May 3, 1927. 1,626,915

E. C. BUFFINGTON

APPARATUS FOR MAKING RINGS

Filed Jan. 26, 1926 4 Sheets-Sheet 1

Fig. 2

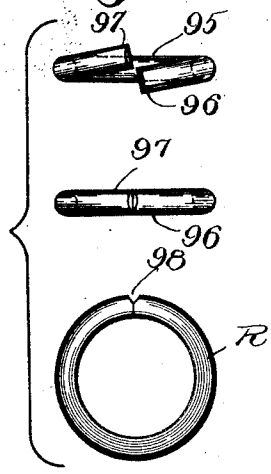


Fig. 1

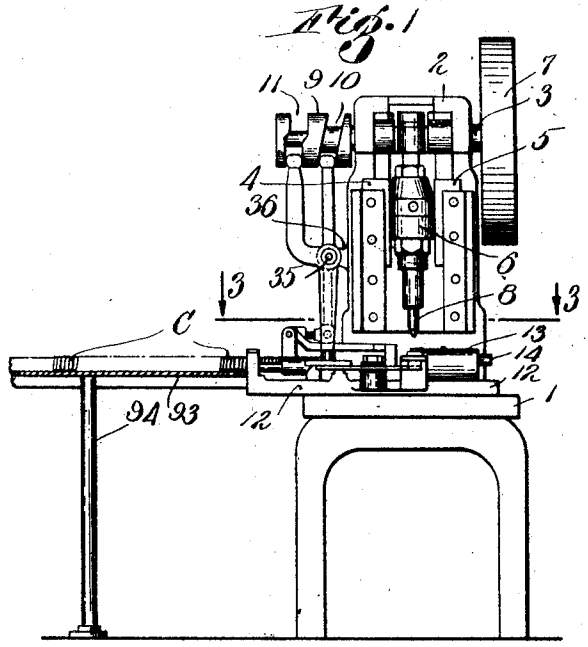


Fig. 7

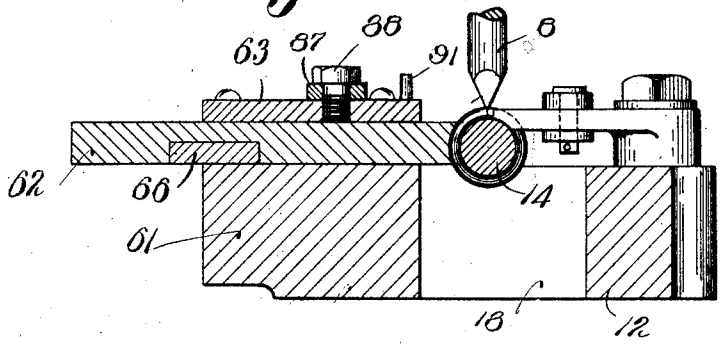


Fig. 8

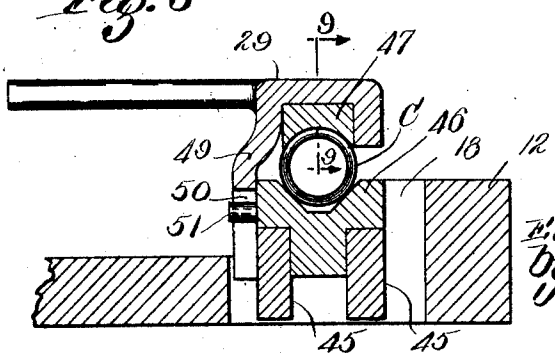
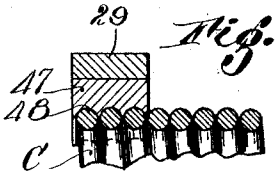


Fig. 9



Inventor
Edwin C. Buffington,
by Roberts Roberts & Allen
Attorneys.

