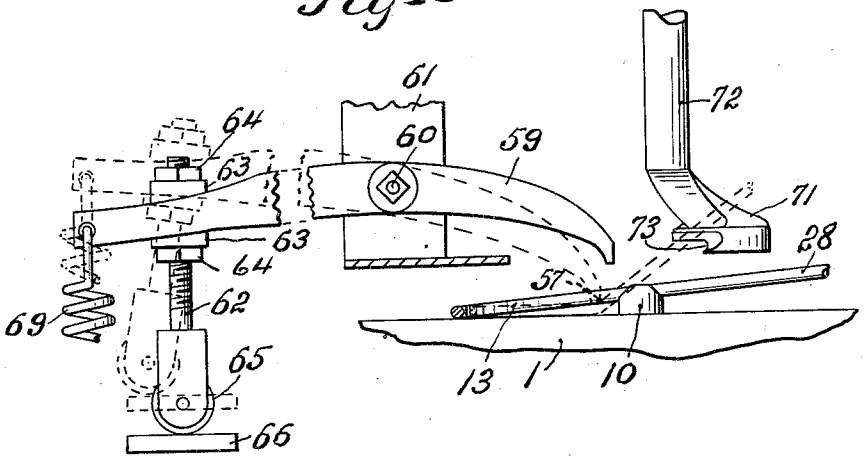


Fig 14

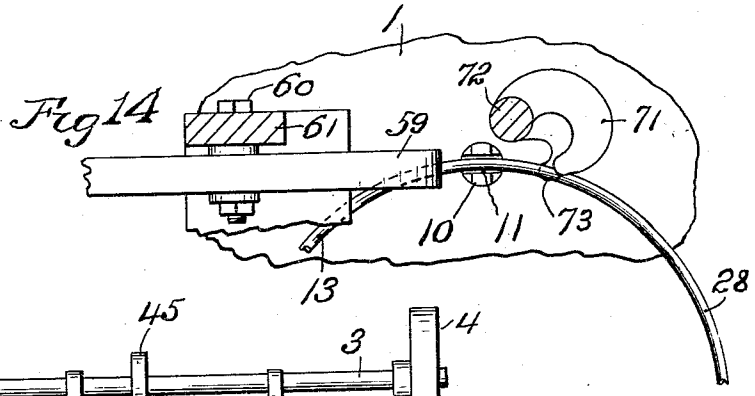
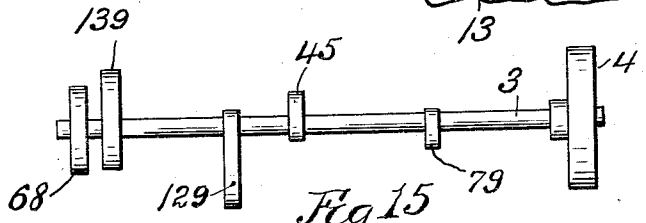


Fig 15



Witness
H. Vernon Olsen

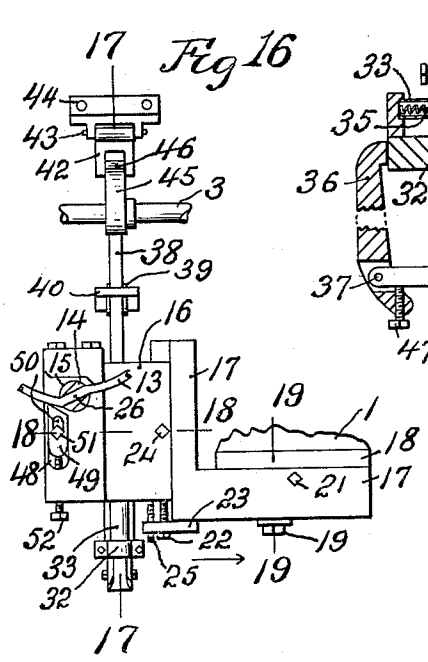
INVENTOR
Carl Kirchner
BY
Warren D. House
His ATTORNEY

