G. E. BIGELOW.

COIL SPRING FORMING MACHINE.

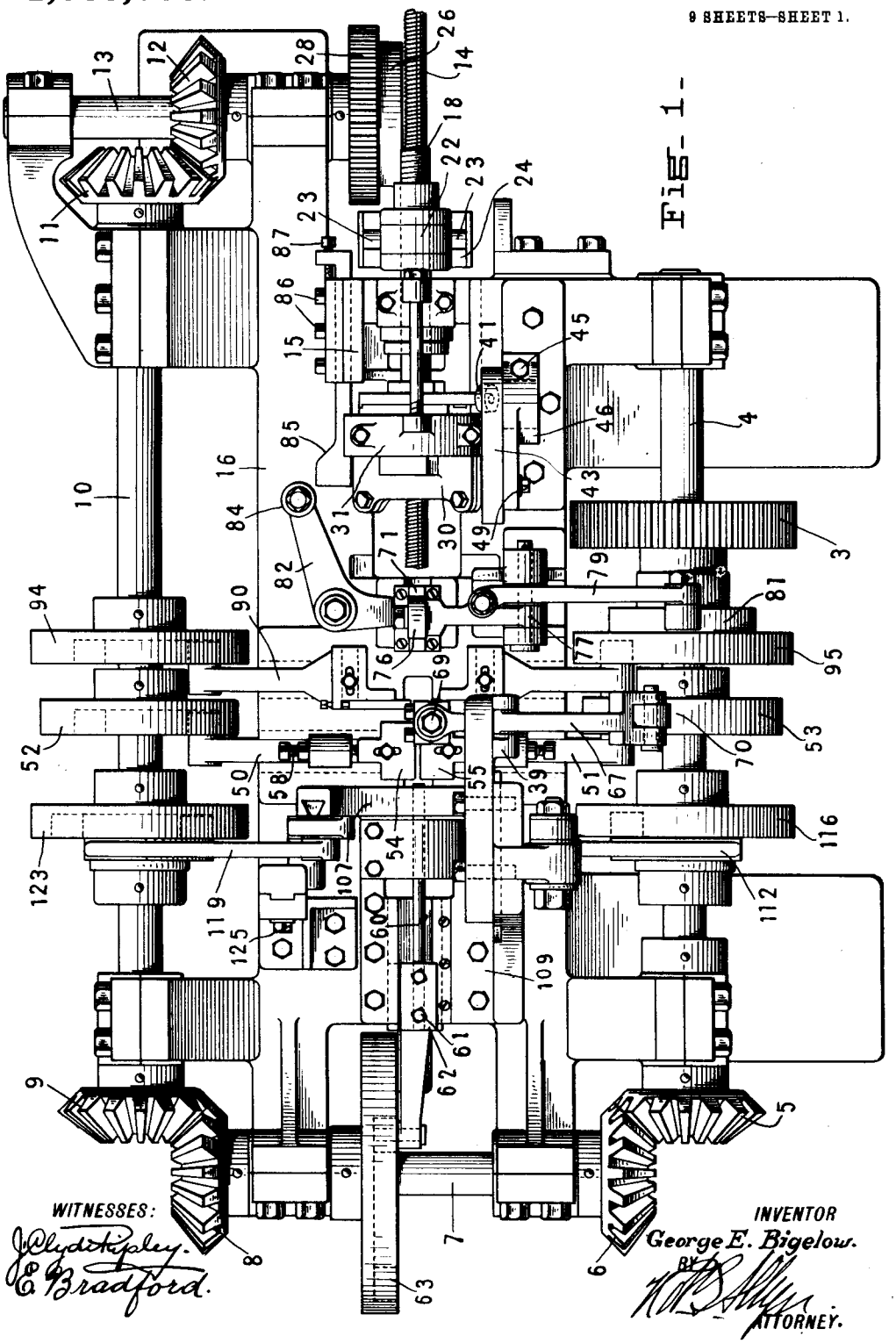
APPLICATION FILED DEC. 20, 1909.