May 3, 1927. 1,626,915

E. C. BUFFINGTON

APPARATUS FOR MAKING RINGS

Filed Jan. 26, 1926 4 Sheets-Sheet 2

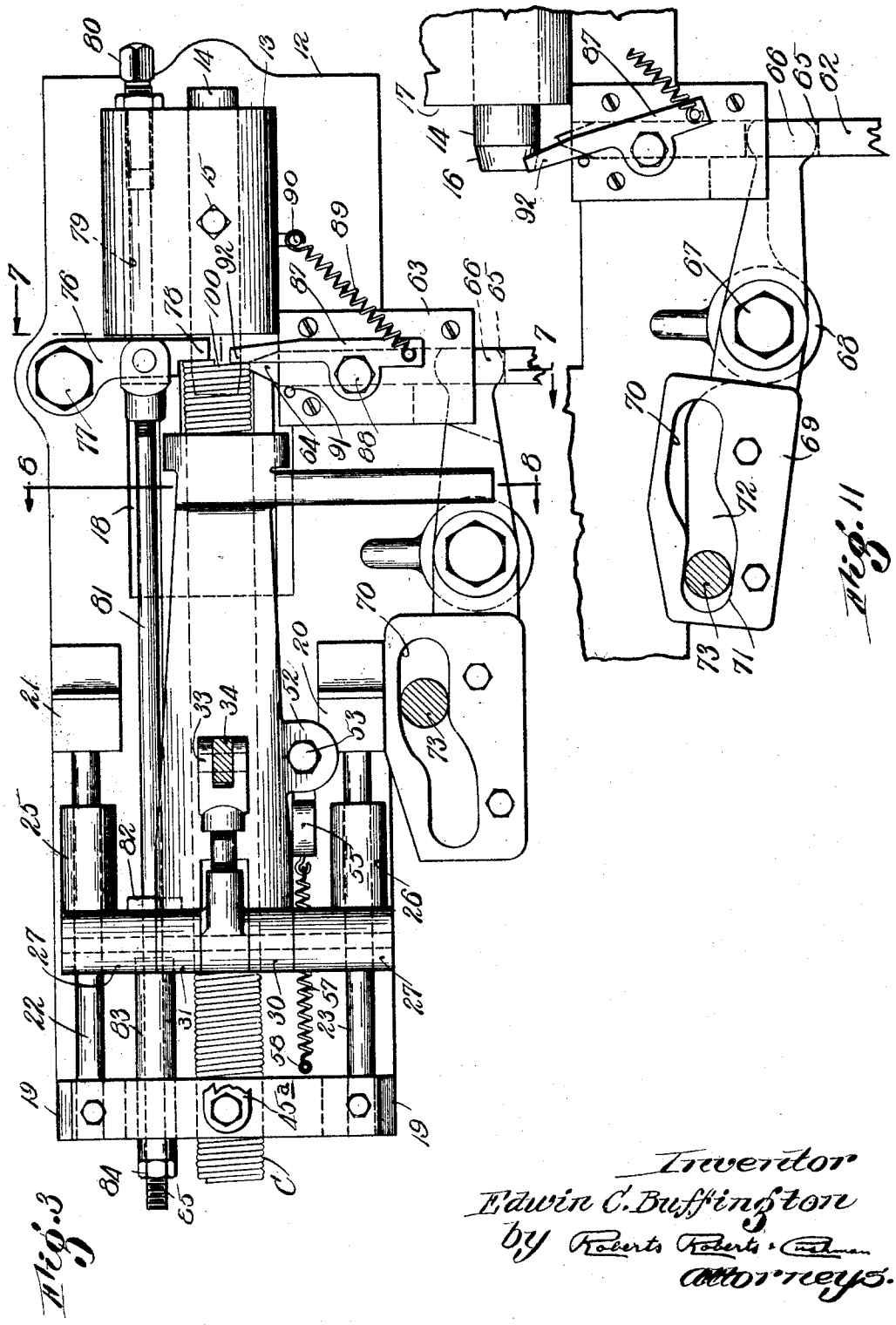


Fig. 3

Fig. 11

Inventor
Edwin C. Buffington
by Roberts Roberts & Cushman
Attorneys.

May 3, 1927. 1,626,915

E. C. BUFFINGTON

APPARATUS FOR MAKING RINGS

Filed Jan. 26, 1926 4 Sheets-Sheet 3

Fig. 6

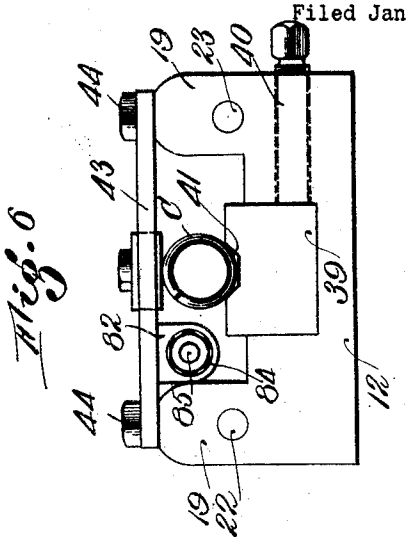
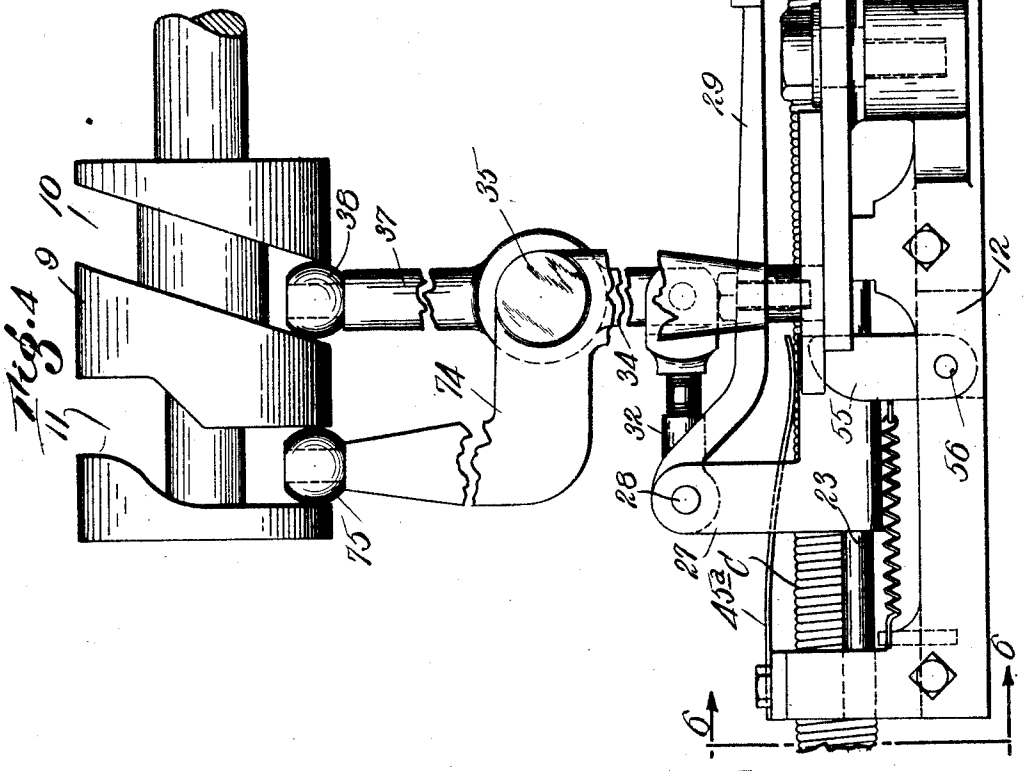


Fig. 4



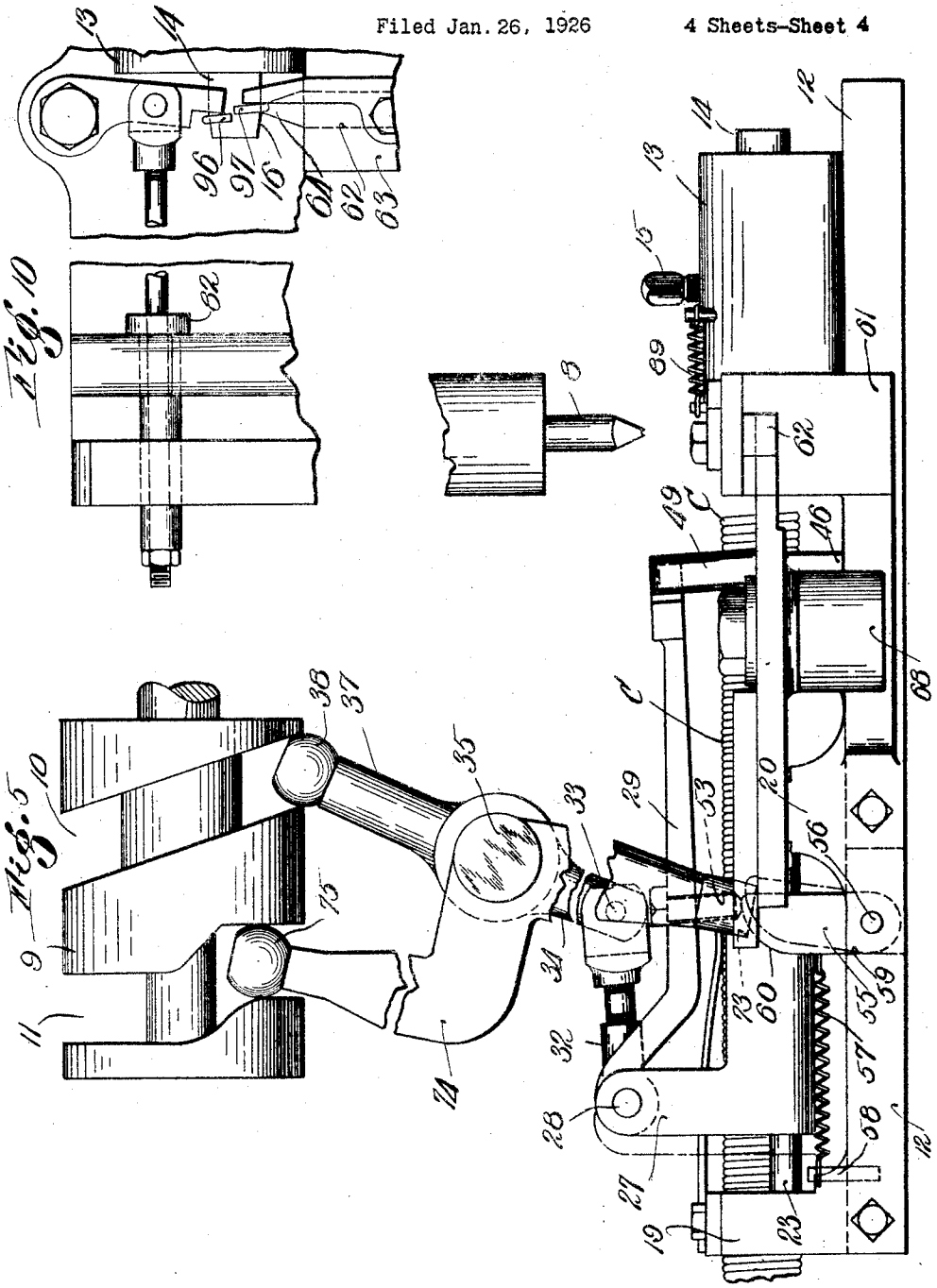
Inventor:
Edwin C. Buffington
by Roberts Roberts & Cushman
Attorneys.