May 31, 1932. C. KIRCHNER 1,860,582

HOOK AND KNOT FORMING MACHINE

Filed July 11, 1931 6 Sheets-Sheet 6

Fig 16



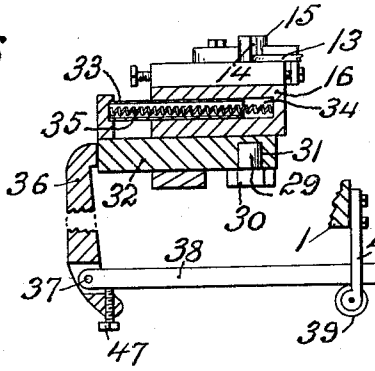


Fig 17

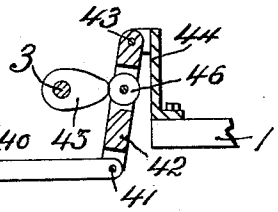


Fig 18

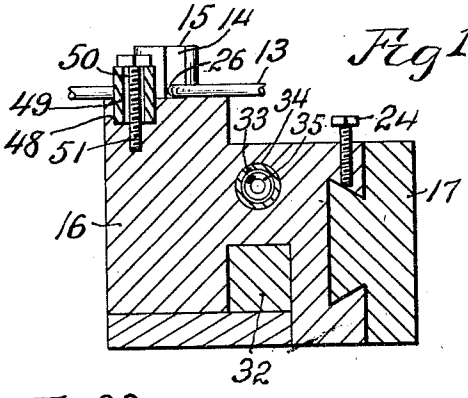


Fig 19

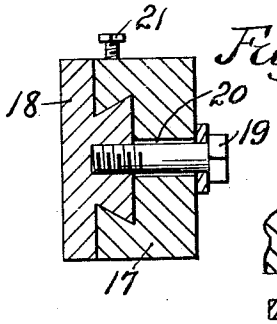


Fig 23

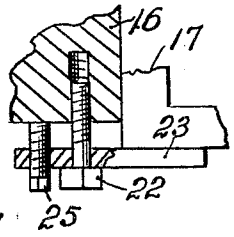


Fig 22

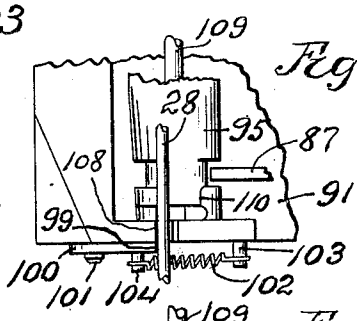


Fig 21

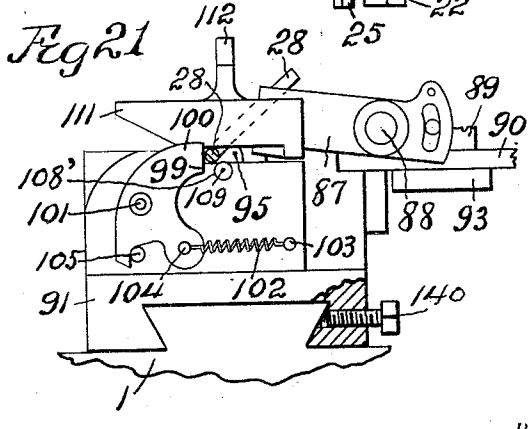
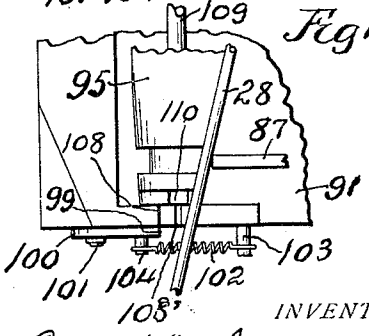


Fig 20



Witness
H. Vernon Olsen

INVENTOR
BY Carl Kirchner
Warren D. House
His ATTORNEY

Patented May 31, 1932 1,860,582

UNITED STATES PATENT OFFICE

CARL KIRCHNER, OF CARTHAGE, MISSOURI, ASSIGNOR TO LEGGETT AND PLATT SPRING BED AND MANUFACTURING COMPANY, OF CARTHAGE, MISSOURI, A CORPORATION OF MISSOURI

HOOK AND KNOT FORMING MACHINE

Application filed July 11, 1931. Serial No. 550,177.

My invention relates to improvements in hook and knot forming machines.

It relates particularly to a machine which operates upon an end coil of a spiral spring, such as is embodied in bed bottoms, spring mattresses, spring seats and the like, for forming said end coil so that it is adapted for connection with end coils of similar springs.

In such forming operation it is usual to knot an end portion around the end coil at a distance from the tip of said end portion so as to provide an outwardly laterally extending part termed the stem; to provide at the outer end of said stem a hook adapted to engage the end coil of a similar spring; and to form in the end coil substantially diametrically opposite said stem an offset portion in the arc of the coil adapted to be engaged by the hook of the stem of another similar spring.

One of the objects of my invention is to provide in a machine of the kind described novel means by which the length of the stem may be adjustably varied to suit different spacings of the assembled springs.

A further object of my invention is to provide novel means for making a bend in the end coil where the knot is formed, so as to form a shoulder against which the stem bears after the knot is formed, and to dispose the free end portion so that the knotting mechanism will reliably engage it preliminary to the formation of the knot.

Another object of my invention is to provide novel crimping mechanism which forms the offset portion, whereby it may be adjusted for different diameters of end coils, and by which the length of the offset portion may be varied.

Still another object of my invention is to provide novel means for straightening the arcuate end portion of the coil which is to form the stem.

My invention provides further novel means for forming the hook at the end of the stem.

My invention provides still further a novel machine of the kind described, which is relatively simple, strong, durable, not likely to get out of order, and which is rapid, reliable and efficient in operation.

The novel features of my invention are hereinafter fully described and claimed.

In the accompanying drawings which illustrate a machine embodying my improvements,

Fig. 1 is a rear elevation of the machine.

Fig. 2 is a side elevation, partly broken away and parts omitted, of the machine.

Fig. 3 is a top view of the same, parts being broken away and parts omitted.

Fig. 4 is an enlarged top view, partly broken away of a portion of the hook forming mechanism, parts being omitted.

Fig. 5 is an enlarged rear elevation of a portion of the hook forming mechanism, shown in Fig. 4.

Fig. 6 is a front elevation of what is shown in Figs. 4 and 5.

Fig. 7 is a section on the plane of the line 7—7 of Fig. 4, parts being broken away and parts omitted.

Fig. 8 is an enlarged front view of the rotary hook forming member and the mandrel around which the hook is formed.

Fig. 9 is an enlarged side elevation, partly broken away, of the notched oscillatory crimping member and the reciprocatory member which oscillates it.

Fig. 10 is a top view of what is shown in Fig. 9.

Fig. 11 is a plan view of the completed end coil.

Fig. 12 is a side elevation of the same.

Fig. 13 is an enlarged front elevation of the tilting coil bending lever, partly broken away, and parts associated therewith.