1,065,336.

Patented June 24, 1913.

9 SHEETS—SHEET 1.

Fig. 1.



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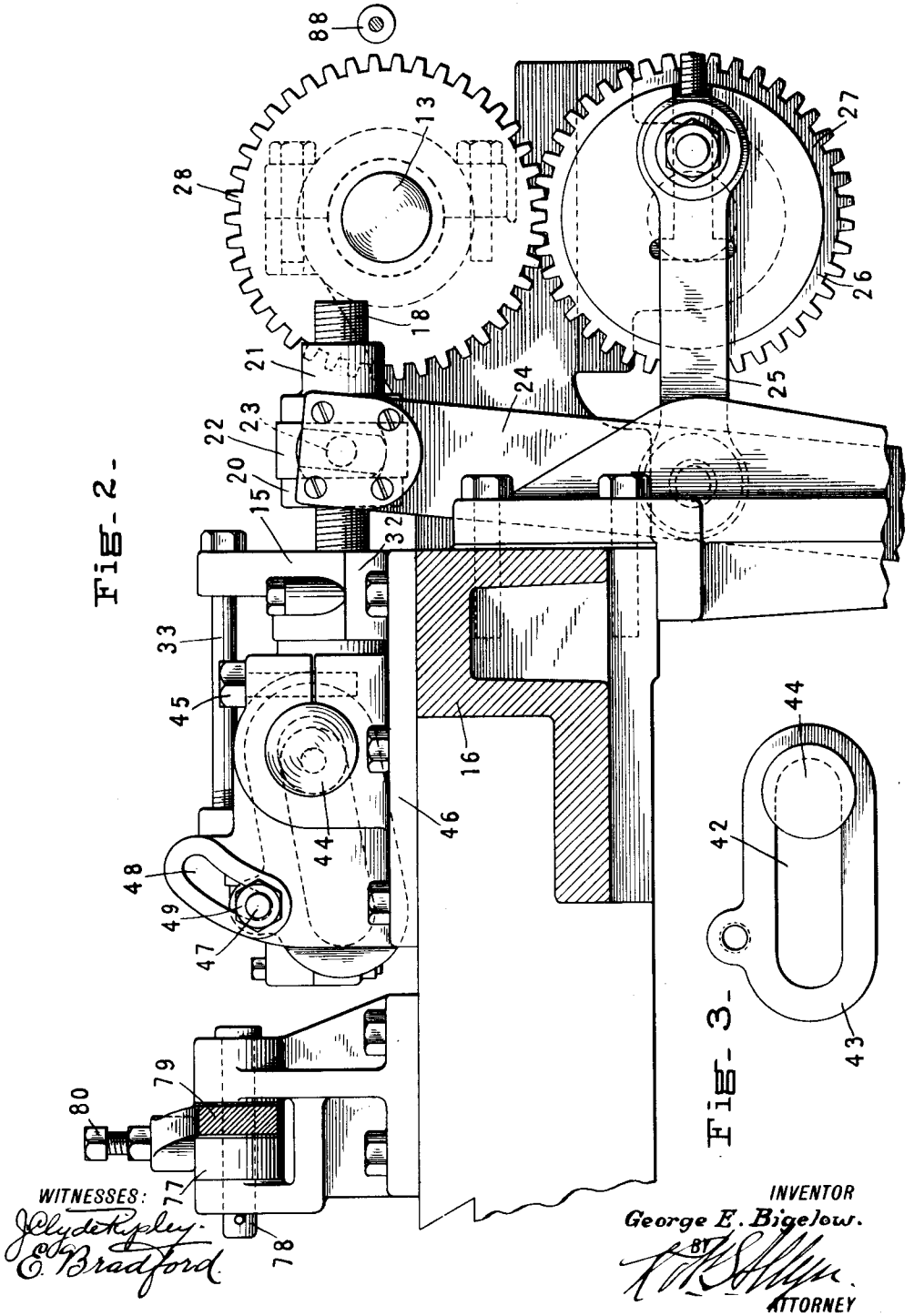

Fig. 2.