May 3, 1927. 1,626,915

E. C. BUFFINGTON

APPARATUS FOR MAKING RINGS

Filed Jan. 26, 1926 4 Sheets-Sheet 4



Inventor:
Edwin C. Buffington,
by Roberts Roberts & Cushman
Attorneys

Patented May 3, 1927. 1,626,915

UNITED STATES PATENT OFFICE.

EDWIN C. BUFFINGTON, OF MANCHESTER, NEW HAMPSHIRE, ASSIGNOR TO U. S. BOBBIN & SHUTTLE COMPANY, OF MANCHESTER, NEW HAMPSHIRE, A CORPORATION OF RHODE ISLAND.

APPARATUS FOR MAKING RINGS.

Application filed January 26, 1926. Serial No. 83,360.

This invention pertains to the manufacture of rings from ductile material, for example steel wire, and more particularly to apparatus for making rings by cutting successive spires or turns from a helical coil.

When a complete turn of a helix is severed from the body of the helix the ends of said severed turn are out of alignment to a greater or lesser degree, the minimum amount of displacement usually occurring when the helix is closely wound so that its coils are in contact. Thus a turn cut from a helical coil is not a true ring, since it does not lie in a plane and in order that it may be acceptable for most purposes for which rings are employed it is necessary, as a step subsequent to severing it from the coil, to subject the severed turn to an operation which brings its ends into substantial alignment and causes it to lie in a plane.

Principal objects of the present invention are to provide improved apparatus for automatically cutting off successive spires from a helical coil, flattening the severed spires to form true rings, automatically ejecting the flattened rings from the apparatus as they are completed, and performing the several operations at high speed and in an accurate and reliable manner.

While the apparatus herein disclosed is capable with but slight and obvious modifications of making rings of a wide variety of sizes and from wire of different sections and for a great number of purposes, it is here illustrated as adapted to make bobbin rings. A bobbin ring is usually made of spring tempered steel wire and while the ends of the piece of wire forming the ring abut, they are not usually united, so that such rings may be sprung over the base of a wooden bobbin to form the ribs usually provided for engagement with the jaws of a weaving shuttle.

While the apparatus herein shown and described is adapted to make rings which are split at one point and resiliently expansible, it is obvious that as a further step in the completion of such rings, the abutting ends might be united as, for example, by electric welding if continuous rings were preferred for any particular purpose.

In the accompanying drawings, a preferred embodiment of the invention is illustrated by way of example and in the drawings,

Fig. 1 is a front elevation showing the complete machine;

Fig. 2 is a composite view showing in edge elevation one of the turns as severed from the coil and also showing this turn in edge elevation and in plan after it has been flattened;

Fig. 3 is a section substantially on the line 3—3 of Fig. 1, but to larger scale, showing the parts in position for the cutting operation to be performed;

Fig. 4 is a fragmentary side elevation to substantially the same scale as Fig. 3 and showing the parts in cutting position;

Fig. 5 is a view similar to Fig. 4 but showing the parts as positioned subsequent to the cutting operation and during the flattening or bending of the severed turn;

Fig. 6 is a fragmentary end elevation substantially on the line 6—6 of Fig. 4;

Fig. 7 is a fragmentary section substantially on the line 7—7 of Fig. 3;

Fig. 8 is a fragmentary section on the line 8—8 of Fig. 3;

Fig. 9 is a fragmentary section on the line 9—9 of Fig. 8; and

Figs. 10 and 11 are fragmentary sections substantially on the plane of the line 3—3 of Fig. 1, but illustrating the parts as positioned for bending the severed spire, and for ejecting the completed ring, respectively.

Referring first to Fig. 1 of the drawings, the numeral 1 designates a table which supports a frame 2 provided with bearings at its upper part for a drive shaft 3. The frame also provides spaced vertical guides 4 and 5 for a vertically reciprocating crosshead or ram 6. The shaft 3 is preferably provided with a flywheel 7 adapted to receive a driving belt, and is furnished with a crank or eccentric, for reciprocating the ram 6. The ram 6 is provided with means for holding a cutter member 8, sharpened to a four-sided substantially pyramidal knife edge which is slightly concaved to center it on the coil to be severed.

As here disclosed the shaft 3 projects beyond the side of the frame 2 and is provided with a cylindrical or barrel cam 9 having cam grooves 10 and 11 therein. While it is preferred to mount the cam 9

directly upon the shaft 3, it is contemplated that this cam may be driven through intermediate gearing if desired.

The table 1 also supports a bed plate 12 which is provided near one end with a boss 13 having a horizontal bore for the reception of a substantially cylindrical anvil member 14. While the anvil is herein shown as cylindrical, it is contemplated that anvils of other shapes may be used if circumstances make it desirable to do so, and while as here shown the anvil is adjustable longitudinally in the bore in the boss 13, a fixed anvil may be preferred in some cases.

The anvil 14 is retained in adjusted position by means of a set screw 15 and its inner end which is disposed directly in the path of the cutter 8 projects beyond the left hand face 17 of the boss 13, overhanging an opening or recess 18 in the bed plate 12. The extreme inner end of the anvil is preferably tapered as shown at 16 to facilitate its entry into the end of the coil.