Fig. 14 is a top view of part of what is shown in Fig. 13.

Fig. 15 is a plan view of the main rotary shaft, and cams and pulley thereon.

Fig. 16 is a plan view, enlarged, of the crimping mechanism.

Fig. 17 is a section on the line 17—17 of Fig. 16.

Fig. 18 and Fig. 19 are cross sections respectively on the line 18—18 and 19—19 of Fig. 16.

Fig. 20 is an enlarged plan view of part

of the hook bending mechanism, showing one position of the rotary hook forming member.

Fig. 21 is a front elevation, enlarged, of part of the hook forming mechanism.

Fig. 22 is a view similar to Fig. 20, showing another position of the hook forming member.

Fig. 23 is an enlarged horizontal section of part of the crimping mechanism.

Similar reference characters designate similar parts.

1 designates the body of the machine and 2 the legs thereof. 3 is a horizontal rotary main shaft on the body 1 having rotatable on it a driving pulley 4 having driving engagement with the shaft 3 through any suitable clutch mechanism 5 operable by a link 6 connected to a crank 7 on a pedal shaft 8 having an operating pedal 9. Fig. 1.

A vertical stationary post 10 having in its upper end a slot 11 extends upwardly from the body 1, at the rear of an arcuate guard 12 on the body 1. The slot 11 is adapted to receive the rear side of an end coil 13, which is to be formed, Figs. 2, 3, 13 and 14.

When a spring is to be formed, its end coil 13 is placed horizontally on the body 1 with the rear side of the coil in the notch 11 of the fixed post 10, the coil encircling the arcuate guard 12, as shown in Fig. 3 and in Figs. 13 and 14.

The forward side of the coil 13 is placed in a slot or notch 14 in the upper end of a vertical cylindrical portion 15 of a crimping member, which extends through and is oscillative in a block 16, which is horizontally forwardly and rearwardly adjustable, to suit coils 13 of different diameters, upon another block comprising an L shaped member 17, with which the block 16 has sliding dovetail engagement, as shown in Figs. 3, 16 and 18.

The other arm of the L shaped member 17 has horizontal sliding dovetail engagement with a plate 18, so as to be adjustable transversely at right angles to the adjustment of the block 16 upon the block 17. The plate 18 is fastened rigidly to and is a part of the body 1, Figs. 3, 16, 18 and 19.

The block 17 is held in the position to which it is adjusted on the plate 18 by a bolt 19 which extends through a horizontal slot 20 in the block 17 and has threaded engagement with the plate 18. By tightening the bolt 19, its head will engage the front side of the block 17. A set screw 21 in the block 17 bears on the plate 18 to aid in holding the block in the position to which it is adjusted, Figs. 16 and 19.

A forwardly and rearwardly extending bolt 22 having threaded engagement with the block 16 extends through a plate 23 mounted on the front side of the block 17. The head of the bolt 22 bears against the front side of the plate 23. A set screw 24 mounted in the block 16 bears on the block 17, so as to hold the block 16 in the position to which it may be adjusted. By loosening the set screw 24, and turning the bolt 22 in the proper directions, the block 16 may be adjusted forwardly and rearwardly to the desired position, and then held by tightening the set screw 24, Figs. 16 and 18.

By turning the bolt 22 in one direction, the block 16 is drawn forwardly. Another set screw 25 extending through and having threaded engagement with the plate 23 bears at its rear end against the front side of the block 16. By turning the set screw 25 in the proper direction, the block 16 will be forced rearwardly, the bolt 22 and set screw 24 being also turned to permit such adjustment, Figs. 23, 16 and 19.

To oscillate the slotted crimping member 15 so as to make the offset portion 26 in the coil 13, Fig. 11, to which is to be attached a hook 27 at the end of a stem 28 of another coil 13, Figs. 11 and 12, the lower end of the crimping member 15 has a horizontal crank on the upper side of which is mounted a roller 29, the crank being designated by 30, Figs. 9, 10 and 17.

The roller 29 is mounted in a transverse groove 31 in the under side of a forwardly and rearwardly reciprocative member 32 horizontally slidably mounted in the block 16, Figs. 2, 3, 9, 10, 16, 17 and 18.

For normally forcing the reciprocative member 32 rearwardly and to normally hold the crimping member 15 in the position shown in Fig. 3, and in solid lines in Fig. 10, so that the coil 13 can enter the slot 14 in the crimping member 15, there is attached to the reciprocative member 32 the rear end of a horizontal forwardly and rearwardly extending tube 33 which is reciprocative in a hole 34 in the block 16, and in which tube is a compression coil spring 35, the front end of which bears against the block 16, and the rear end of which bears against the reciprocative member 32, Figs. 2, 3, 16, 17 and 18. The tension of the coil spring 35 normally forces the member 32 rearwardly.

To force the reciprocative member 32 forwardly so as to turn the crimping member 15 to the dotted position shown in Fig. 10 and to the position shown in Figs. 16 and 17, the following described mechanism is employed.

Referring particularly to Figs. 2, 3, 16 and 17, 36 designates an upright pushing member the upper end portion of which is adapted to reciprocate forwardly and rearwardly, and in moving forwardly it engages the rear end of the reciprocative member 32, and pushes it forwardly, thereby through the roller 29 and crank 30 turning the crimping member 15 from the position shown in solid lines in Fig. 10 to the dotted position in said figure, thus forming the offset 26 in a coil 13 mounted in the slot 14.