Fig. 3.

WITNESSES:

J. Clyde Ripley.

E. Bradford.

INVENTOR

George E. Bigelow.

BY

ATTORNEY

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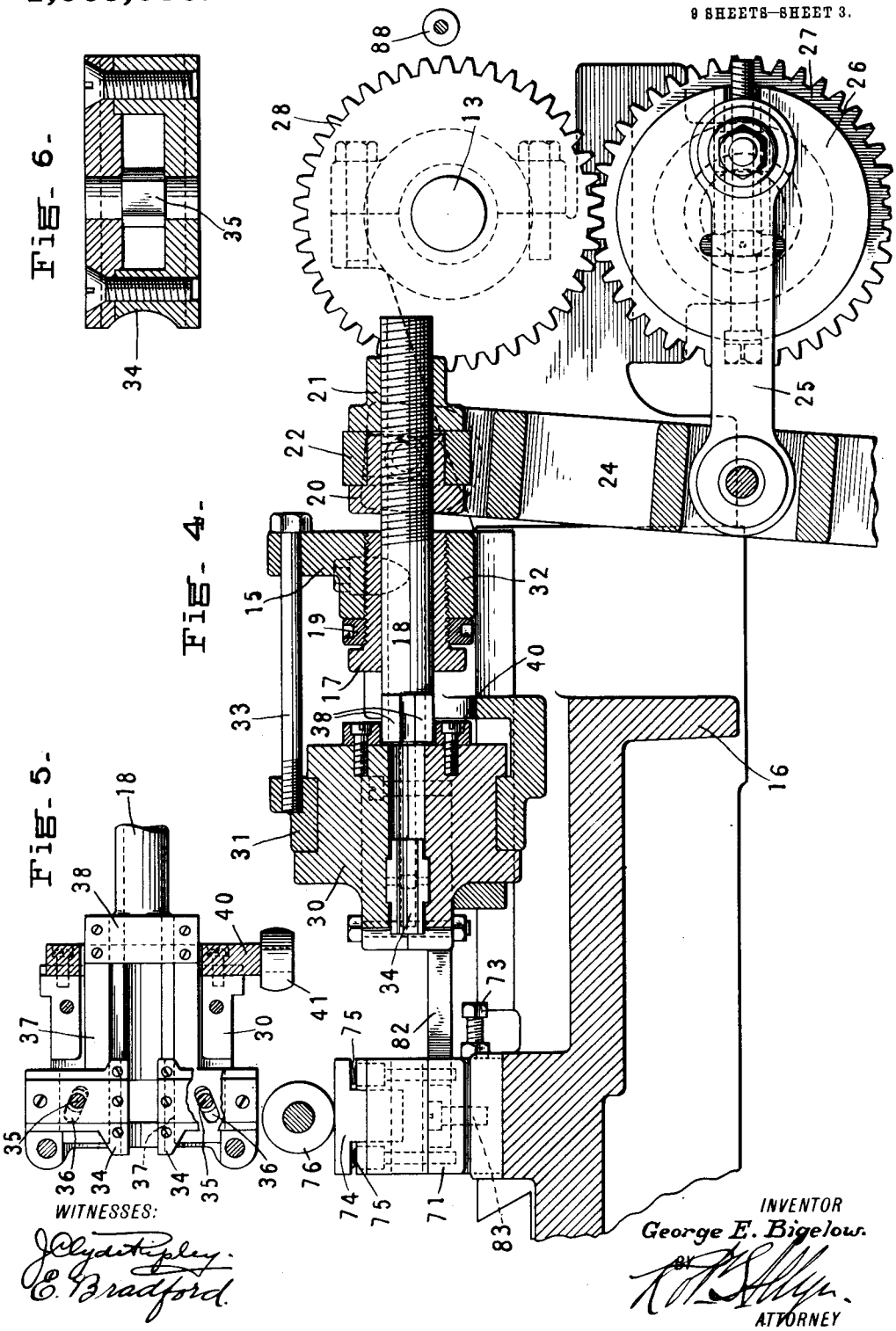