That end of the bed plate 12 which is remote from the boss 13, is furnished with laterally spaced upstanding brackets 19 and at points intermediate its length with brackets 20 and 21. These brackets 19, 20 and 21 support parallel horizontal guide rods 22 and 23 which support a sliding carriage comprising sleeve members 25 and 26 which slide upon the rods 22 and 23 respectively.

The sliding carriage is furnished with a pair of upstanding ears 27 having aligned bearing bosses for the reception of a shaft 28. A lever 29 is pivotally supported at one end upon the shaft 28, the lever preferably having spaced ears 30 and 31 provided with aligned bearing openings for the reception of the shaft. A rock arm 32 is secured to the shaft 29 between the ears 30 and 31. As here shown this rock arm is adjustable in length and is pivotally connected by means of a pin 33 to the lower arm 34 of a lever which is fulcrumed upon a pivot pin 35 carried by a bracket 36 projecting from the side of the frame 2. This lever is furnished with an upper arm 37 preferably provided with a cam follower roll 38 which engages the cam groove 10 in the cam 9.

The bed plate 12 is furnished with a longitudinal slot for the reception of a coil supporting member 39 (Fig. 6) which is secured in adjusted position in the slot by means of a set screw 40. This coil carrier is furnished with a trough-like groove 41 in its upper surface for the reception of the helical wire coil C.

A bridge member 43 is secured by means of bolts 44 to the bracket members 19 and this bridge member supports a flat spring 45[a] which bears upon the upper part of the coil C and thus holds it down in the trough 41.

The coil holder 39 extends lengthwise of the bed plate but at that part of the bed plate at which the opening 18 is provided, the coil holder is furnished with a downwardly offset portion, the upper part of the holder being cut away at this point, and the offset portion is bifurcated to provide parallel guide members 45 (Fig. 8) upon which a slide block 46 is mounted. This slide block is provided with a trough-like groove in its upper surface which is aligned with the groove 41 in the coil holder proper, and the block 46 is adapted to support the end portion of the coil adjacent to the point at which the cutting and bending operations take place.

The end of the lever 29 (see Figs. 8 and 9) is furnished with a socket for the reception of a removable gripper member 47. This gripper member has a coil engaging face which is preferably provided with a helical groove 48 of the same pitch as the coil so that the gripper may fit snugly against the peripheral surface of the coil and clamp the latter firmly between it and the slide block 46. The weight of the lever 29 is sufficient to obtain the desired grip in most cases, although it is contemplated that the pressure of the gripper against the coil may be augmented if desired by means of a spring or weight.

The end of the lever 29 is provided with a downwardly directed finger 49 having a vertical slot 50 which receives a pin 51 projecting from the slide block 46. The slide block 46 is thus constrained to partake of the reciprocating movement of the gripper while at the same time the gripper is permitted to rise from the coil without lifting the block.

The lever 29 (see Fig. 3) is provided with an ear 52 having a threaded opening for the reception of a screw 53 (Figs. 3, 4 and 5) whose lower end constitutes a cam follower. The bed plate 12 is furnished with a slot disposed substantially in the vertical plane of movement of the screw 53 as the latter reciprocates with the sliding carriage and in this slot is arranged a dog 55 pivotally mounted upon a pin 56. A spring 57 is connected on one end to this dog and at its other to a pin 58 projecting up from the bed plate 12. This spring tends to hold the cam dog in the full line position of Fig. 5 with the left hand face of the dog bearing against the vertical wall 59 of the slot which constitutes a stop to limit movement of the dog in a counter-clockwise direction. The upper end of the dog is rounded to provide a cam surface 60 engageable with the lower end of the screw 53.

The bed plate 12 is furnished with a laterally projecting boss 61 (Fig. 5) having a slot in its upper surface for the reception of a slide 62 (Fig. 7) movable in a path sub-

stantially perpendicular to the axis of the anvil and is retained in its slot by means of a cover plate 63. The inner end of this slide is furnished with a clamping nose 64 adapted to engage the end portion of the coil and to press the latter firmly against the anvil 14. Preferably this clamping nose is furnished with a vertical groove conforming to the shape of the outer surface of one of the turns of the coil so that it may securely and firmly grip such turn during the performance of the cutting and bending operation.

The outer end of the slide 62 is furnished with a slot 65 (Fig. 11) for the reception of the end 66 of a lever pivoted at 67 upon a boss 68 projected from the bed plate 12. This lever is furnished with an arm which supports a cam plate 69. Preferably this cam plate is detachable so that it may be interchanged for other cam plates having cams of different configuration. This cam plate is furnished with a cam preferably and as here shown in the form of a slot comprising substantially straight dwell portions 70 and 71 connected by an active or inclined portion 72. When the slide 62 is in clamping position the dwell portion 70 of the cam plate 69 is preferably disposed substantially perpendicular to the path of movement of the slide 62.

The cam slot in the plate 69 receives a cam follower member 73 which may if desired be a roll carried by the lower end of a lever which is pivoted upon the pin 35 above referred to and this lever is furnished with an upper offset arm 74 provided with a cam follower 75 engaging the slot 11 in the cam 9.

A bending lever 76 (Fig. 3) is disposed at the opposite side of the anvil 14 from the slide 62, being pivoted at 77 upon the bed plate 12 and having a coil engaging toe 78. A stop pin 79 is provided within a suitable bore in the boss 13 and adapted to engage the lever 76 to limit the movement of the latter in a counter-clockwise direction, while the other end of this pin engages a set screw 80, by means of which its position may be adjusted.

A connecting rod 81 is pivotally attached at one end to the lever 76 and passes freely through an opening in a bracket 82 upon the slide carriage. A sleeve 83 is arranged upon the left hand end of the rod 81, as viewed in Fig. 3, and this sleeve is of a diameter such that it can not pass through the opening in the bracket 82. The sleeve 83 is held in adjusted position upon the rod 81 by means of a nut 84 engaging the screw-threaded end 85 of the rod. Normally the right hand end of the sleeve 83 is spaced from the bracket 82.

An ejector lever 87 is pivotally mounted at 88 upon the cover member 63 and a spring 89 is connected to one end of this lever, the other end of the spring being attached to a pin 90 projecting from the boss 13. The spring tends to swing the ejector lever 87 in a counter-clockwise direction. The ejector lever comprises a finger 92 which projects beyond the clamp nose 64 of the slide 62 and which is adapted to engage the end or radial face of the coil C at a point substantially opposite to the point at which the bending toe 78 engages the coil. A stop pin 91 limits the movement of the ejector lever 87 under the action of the spring 89.

If desired a table 93 may be provided to support the coil C beyond the left hand end of the bed plate 12, such table being of any desired length and being supported upon one or more legs 94.