The pushing member 36 between its ends is pivoted by a horizontal transverse pin 37 to the forward end of a horizontally reciprocative rearwardly extending bar 38, Figs. 2, 16 and 17, the under side of which rests on a roller 39 mounted on a vertical plate 40 depending from the body 1. The rear end of the bar 38 is pivoted by a transverse pin 41 to the lower end of an upright link 42, the upper end of which is pivoted by a transverse pin 43 to a plate 44 mounted on a part of the body 1.

On the main shaft 3 is secured a cam 45 which in revolving engages the front side of a roller 46 mounted on the link 42.

During each revolution of the main shaft 3, the cam 45 engages the roller 46 and swings rearwardly the link 42, thus moving rearwardly the bar 38 and the pushing member 36, which pushes rearwardly the reciprocative member 32 and thus turns the crimping member 15 so as to form the offset 26 in the coil 13. When the cam 45 permits, the coil spring 33 forces toward the front the member 32 and with it the pushing member 36, bar 38 and link 42 to their initial forward positions.

To adjust the range of movement of the reciprocative member 32, and the angle imparted to the offset portion 26 of the coil, 13, the lower portion of the pushing member 36, at the rear of the pivot pin 37, has through it an upwardly extending threaded hole in which is adjustably fitted a screw 47 the upper end of which bears against the under side of the bar 38 at the rear of the pivot pin 37. By adjusting the screw 47 upwardly and downwardly, the upper end of the pushing member 36 may be moved forwardly and rearwardly. When the screw 47 is moved downwardly the stroke of the reciprocative member 32 will be shortened, and the reverse.

To vary the length of the offset portion 26 of the coil 13, the upper side of the block 16, forward of the crimping member 15, Figs. 2, 3, 16, 17 and 18, has a groove 48 in which is forwardly and rearwardly slidable a gage member 49, the forward end of which is adapted to engage the front side of the coil 13 at the left of and close to the crimping member 15, as viewed in Figs. 2 and 16. By adjusting the gage member 49 forwardly and rearwardly, the length of the offset portion 26 is changed. To hold the gage member in its adjusted position, it is provided with a slot 50 through which extends a vertical bolt 51, the lower end of which has threaded engagement with the block 16, and the head of which is adapted to bear on the top of the gage member 49.

A horizontal forwardly and rearwardly extending bolt 52 is fitted in a threaded hole in the block 16 and has its inner end bearing against the front end of the gage member 49 to hold the latter from moving forwardly after it has been adjusted.

To regulate the length the stem 28 shall be, there is provided on the body 1, at the right of the guard 12, Fig. 3, a forwardly and rearwardly adjustable gage member 53, which has a lateral arm 54 and a longitudinal slot 55.

The free end of the stem portion 28 of the coil is adapted to bear against the lateral arm 54. By adjusting the gage member 53 forwardly and rearwardly, the length of the stem portion 28 can be varied as desired. Two vertical bolts 56 extend through the slot 55 and have their lower ends fitted in threaded holes in the body 1, the heads of the bolts being adapted to bear on the top of the gage member 53 to hold the latter in the position to which it may be adjusted.

To bend the coil 13 to form a shoulder 57, Fig. 11, where the knot 58 is to be made, and to hold the coil while the knot 58 is being formed, a substantially horizontal transverse bending and holding lever 59, Figs. 1, 3, 13 and 14, at the left of the slotted coil holding post 10, as viewed in Figs. 3, 13 and 14, is pivoted on a horizontal rearwardly extending bolt 60 mounted in a bracket 61 supported by and over the body 1 of the machine.

The right end of the lever 59 is adapted to press on the upper side of the coil 13, just to the left of the post 10, Figs. 3 and 13, and cause the stem portion 28 to be tilted upward to the position shown in dotted lines in Fig. 13, thus forming the shoulder 57, Fig. 11, and shown in dotted lines in Fig. 13.

To so tilt the lever 59, it has, at the left of the bolt 60, Fig. 13, vertically adjustable in it the threaded upper end of a vertical bolt 62 on which are mounted two washers 63 which respectively bear against the upper and lower sides of the lever 59 and having respectively bearing against them two nuts 64 on the bolt 62. The lower end of the bolt 62 carries a roller 65 which bears on the upper side of a rearwardly extending lever 66, the rear end of which is pivoted on a horizontal transverse bolt 67 mounted on the body 1, Figs. 1, 2, 3 and 13. The lever 66 rests upon and is lifted by a cam 68 on the main shaft 3, once during each revolution of the latter.

A vertical coil spring 69 has its upper end fastened to the outer or left end of the lever 59, as viewed in Figs. 3 and 13, the lower end of the spring being fastened to a bracket 70 fastened to the body 1, Figs. 1 and 2. The tension of the spring 69 normally swings the outer end of the lever 59 downwardly to the position shown in solid lines in Fig. 13, when the cam 68 permits the lever 66 to swing downwardly to the position shown in Fig. 2 and in solid lines in Fig. 13, thus releasing the coil 13 from the lever 59 as the knot 58

is being completed, and permitting the stem portion 28 to pass under the lever 59, as said stem portion is being pressed by the knotting arm 71 to the straightening position, shown in Fig. 20.

The knotting arm 71, Figs. 13 and 14, is at the lower end of a vertical shaft 72 rotatably mounted in the bracket 61 and adapted to be turned therein to form the knot 58 in the coil 13, and to then be retracted. The shaft 72 is located closely adjacent to the post 10 at the side opposite the lever 59. The arm 71 of the knotter arm 72 has a notch 73 at its free end, which is above the stem portion 28, before the latter is tilted upwardly by the lever 59, as shown in solid lines in Fig. 13, but which, after the stem portion 28 has been bent to the position shown in dotted lines in Fig. 13, is adapted to receive said stem portion, when the shaft and arm 71 are revolved clockwise, as viewed in Fig. 14.