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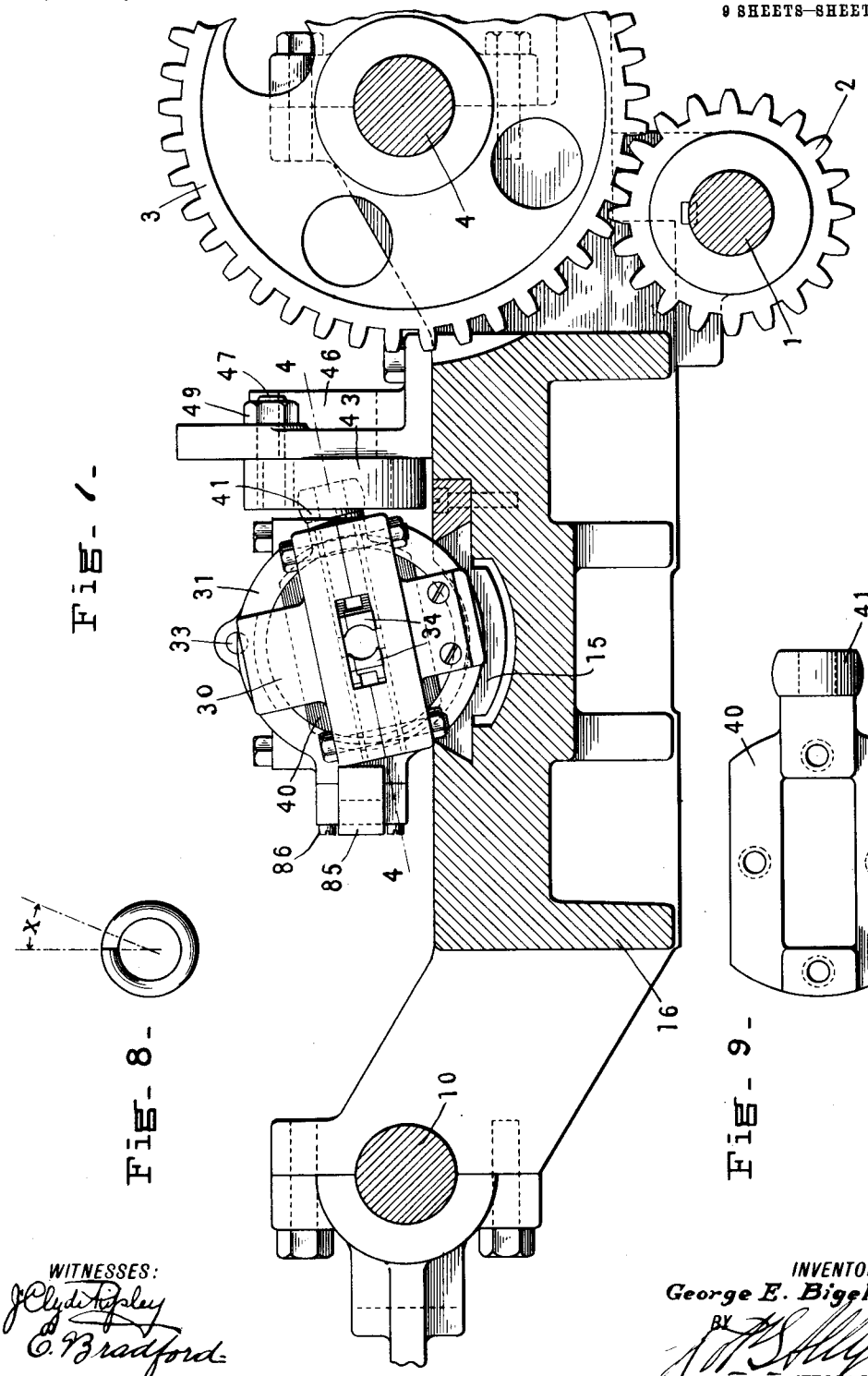

Fig. 1.