The operation of the machine is substantially as follows, it being assumed that the initial position of the parts is that indicated in Figs. 3 and 4. In this position the endmost turn of the closely wound helical coil C bears against the bending toe 78 and against the finger 92 of the ejector lever, while the end of the anvil 14 is disposed within this end of the coil and supports it. The cam follower member 73 at this time engages the dwell portion 70 of the slot in the plate 79 and thus holds the slide 62 in advanced position with the clamping nose 64 pressing the endmost turn of the coil firmly into engagement with the anvil 14. The parts are thus positioned at the instant that the cutter 8 descends and severs the last turn of the coil at the point 100, Fig. 3, thus removing a single complete turn or spire 95 (Fig. 2) from the end of the coil. As shown in Fig. 2 this severed turn constitutes an element of a helix and its ends 96 and 97 are out of alignment. It may be assumed for convenience in description that the end 96 was the original end of the coil and that the end 97 of this turn is the newly severed end.

As soon as the cutter has severed the last turn from the coil as just described, the rotation of the shaft 3 begins to retract the cutter while at the same time the cam 9 is rotated. The shape of the cam groove 11 is such that during a substantial portion of the rotation of the shaft the cam follower 73 remains undisturbed in the position shown in Fig. 3 so that the clamp slide remains in clamping position, holding the severed turn against the anvil. The cam groove 10 on the other hand is so shaped that immediately after the cutter has acted, the sliding carriage begins to retreat toward the left hand end of the machine. During the first part of this movement the gripper member 49, being in engagement with the upper surface of the coil C and firmly clamping the latter between itself and the slide 46, moves to the left and draws the body portion of the coil with it away from the anvil until

the end of the coil is clear of the anvil as shown in Fig. 5.

At about the time that the end of the coil clears the anvil the cam follower pin 53 engages the cam dog 55 and, as the latter can not swing to the left, the pin 53 is constrained to rise, thus lifting the lever 29 and disengaging the gripper 48 from the coil, allowing the latter to come to rest. As the carriage continues to move the pin 53 slides down off of the dog 55, thus permitting the gripper again to engage the peripheral surface of the coil. The extent of movement of the gripper between the time of its disengagement from the coil and its reengagement therewith may be determined by adjusting the pin 53. Ordinarily when a single turn is to be severed from the end of the coil, at each operation, this distance which the gripper travels while out of engagement with the coil is equal to the pitch of the coil.

After the carriage has traveled sufficiently to carry the end of the body portion of the coil away from the newly severed turn, the bracket 82 of the carriage engages the end of the sleeve 83, pushing the latter to the left and through the connecting rod 81 swinging the bending lever 76 in a clockwise direction until it occupies a position substantially such as shown in Fig. 10. This movement of the bending lever causes the toe 78 thereof to press the end 96 of the severed turn to the left, thus bending the wire forming the severed turn sufficiently to cause it to lie in a plane and thus to form a true ring as shown at R, Fig. 2. Since the wire is usually somewhat resilient, it is preferred to cause the lever 76 to swing as indicated in Fig. 10 until the end 96 of the severed turn is pushed beyond the end 97 so that when the lever 76 again retreats the resiliency of the wire will bring the ends of the severed turn into exact alignment, said end substantially meeting as shown at 98 (Fig. 2). The amount of travel of the lever 76 may be varied by adjusting the nut 84 and will depend upon the character of the material being worked.

At about the time that the lever 76 completes the bending operation the cam follower 75 reaches an active portion of the cam groove 11 thereby quickly moving the slide 62 outwardly and releasing the severed turn which is immediately ejected from the anvil by the ejector lever 87 actuated by spring 89. The severed turn falls down through the opening 18 and may be caught in any suitable receptacle provided for the purpose.

Immediately after the action of the ejector and while the cam follower 73 occupies the dwell portion 71 of the groove in the plate 69, the cam 10 acts to move the sliding carriage towards the right. As above described the gripper 48 is now in engagement with the coil C, pressing the latter against the sliding block 46. As the pin 53 moves to the right (Fig. 5) it pushes the cam dog 55 over into the dotted position without lifting the lifting lever 29, so that the gripper advances the coil until its end again encircles the projecting portion of the anvil and is supported thereby ready for the next cutting operation. The advance movement of the coil pushes the bending lever 76 back to its normal position against the stop pin 79 and at the same time pushes the ejector lever 87 back to the position of Fig. 3. During these operations the cam follower 75 has occupied a dwell in the groove 11 but an active portion of this groove now engages the follower 75 and again advances the clamping slide until it occupies the position of Fig. 3. The parts thus having been restored to the initial position are ready for the formation of another ring.

While the mechanism here described is shown as adapted for cutting single turns from the end of the coil, it is contemplated that by slight adjustments it may be made to cut a plurality of turns from the coil at each operation. The machine is adapted to operate at high speed and performs its work in a very accurate and reliable manner, and is capable with but slight modification of handling wire coils of different diameters, different pitch, and of wire of different gauge or cross section.

While a preferred arrangement of parts has herein been illustrated by way of example, it is to be understood that various changes and re-arrangements of parts may be made if desired, that equivalent parts may be substituted for those here shown and that under some circumstances some of the parts may be omitted without departing from the spirit of the invention.

I claim:

1. Apparatus of the class described comprising means for severing a turn from a helical coil, means for holding said turn during the severing operation and means forming said turn into a true ring, the turn being discharged from the forming means before the next turn is severed from the coil.

2. Apparatus of the class described comprising means for severing a turn from a helical coil of wire, and automatic means for so bending said turn a predetermined distance beyond the point where the ends are in registration as to cause the axis of the wire composing it to lie substantially in a plane when the turn is released from the apparatus.

3. Apparatus of the class described comprising means for supporting a helical coil, means for severing the last turn from the coil, and means engageable with one end only of the severed turn for moving it into

alignment with the other end of said turn said other end being held in a fixed position during the severing and bending operations.

4. Apparatus of the class described comprising means for supporting a helical coil, a cutter for severing the last turn from the coil, means engageable with a part of the severed turn to bring its ends into axial alignment while another part of said turn is held in the position which it occupied during the severing operation, and means for actuating the cutter and aligning means in timed relation.

5. Apparatus of the class described comprising an anvil adapted to enter the end of a helical coil, a cutter movable toward the anvil for severing the endmost turn from the coil, and means for bending said turn to form a true ring while it is in position on said anvil.

6. Apparatus of the class described comprising means for supporting a helical coil, means for severing the last turn from the coil, a lever engageable with the severed turn at one side only of the gap therein, and means for actuating the lever to bend said side of said turn to the opposite side of the gap and cause it to lie in a plane when released.

7. Apparatus of the class described comprising means for supporting a helical coil, means for severing the last turn from the coil, a lever engageable with the original end of said turn, and means for actuating the lever to push said end into alignment with the newly severed end of said turn.

8. Apparatus of the class described comprising means for supporting a helical coil, a cutter for severing the last turn from the coil, a lever engageable with one end of the severed turn, means for actuating the lever to bring one end of the severed turn into axial alignment with the other end, and power driven means for operating the cutter and the lever actuating means.