To revolve the said shaft 72 and arm 71 in said direction, said shaft 72 has attached to and adapted to be wound on its periphery one end portion of a cable 74, Fig. 1, which cable passes laterally to and on a pulley 75 mounted in the top of a vertical bar 76, the cable 74 passing thence downwardly and being attached at its lower end to the rear end of a rearwardly extending lever 77 pivoted by a horizontal pin 78 to the body 1. The bar 76 is fastened at its lower end to the body 1.

The lever 77 is depressed so as to draw downwardly the cable 74 to turn the knotting shaft 72 in the knotting direction by a cam 79 on and revoluble with the main shaft 3, which cam is so set and formed as to depress the lever 77 after the offset 26 has been formed in the coil 13.

To retract the knotting shaft 72, after it has been turned to form the knot 58, a coil spring 80 encircling the shaft 72 has one end fastened to said shaft and its other end fastened to the bracket 61.

To normally swing the lever 77 upwardly, when the cam 79 so permits, the rear end of the lever 77 has pivoted to it the upper end of a normally upright rod 81, Fig. 1, by a transverse pin 82. The rod 81 is slidable in a bearing 83, which bearing is oscillative on a horizontal rod 84 fastened to one of the legs 2 of the machine. A pull spring 85 encircling the rod 84 has its lower end attached to the lower end of the rod 84 and its upper end attached to the bearing 83.

In the operation, a spring is placed with its coil 13 in the slot 11 of the post 10, and in the slot 14 of the crimping member 15, with the free end of the stem portion 58 against the arm 54 of the gage member 53.

The pedal 9 is then depressed to establish driving connection between the driving pulley 4 and the shaft 3, through the clutch mechanism 5. The main shaft will now be revolved, and through the cam 45, roller 46, link 42, bar 38 pushing member 36 and screw 47, the member 32 will be forced forwardly, against the pressure of the retracting spring 35, thus swinging the crank 30, by means of the roller 29, thereby turning the crimping member 15 to the position shown in Fig. 16, and thus forming the offset portion 26 in the coil 13.

The cam 79 will swing downwardly the lever 77, thus through the cable 74 turning the knotting shaft 72 and its arm 71 clockwise as viewed in Fig. 14. In the meantime, the cam 68 will lift the lever 66, thus through the roller 65, bolt 62, washers 63 and nuts 64 swinging the lever 59 so that its inner end will engage the upper side of the coil 13 and bend the coil to form the shoulder 57, and to cause the stem portion 28 to assume the position shown in dotted lines in Fig. 13.

The arm 71 will now engage the raised stem portion 28 and will carry such portion first over the coil 13, and then under the next coil above, designated by 86, Figs. 3, 11 and 12, and against the shoulder 57, the cam 68 in turning permitting the spring 69 to swing upwardly the inner end of the lever 59, so that the stem portion 28 can pass thereunder.

The arm 71 carries the stem portion 28 against the left end, Figs. 3 and 6, of a stop plate 87 which is secured on a rearwardly extending shaft 88, Figs. 4, 5 and 6, oscillatively mounted in a member 89, which is adjustable horizontally transversely on a bracket 90 fastened to one side of a block 91, which has dove-tail forwardly and rearwardly slidable connection with the body 1, Fig. 21, the block 91 being a part of the mechanism for forming the hook 27 at the end of the stem portion 28, and being forwardly and rearwardly adjustable to accommodate the mechanism for forming the hooks 27 on stems 28 of different lengths.

The member 89 has extending vertically through it a securing bolt 92 which extends through a slot 90′ in the bracket 90, a nut 93 being mounted on the bolt 92 and bearing against the under side of the bracket 90. By loosening the nut 93, the member 89 with the stop plate 87 may be adjusted to the right or left to suit conditions as to form and length of the stem portion 28.

When the arm 71 of the knotting shaft 72 brings the stem portion 28 of the coil under the lever 59, it presses the stem portion 28 against the left edge of the plate 87, Fig. 6, and straightens the said stem portion from the arcuate form which it had, as shown in Fig. 22.

From the rear side of the stop plate 87 extends transversely an arm 94 which bears on the periphery of a rotary hook forming member 95, which is fixed on the forward end of a horizontal rearwardly extending rotary shaft

96, which is rotative in both directions in the block 91. A coil spring 97 has its lower end fastened to the plate 87, at the right of the shaft 88, Fig. 6, said spring having its upper end attached to a lateral arm of a right angled rod 98, the lower end of which is fastened to the member 89. The spring 97 holds the arm 94 against the top of the hook forming member 95.

After the stem portion 28 has been straightened by the pressure of it on its convex side by the arm 71 and against the edge of the stop plate 87, the cam 79 permits the lever 77 to rise, thus permitting the coil spring 80 to retract the knotting shaft 72, so as to retract the knotter arm 71 to its original initial starting position, Fig. 14. The stem portion 28, thus straightened and released from the arm 71, will spring from the position shown in Fig. 22 to the left where it will contact with and be stopped by the vertical edge 99 of a stop plate 100, Figs. 6, 21, 22 and 23.

Said stop plate is pivoted to the front side of the block 91 on a forwardly extending pin 101 on said block 91. A horizontal coil spring 102 fastened at one end to a pin 103 in the block 91, and attached at its other end to a pin 104 in the stop plate 100, below the pin 101, normally swings the stop plate 100, so that its vertical edge 99 extends above the upperside of the adjacent front side of the block 91, so as to engage and hold the straightened stem 28 from moving further to the left, Fig. 6. A stop pin 105 in the block 91 limits the movement by the spring 102 of the stop plate 100, Figs. 6 and 21.

As shown in Fig. 7, the block 91 has in its upper side a recess 106 in which the hook forming member 95 is located and into which is carried by the member 95 the rear portion of the stem portion 28 in the formation of the hook 27.

The front wall of the recess 106, designated by 107 has in its upper side a stop shoulder 108 which alines with the wall 99 of the stop member 100, when the latter is in the stopping position shown in Figs. 20, 21 and 22. The shoulder 108 is to relieve the stop member 100 of undue pressure by the wire when the hook is formed.

The wall 107 has a hole therethrough which alines with an axial hole that extends through the shaft 96 and the hook forming member 95. Longitudinally slidable in the hole in the shaft 96 and into the hole 108′ in the wall 107 is a rod 109 comprising a mandrel around which the hook 27 is formed by the member 95.

After the stem portion 28 has been straightened and released from the arm 71, it assumes the position shown in Fig. 22, in which position it is against the shoulder 108 and against the wall 99 of the stop member 100. If now the shaft 96 and hook forming member 95 are revolved counter-clockwise, as viewed in Figs. 8 and 21, and in Fig. 6, a hook 110 on the front end and at one side of the mandrel 109 will engage the stem portion and will carry it around the mandrel to the position shown in dotted lines in Fig. 8, thus completing the hook 27.

The stem portion 28 is held down against the upper edge of the wall 107 by the transverse portion 111 of a T shaped lever 112, the rearwardly extending stem of which is pivoted on a transverse horizontal bolt 113 mounted in the block 91, Figs. 2, 3, 4 and 7.

A vertical spring 114 has its lower end attached to the stem 112 of the lever 111, forward of the pivot bolt 113, the upper end of the spring being attached to the lateral arm of a right angled rod 115, the lower end of which is mounted on the block 91. The spring 114 normally swings the lever so as to lift its front transverse part 111 upwardly from the upper edge of the wall 107, so that the stem portion 28 of the coil 13, can be brought over the wall 107 and against the stop member 87, and under the part 111 of the lever. The spring also lifts the front part of the lever 111 so as to permit the hook 27, after it has been formed being withdrawn.

After the stem portion 28 has been carried by the arm 71 to the straightening position, and has been released, so as to spring against the shoulder 108 and the stop plate wall 99, the lever 111 is swung so as to bring the front transverse part 111 to the closed position, shown in Fig. 21 and against the stem portion 28, thus holding the latter, while the hook member revolves counter-clock-wise, as viewed in Figs. 6, 8 and 21, to form the hook 27.

For swinging the rear end of the lever stem 112 upwardly and the transverse part 111 of the lever downwardly to the stem holding position, shown in Fig. 21, the shaft 96 has fastened to it, a circular cam member 116 having a peripheral notch 117 adapted to receive the rear end portion of the lever stem 112, Figs. 5 and 7, also Figs. 2 and 4. This notch is adapted to register with a peripheral notch 118 in a nearly circular cam, 119, which is revoluble on the shaft 96 and is revolubly fitted in a hole 120 in a vertical plate 121 fastened to the rear end of the block 91 forward of the cam member 116. The hole 120 has an upward extension 122 adapted to receive the lever stem 112, when the latter rides on the peripheries of the cams 116 and 119.

When the cams 116 and 119 are in the initial starting position, the notches 117 and 118 are in register, and the spring 114 swings the lever stem 112 into the notches 117 and 118, as shown in Figs. 5 and 7. A pin 123, Fig. 5, is then extending from the cam 119 through the left end of an arcuate slot 124.

When the shaft 96 is revolved, clock-wise, as viewed in Fig. 5 and counter-clock-wise, as viewed in Fig. 6, the hook 110 on the

front end of the hook forming member 95 will engage the stem portion 28, after the shaft 96 has turned the cam 116 so as to swing upwardly the rear end of the lever stem 112 and downwardly the front transverse part 112 to the stem holding position. After the shaft 96 has so revolved far enough to form the U shaped hook 27, the shaft 96 and with it the hook forming member 95 will be retracted, the rod mandrel 109 will be retracted out of the hole 108 in the wall 107, and the lever stem 112 will enter the notches 117 and 118. When the cam 116 has revolved clock-wise about a quarter of a revolution, as viewed in Fig. 5, the pin 123 will reach the other or right end of the arcuate slot 124, and the cam 116 will turn the cam 119 clock-wise until the hook has been formed. The cam 116 will then retract, but will not engage the pin 123 until it has retracted about a quarter of a revolution, after which the cam 116 will retract the cam 119 until both reach the initial starting position, shown in Fig. 5.

For turning the shaft 96 in both directions, it has secured to it a pinion 125, Figs. 1, 2, 3 and 4, which meshes with a vertical rack 126 vertically slidable in the body 1, and having pivoted to its lower end the rear end of a substantially horizontal rearwardly extending lever 127, Fig. 2, the front end of which is pivoted by a horizontal pin 128 to the body 1.

A cam 129 on the main shaft 3 is adapted to engage the upper side of the lever 127 and depress the same, thus forcing downwardly the rear end of the lever 127 and with it the rack 126, which will turn the pinion so as to rotate the shaft 96 in the hook forming direction described hereinbefore.