9. Apparatus of the class described comprising a reciprocating cutter and means operating in time with the cutter for advancing a helical coil in an endwise direction a distance substantially equal to the pitch of the coil whereby at each advance of the cutter to bring the endmost turn of the coil into the path of the cutter.

10. Apparatus of the class described comprising a cutter, a support for a helical coil, resilient means tending to hold the coil in fixed position upon the support, and gripper means for positively moving the coil endwise toward the cutter.

11. Apparatus of the class described comprising a cutter, a trough-like support for a helical coil, a spring pressing the coil against the support, and a reciprocating gripper having a helically grooved face engageable with the peripheral surface of the coil.

12. Apparatus of the class described comprising a cutter, a support having an elongate channel for the reception of a helical coil, a flat spring engageable with the coil to retain it in the channel, and a reciprocating gripper having a coil engaging face provided with a helical groove of the same pitch as the coil.

13. Apparatus of the class described comprising a support adapted to enter the end portion of a helical coil, means for severing a portion of the coil from the main body thereof, and means for retracting the main body of the coil from the support to permit removal of the severed end portion of the coil from the support.

14. Apparatus of the class described comprising a cutter, feed means for advancing a helical coil into operative relation to the cutter to permit the cutter to sever the endmost turn from the coil, said feed means retracting the main body of the coil from the vicinity of the cutter after each operation of the latter, and then again advancing the coil the distance it was retracted plus a distance substantially equal to the pitch of the coil.

15. Apparatus of the class described comprising a cutter, means for actuating the cutter, a reciprocating carriage, a lever pivotally connected at one end to the carriage and having a coil gripper adjacent to its other end, said gripper being adapted to engage a helical coil for moving the latter toward the cutter, the gripper engaging the coil throughout substantially the entire advance movement of the carriage, and cam means arranged to swing the lever to disengage the gripper from the coil during an intermediate position of the retracting movement of the carriage.

16. Apparatus of the class described comprising a cutter, means for actuating the cutter, a reciprocating carriage, a lever pivotally connected at one end to the carriage and having a coil gripper adjacent to its other end, said gripper being adapted to engage a helical coil for moving the latter toward the cutter, the gripper engaging the coil throughout substantially the entire movement of the carriage in one direction, and cam means for swinging the lever to disengage the gripper from the coil during an adjustably determinate portion of the movement of the carriage in the other direction.

17. Apparatus of the class described comprising a cutter, means for actuating the cutter, a reciprocating carriage, a lever pivotally connected at one end to the carriage and having a coil gripper adjoined to its other end, said gripper being adapted to

engage a helical coil for moving the latter toward the cutter, the gripper engaging the coil throughout substantially the entire advance movement of the carriage, means for swinging the lever to disengage the gripper from the coil during a part of the retracting movement of the carriage, a power driven shaft, and means actuated by the shaft for operating the cutter and carriage in timed relation.

18. Apparatus of the class described comprising a cutter, means for actuating the cutter, a reciprocating carriage, a lever pivotally connected at one end to the carriage and having a coil gripper adjacent to its other end, said gripper being adapted to engage a helical coil for moving the latter toward the cutter, the gripper engaging the coil throughout substantially the entire advance movement of the carriage, means for swinging the lever to disengage the gripper from the coil during a part of the retracting movement of the carriage, a power driven shaft for actuating the cutter, and a cam operated by the shaft for reciprocating the carriage.

19. Apparatus of the class described comprising a cutter, and means for advancing a helical coil step by step toward the cutter to permit the latter successively to sever sections from the coil, said coil advancing means comprising a gripper adapted to engage the coil, means for advancing the gripper to move the coil a predetermined distance toward the cutter and for retracting the gripper after the cutting operation, the gripper engaging the coil throughout substantially its entire advancing movement but disengaging the coil during a predetermined portion of its retracting movement.

20. Apparatus of the class described comprising a cutter, and means for advancing a helical coil step by step toward the cutter to permit the latter successively to sever sections from the coil, said coil advancing means comprising a gripper adapted to engage the coil, means for advancing the gripper to feed the coil toward the cutter, said means thereafter retracting the gripper and coil, and adjustable means for disengaging the gripper from the coil at a predetermined point in the retracting movement of the gripper and for permitting reengagement of the gripper with the coil as the gripper approaches the end of its retracting movement.

21. Apparatus of the class described comprising a cutter, and means for advancing a helical coil step by step toward the cutter to permit the latter successively to sever sections from the coil, said coil advancing means comprising a gripper adapted to engage the coil, means for advancing the gripper to feed the coil toward the cutter and for retracting the gripper after the cutting operation, and a dog for disengaging the gripper from the coil at a determinate period in the retracting movement of the gripper, the dog permitting the gripper to engage the coil throughout the advancing movement of the gripper.

22. Apparatus of the class described comprising a cutter, and means for advancing a helical coil step by step toward the cutter to permit the latter successively to sever sections from the coil, said coil advancing means comprising a gripper adapted to engage the coil, means for reciprocating the gripper to feed the coil toward the cutter and for retracting the gripper after the cutting operation, a cam dog engageable with a part moving with the gripper as the latter is retracted to disengage the gripper from the coil, said dog being arranged to yield to permit engagement of the gripper with the coil throughout the entire advance movement of the gripper.

23. Apparatus of the class described comprising a cutter, and means for advancing a helical coil step by step toward the cutter to permit the latter successively to sever sections from the coil, said coil advancing means comprising a gripper having a grooved face adapted to engage the peripheral surface of the coil, means for reciprocating the gripper to feed the coil toward the cutter and to retract the gripper after the cutting operation, a pivoted dog engageable by an element moving with the gripper, means preventing the dog from swinging when engaged by said part during retracting of the gripper whereby the dog acts as a cam to disengage the gripper from the coil as the gripper retracts, the dog yielding as the gripper moves in the opposite direction to permit the gripper to engage the coil throughout substantially the entire advancing movement of the gripper.

24. Apparatus of the class described comprising a cutter, and means for advancing a helical coil step by step toward the cutter to permit the latter successively to sever sections from the coil, said coil advancing means comprising a lever provided with a coil gripping element normally engaging the coil, means for bodily reciprocating the lever to advance the gripper element to move the coil toward the cutter and to retract the gripper after each cutting operation, a cam follower carried by the lever, and a cam engageable by said cam follower as the lever retracts to disengage the gripper element from the coil, the cam follower passing out of engagement with the cam as the retracting movement continues, said cam yielding to permit the gripper element to remain in engagement with the coil throughout the entire advance movement of the lever.

25. Apparatus of the class described comprising a cutter, and means for advancing

a helical coil step by step toward the cutter to permit the latter successively to sever sections from the coil, said coil advancing means comprising a lever provided with coil gripping element normally engaging the coil, means for bodily reciprocating the lever to advance the gripper element to move the coil toward the cutter and to retract the gripper after each cutting operation, an adjustable pin carried by the lever, a pivoted cam dog disposed in the path of movement of the pin, and a stop preventing movement of the dog by the pin as the lever is retracted whereby the cam swings the lever to disengage the gripper element from the coil as the pin wipes over the surface of the dog, the dog swinging under impact of the pin as the lever again advances to permit the gripper element to engage the coil throughout substantially the entire advance movement of the lever.

26. Apparatus of the class described comprising an anvil supported at one end and having a projecting nose adapted to enter the end of a helical coil, a cutter movable toward the anvil nose to sever the last turn from the coil, means for bending the severed turn to cause its ends to lie substantially in alignment, means for ejecting the severed and bent turn from the anvil, and means for retracting the body of the coil axially to permit ejection of the severed turn from the anvil nose and for thereafter advancing the body portion of the coil until its end is again supported by the anvil, and means for retracting and advancing the body portion of the coil being constructed and arranged to advance the coil a distance greater than it is retracted, the difference between the advance and retracting movement being substantially equal to the pitch of the helical coil.

27. Apparatus of the class described comprising an anvil adapted to support the end portion of a helical coil, a cutter movable toward the anvil to sever the last turn from the coil, and a clamp member movable toward the anvil to clamp the coil thereagainst during the cutting operation.

28. Apparatus of the class described comprising means for supporting the end portion of a helical coil, a cutter for severing the endmost turn from said coil, means for clamping one end of said turn, and means for pushing the other end of said turn into alignment with said first end.

29. Apparatus of the class described comprising an anvil for supporting the end portion of a helical coil, a cutter for severing the endmost turn from the coil, a reciprocable clamp for temporarily holding one end of the severed turn against the anvil, and a bending device engageable with the other end of the severed turn for forcing it into alignment with the clamped end.

30. Apparatus of the class described comprising an anvil for supporting the end portion of a helical coil, a cutter for severing the endmost turn from the coil, a clamp for temporarily holding one end of the severed turn, and means engageable with the other end of said turn for bringing said end into axial alignment with the clamped end.

31. Apparatus of the class described comprising an anvil having a tapered end adapted to enter the end of a helical coil, a cutter movable toward the anvil to sever the endmost turn from the coil, a clamp for temporarily retaining the severed turn upon the anvil, and bending means engageable with the severed turn for bringing its ends into axial alignment.

32. Apparatus of the class described comprising a cylindrical anvil adapted to enter the end of a helical coil, a cutter movable toward the anvil to sever the last turn from the coil, a clamp reciprocable toward the periphery of the anvil, means for moving the clamp into engagement with the last turn of the coil and for temporarily holding it in engagement therewith, and a bending device engageable with the severed turn to bring its ends into alignment.

33. Apparatus of the class described comprising an anvil for supporting the end portion of a helical coil, a cutter for severing the endmost turn from the coil, a clamp for temporarily positioning the newly severed end of the severed turn, a lever engageable with the other end of said turn, and means for actuating the lever to force that end of the turn with which it engages into axial alignment with the clamped end.

34. Apparatus of the class described comprising an anvil adapted to enter the end portion of a helical coil, a cutter moving toward the coil to sever the last turn from the latter, a reciprocating clamp engageable with the last turn of the coil at a point adjoined to but to one side of the point of engagement of the cutter, a bending device engageable with said turn at the other side of the cutting point, and power actuated means for operating the clamp, cutter and bending means in timed relation.

35. Apparatus of the class described comprising an anvil adapted to enter the end portion of a helical coil, a cutter movable to sever the last turn from the coil, a reciprocating clamp engageable with the last turn of the coil at a point adjoined to but to one side of the point of engagement of the cutter, a bending device engageable with said turn at the other side of the cutting point, a power shaft for actuating the cutter, and cams carried by the shaft for actuating the clamp and bending device respectively.

36. Apparatus of the class described comprising an anvil adapted to enter the end portion of a helical coil, a cutter for

severing the last turn from the coil, a reciprocating clamp engageable with the last turn of the coil at a point adjacent to but to one side of the point of engagement of the cutter, a bending device engageable with said turn at the other side of the cutting point, means for retracting the main portion of the coil from the anvil after severance of the last turn, and means for actuating the bending device after the main portion of the coil has been withdrawn.

37. Apparatus of the class described comprising an anvil adapted to support the end portion of a helical coil, a cutter movable toward the anvil to sever the last turn from the coil, a clamp engageable with the endmost turn of the coil to clamp it against the anvil, and means for moving the clamp into operative position and for locking it in said position.

38. Apparatus of the class described comprising an anvil adapted to support the end portion of a helical coil, a cutter movable toward the anvil to sever the last turn from the coil, a reciprocable clamp engageable with the endmost coil for clamping the latter against the anvil, and cam means for advancing and retracting the clamp, said cam means having a dwell for positively holding the clamp in operative position.

39. Apparatus of the class described comprising an anvil adapted to enter and support the end portion of a helical coil, a cutter movable toward the anvil to sever the last turn from the coil, a reciprocable clamp engageable with the end portion of the coil for clamping it against the anvil, a lever for actuating the clamp, said lever being provided with a cam element one portion of which is substantially perpendicular to the path of movement of the clamp when the latter is in clamping position, and a member engaging said cam element for rocking the lever.

40. Apparatus of the class described comprising a cylindrical anvil adapted to enter the end of a helical coil, a cutter movable toward the anvil to sever the last turn from the coil, a clamp reciprocable toward and from the periphery of the anvil, means for moving the clamp into engagement with the last turn of the coil prior to the operation of the cutter and for holding it in engagement with the severed turn, and bending means operative while the clamp holds the severed turn in fixed position for bringing the end portions of the severed turn into alignment.

41. Apparatus of the class described comprising an anvil adapted to enter the end portion of a helical coil, a cutter adapted to sever the last turn from the coil, a reciprocating clamp engageable with the last turn of the coil at a point adjoined to but to one side of the point of engagement of the cutter, a bending device engageable with said turn at the other side of the cutting point, a power shaft for actuating the cutter and bending device, and a cam actuated by the shaft for operating the clamp, said cam having a dwell to hold the clamp in operative position during cutting and bending.

42. Apparatus of the class described comprising an anvil adapted to support the end portion of a helical coil, a cutter movable toward the anvil to sever the last turn from the coil, a slide member provided with a clamp element engageable with the last turn of the coil for clamping the latter against the anvil, a lever for moving the slide, said lever having a cam slot provided with an active portion and an elongate dwell portion, the dwell portion being substantially perpendicular to the path of the slide when the clamping element is in operative position, an actuating lever swinging in a plane perpendicular to the path of the slide, one end of the actuating lever engaging the cam slot in the feed lever, and a rotary cam for moving the actuating lever.