To retract the rack 126, the lever 127 and the pinion 125, a vertical coil spring 130 has its lower end attached to the lever 127 and its upper end attached to the body 1, Fig. 2.

To force the mandrel 109 forwardly into its operative position, it has attached to its rear end portion the upper end of an oblique bar 131, Fig. 2, the lower end of which is fastened on the rear end portion of a rearwardly extending horizontal bar 132 slidably mounted in bearings 133 and 134 on the body 1. To force the bar 132 forwardly and with it the bar 131 and the mandrel 109, a coil spring 135 encircling the bar 132, bears at its rear end against the bearing 133, and at its forward end against a collar 136 fastened on the bar 132.

To force the bar 132, bar 131 and mandrel 109 rearwardly against the pressure of the spring 135, an upright bar 137 is pivoted at its lower end on a horizontal pin 138 on the body 1, the rear side and upper portion of the bar 137 bearing against the front end of the bar 132. A cam 139 on the main shaft 3 is adapted, when the shaft 3 is revolved to, at the proper time engage the forward side of the bar 137 and force the same, and the bar 132 rearwardly, so as to force the mandrel 109 rearwardly to its inoperative position.

Sets screws 140 in the block 91, hold it in the positions to which it may be adjusted on the body 1, Figs. 5, 6, 7 and 21.

In the operation of the machine, the screws 56 are loosened and the gage member 53 adjusted to suit the length that the portion of the stem extending beyond the knot 58 is to be.

The set screws 140 are loosened, and the block 91 is adjusted on the body 1 to suit the length of the stem portion 28.

The bolt 92 is loosened, and the member 89 adjusted to its proper transverse position. The screws 56 and 140, and the bolt 92 are then tightened, and the spring to be formed is placed with its coil 13 disposed in the slots 11 respectively of the post 10 and the crimping member 15, with the free end of the stem portion against the arm 54 of the gage member 53.

The screws 51 and 52 are adjusted to position the gage member 49 to suit the length desired for the offset 26.

The blocks 17 and 16 are adjusted to suit the diameter of the coil 13, and held in the adjusted positions by means of the screws 19, 21, 22, 24 and 25, as has been described.

The pedal 9 is now depressed, thus operating the clutch 5 to connect the driving pulley 4 with the main shaft 3.

Upon the shaft 3 revolving, the crimper member 15 will be turned to make the offset 26 in the coil 13, and the knotting shaft 72 will be turned so as to cause its arm 71 to engage the upturned portion 28 of the coil 13. the lever 59 first having been tilted to form the shoulder 57 in the coil and to bend upwardly the portion 28.

The arm 71 will carry the portion 28 over the coil 13 and then under the next coil 86 and against the shoulder 57, to form the knot 58.

The arm 71 will bring the portion 28 against the stop plate 87 and will straighten it, following which the arm 71 and its shaft 72 will be retracted, upon which the lever 111 will be pressed downwardly upon the portion 28, which now lies against the shoulder 108 and the wall 99 of the spring stop plate 100.

The shaft 96 which has been in the meantime started rotating will carry the hook forming member 95 to a position in which the hook 110 will engage the portion 28 at the rear of the wall 107. In the meantime, the mandrel 109 will have been forced forwardly into the hole 108', so that as the hook 110 carries the portion 28 around in the recess 106 back of the wall 107, the portion 28 will be wound partly around the mandrel 109 and

the hook 27 will be formed at the end of the stem 28.

The lever portion 111 will now be lifted, and the shaft 96 retracted and with it the member 95. The mandrel 109 will be retracted into the member 95 and the hook 27 will be free to be removed, as will the formed spring, the operations having been completed.

Various modifications of my invention, within the scope of the appended claims, may be made without departing from the spirit of my invention.

What I claim is:—

1. In a hook forming machine, the combination with a support for holding a coil, an oscillatory crimping member adapted to engage and crimp said coil, supporting means for said crimping member forwardly and rearwardly adjustable on said support, and means for oscillating said crimping member, of a stop gage adjustable toward and from said crimping member on said supporting means and in the path of said coil.

2. In a hook forming machine, the combination with a support for holding a coil, and a driving shaft rotatable on said support, of a crimping member having means for engaging and crimping said coil, supporting means on which said crimping member is oscillative, a member reciprocative on said supporting means and engaging and adapted, when reciprocated to oscillate said crimping member, and means actuated by said shaft for reciprocating said reciprocative member.

3. In a hook forming machine, the combination with a support for holding a coil, and a driving shaft rotatable on said support, of an oscillatory crimping member having a crank, supporting means on which said crimping member is oscillative, said crimping member having means for engaging and crimping said coil, a member reciprocative on said supporting means and engaging said crank for oscillating said crimping member, means actuated by said shaft for moving said reciprocative member in one direction, and means for normally forcing said reciprocative member in the opposite direction.

4. In a hook forming machine, a support, a member adjustable transversely thereon, a block adjustable forwardly and rearwardly on said member, a coil crimping member oscillative on said block and having a crank, a member reciprocative on said block and engaging said crank for oscillating said crimping member, and means for reciprocating said reciprocative member.

5. In a hook forming machine, a support, a member adjustable forwardly and rearwardly on said support, a crimping member oscillative in said member and having at its upper end a slot for receiving a coil and provided with a crank, a member reciprocative on said adjustable member and engaging said crank for oscillating said crimping member, a spring for moving said reciprocative member in one direction, and means for moving said reciprocating member in the opposite direction.

6. In a hook forming machine, a support, a supporting means adjustable forwardly and rearwardly on said support, a hook forming member rotatable in both directions on said supporting means and having means for engaging the stem portion of a coil and revolving said portion around the axis of said member, a mandrel alining with the axis of said member and around which said portion is revolved, and means for turning said member in one direction to form a hook on said portion and for retracting said member.

7. In a hook forming machine, a support, a supporting means adjustable forwardly and rearwardly on said support, a hook forming member rotatable in both directions on said supporting means and having means for engaging the stem portion of a coil and revolving said portion around the axis of said member, a mandrel alined with the axis of said member and slidable to and from a position in which said portion will be revolved around it, means for turning said member in one direction to form a hook on said portion and for retracting said member, and means for moving said mandrel to and from said position.

8. In a hook forming and knotting machine, a support, means thereon for holding an end coil of a spring and for bending out of the plane of said coil an end portion thereof, means for knotting said end portion around said coil and for forcing said end portion to a laterally outwardly extending position, means for forming a hook at the free end of said end portion, and means for crimping said coil at a point substantially diametrically opposite to said knotted portion.

9. In a hook forming and knotting machine, a support, means thereon for holding an end coil of a spring and for bending out of the plane of said coil an end portion thereof, means for knotting said end portion around said coil and for forcing said end portion to a laterally outwardly extending position, means adjustable toward and from said coil holding means for forming a hook at the free end of said end portion, and means for crimping said coil at a point substantially diametrically opposite to said knotted portion.

10. In a hook forming and knotting machine, a support, means thereon for holding an end coil of a spring and for bending out of the plane of said coil an end portion thereof, means for knotting said end portion around said coil and for forcing said end portion to a laterally outwardly extending position, means adjustable toward and from said coil holding means for forming a hook at the free end of said end portion, and means adjustable toward and from and transversely

to said coil holding means for engaging and crimping said coil at a point substantially diametrically opposite to said knotted portion.

11. In a hook forming and knotting machine, a support, means thereon for holding an end coil of a spring and for bending out of the plane of said coil an end portion thereof, means for knotting said end portion around said coil and for forcing said end portion to a laterally outwardly extending position, means for forming a hook at the free end of said end portion, an oscillatory crimping member having means for engaging and crimping said coil at a point substantially diametrically opposite said knotted portion and having a crank, a reciprocative member engaging and adapted to oscillate said crank and crimping member, and means for reciprocating said reciprocative member.

12. In a coil crimping mechanism, a support, means thereon for holding an end coil of a spring, an oscillatory crimping member having means for engaging and forming a crimp in said coil and having a crank, means supporting said crimping member adjustable in two directions at right angles to each other, and means engaging said crank for oscillating said crimping member.

13. In a coil crimping mechanism, a support, a crimping member oscillative thereon having means for engaging and crimping a coil of a spring and having a crank, a reciprocative member engaging said crank and adapted to oscillate said crimping member, means for moving said reciprocative member in one direction, and a spring for moving said reciprocative member in the opposite direction.

14. In a coil crimping mechanism, a support adjustable in two directions at right angles to each other, a coil crimping member oscillative on said support and having a crank, a member engaging said crank and reciprocative on said support, and means for reciprocating said reciprocative member.

15. In a coil crimping mechanism, a support, a coil crimping member oscillative on said support and having a crank, a member engaging said crank and reciprocative on said support for oscillating said crimping member, a spring for forcing said reciprocative member in one direction, supporting means on which said support is adjustable in two directions at right angles to each other, and means for moving said reciprocative member in the opposite direction against the pressure of said spring.

16. In a hook forming mechanism, the combination with a support, and means thereon for holding an end coil of a spring, of a block adjustable on said support toward and from said coil holding means, means carried by said block for releasably clamping against said block an end portion of said coil, a hook forming member rotatable in opposite directions on said block, an axial mandrel slidable in said hook forming member to and from a position in which it projects therefrom, said hook forming member having means for engaging said end portion of said coil and forming it around said mandrel, when said hook forming member is rotated in one direction, means for alternately rotating said hook forming member in said directions, means for moving said mandrel to said projecting position, when said hook forming member is operatively engaging said end portion, means for retracting said mandrel after the hook has been formed, means for forcing said clamping means to the clamping position, and means for retracting said clamping means from said clamping position after the hook has been formed.

17. In a hook forming mechanism, a support, a hook forming member revoluble thereon in opposite directions, a plate on said block having a hole therethrough, a cam revoluble in said hole and on said member having a peripheral notch, a second cam on and revoluble with said member and having a lost motion connection with and adapted to revolve the first cam in both directions and provided with a peripheral notch adapted to register with the notch in the first cam, a wire clamping lever extending through said hole and adapted to ride on said cams and to be held thereby in the clamping position, and adapted to enter said notches when the notches are alined and swing out of said clamping position, and movable by said second cam to the clamping position, and means for revolving said hook forming member in both directions.

18. In a hook forming mechanism, a support, a hook forming member revoluble thereon in opposite directions, a cam revoluble with said member and having a peripheral notch, a second cam revoluble on said member and having a lost motion connection by which the first cam revolves the second cam, said second cam having a notch adapted to register with the notch in the first cam, means for revolving said member in both directions, and a wire clamping member adapted to ride on said cams and to be held thereby in the clamping position and to move to the non-clamping position when it enters said notches, and movable by said first cam to the wire clamping position.

In testimony whereof I affix my signature.

CARL KIRCHNER.