43. Apparatus of the class described comprising an anvil adapted to support the end portion of a helical coil, a cutter movable toward the anvil to sever the last turn from the coil, a slide member provided with a clamp element engageable with the last turn of the coil for clamping the latter against the anvil, a lever for moving the slide, said lever having a cam slot provided with a substantially straight dwell portion which is disposed substantially perpendicular to the path of the slide when the clamp is in operative position, and a member oscillating in a plane perpendicular to the path of the slide and engaging the cam slot in the lever for rocking the latter.

44. Apparatus of the class described comprising a cylindrical anvil adapted to enter the end of a helical coil, a cutter movable toward the anvil to sever the last turn from the coil, a clamp reciprocable toward and from the periphery of the anvil, means for moving the clamp into engagement with the endmost turn of the coil and to cause it to dwell in said position during and after the cutting operation, a lever device disposed at the opposite side of the anvil from the clamp, and means for actuating said lever while the severed turn is held by the clamp to bend the severed turn and cause it to assume the form of a true ring.

45. Apparatus of the class described comprising an anvil adapted to enter the end portion of a helical coil, a cutter moving substantially radially of the coil to sever the last turn from the latter, a reciprocating clamp engageable with the last turn of the coil at one side of the point of engagement of the cutter, a bending device engageable

with said turn at the other side of the cutting point, a power driven shaft, and means actuated thereby for moving the clamp into engagement with the end turn of the coil and for causing it to dwell in said position, means actuated by the shaft for operating the cutter while the end turn is clamped in position, and means actuated by the shaft for operating the bending device while the clamp is in operative position, the clamp operating means retracting the clamp when the bending device has finished its work.

46. Apparatus of the class described comprising a cylindrical anvil having a tapered end adapted to enter and to support the end portion of a helical wire coil, a cutter movable toward said anvil for severing from the coil its endmost turn while it rests upon said anvil, automatic means for reciprocating the cutter and automatic means for ejecting the severed portion of the coil from the mandrel, the ejecting means being automatically timed to coact with the cutter.

47. Apparatus of the class described comprising a mandrel adapted to fit snugly within the end portion of a helical coil and to support said end portion, a cutter movable toward said mandrel for severing from the coil its endmost turn while said turn is supported by said mandrel, means for ejecting the severed turn from the mandrel, and means interconnecting the cutter and ejecting means to cause them to coact one with the other.

48. Apparatus of the class described comprising an anvil supported at one end and having a projecting nose adapted to enter the end of a helical coil, a cutter movable toward the anvil nose to sever the last turn from the coil, means for retracting the body of the coil from the anvil to clear the latter after the cutting operation, means for bending the severed turn to cause its ends to lie substantially in alignment, and means for ejecting the severed turn from the nose of the anvil.

49. Apparatus of the class described comprising an anvil adapted to support the end portion of a helical coil, a cutter movable toward the anvil to sever the last turn from the coil, means for moving the body portion of the coil to clear the anvil after the cutting operation, and means for ejecting the severed portion of the coil from the end of the anvil.

50. Apparatus of the class described comprising an anvil adapted to support the end portion of a helical coil, a cutter movable toward the anvil to sever the last turn from the coil, means for axially retracting the body portion of the coil to clear the anvil after the cutting operation, leaving the severed portion on the anvil, and means for pushing the severed portion off of the anvil in the direction of the retracting movement of the body of the coil.

51. Apparatus of the class described comprising an anvil supported at one end and having a projecting nose adapted to enter the end of a helical coil, a cutter movable toward the anvil nose to sever the last turn from the coil, means for retracting the body of the coil from the anvil to clear the latter after the cutting operation, means for bending the severed turn to cause its ends to lie substantially in alignment, means for clamping the last turn of the coil against the anvil nose during the cutting and bending operations, and means for ejecting the severed turn from the anvil when the clamping means is released.

52. Apparatus of the class described comprising an anvil adapted to enter and support the end portion of a helical coil, a cutter movable toward the anvil to sever the last turn from the coil, means for retracting the body portion of the coil to clear the end of the anvil, means for bending the severed portion of the coil to form a true ring, and means for ejecting the severed portion of the coil from the anvil while the body portion of the coil remains in retracted position.

53. Apparatus of the class described comprising an anvil supported at one end and having a projecting nose adapted to enter the end of a helical coil, a cutter movable toward the anvil nose to sever the last turn from the coil, means for retracting the body of the coil from the anvil to clear the latter after the cutting operation, means for bending the severed turn to cause its ends to lie substantially in alignment, and means for ejecting the severed turn from the nose of the anvil, the body of the coil then advancing until its end is again supported upon the anvil.

54. Apparatus of the class described comprising an anvil supported at one end and having a projecting nose adapted to enter the end of a helical coil, a cutter movable toward the anvil nose to sever the last turn from the coil, means for bending the severed turn to cause its ends to lie substantially in alignment, means for ejecting the severed and bent turn from the anvil, and means for retracting the body of the coil axially to permit ejection of the severed turn from the anvil nose and for thereafter advancing the body portion of the coil until its end is again supported by the anvil.

55. Apparatus of the class described comprising an anvil adapted to support the end portion of a helical coil, a cutter movable toward the anvil to sever the last turn from the coil, a slide movable toward and from the anvil, said slide having a clamping element engageable with the peripheral surface of the coil for clamping the latter against the anvil, an ejector lever, one side of the lever projecting beyond the clamping ele-

ment whereby to engage the end surface of the coil, and a spring operative as the clamp is withdrawn from clamping position to swing the lever and thereby to eject the severed portion of the coil from the anvil.

56. Apparatus of the class described comprising an anvil adapted to enter and support the end portion of a helical coil, a cutter movable toward the anvil to sever the last turn from the coil, a clamp member movable toward the anvil for clamping the end portion of the coil thereagainst during the cutting operation, and an ejector device operable as the clamp is retracted from the anvil for disengaging the severed portion of the coil from the anvil.

57. Apparatus of the class described comprising an anvil adapted to support the end portion of a helical coil, a cutter movable toward the anvil to sever the last turn from the coil, a reciprocable clamp member movable toward the anvil for clamping the end portion of the coil thereagainst during the cutting operation, and an ejector bearing against the end of the coil during the cutting operation, said ejector becoming effective when the clamp is retracted to eject the severed portion of the coil from the anvil.

58. Apparatus of the class described comprising an anvil adapted to support the end portion of a helical coil, a cutter movable toward the anvil to sever the last turn from the coil, a slide movable toward and from the anvil, said slide having a clamping element engageable with the coil for clamping the latter against the anvil, an ejector, said ejector engaging the end of the coil during the cutting operation, and means for actuating the ejector as the clamp slide is withdrawn to force the severed portion of the coil from off of the anvil.

Signed by me at Boston, Massachusetts, this 14th day of January, 1926.

EDWIN C. BUFFINGTON.