Fig. 8.

Fig. 9.

WITNESSES:

J. Clyde Ripley

C. B. Bradford

INVENTOR

George E. Bigelow.

BY

ATTORNEY.

G. E. BIGELOW.

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9 SHEETS—SHEET 5.

Fig. 10.

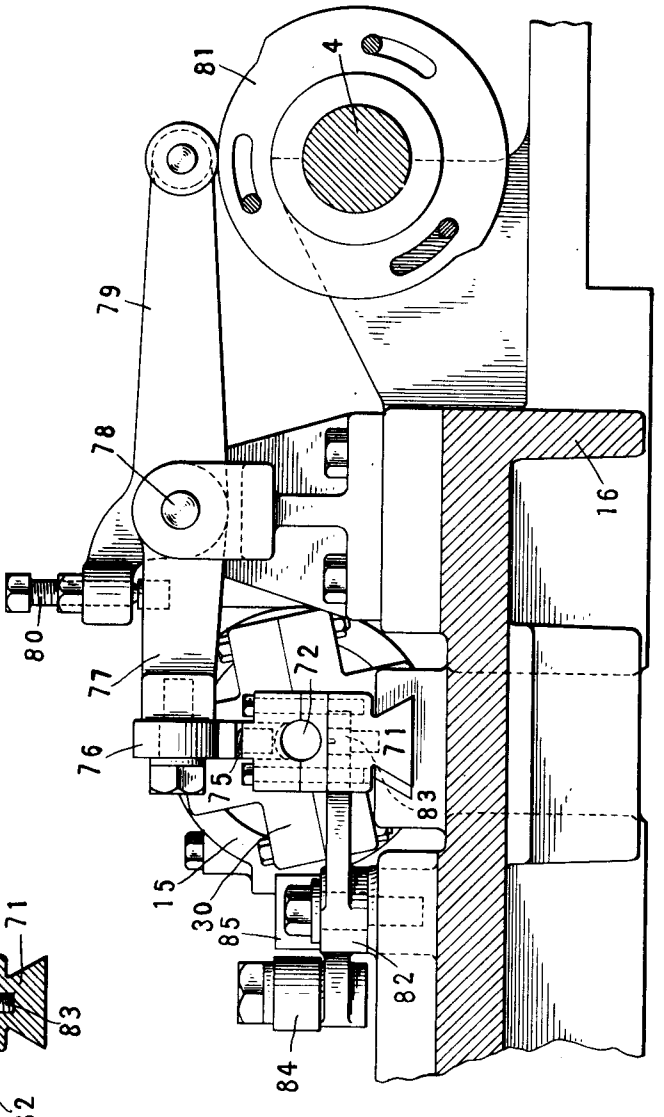


Fig. 11.

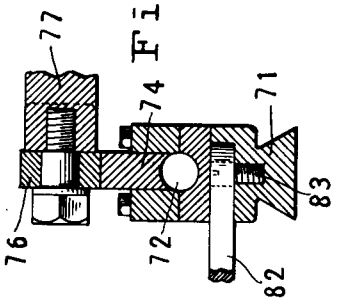
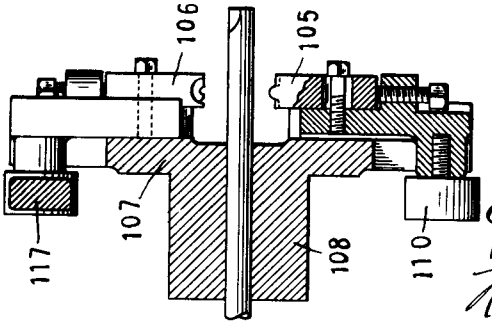


Fig. 12.



WITNESSES:

J. Clyde Tapley.

E. Bradford.

INVENTOR

George E. Bigelow.

BY

ATTORNEY

G. E. BIGELOW.

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APPLICATION FILED DEC. 20, 1909.

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9 SHEETS—SHEET 6.

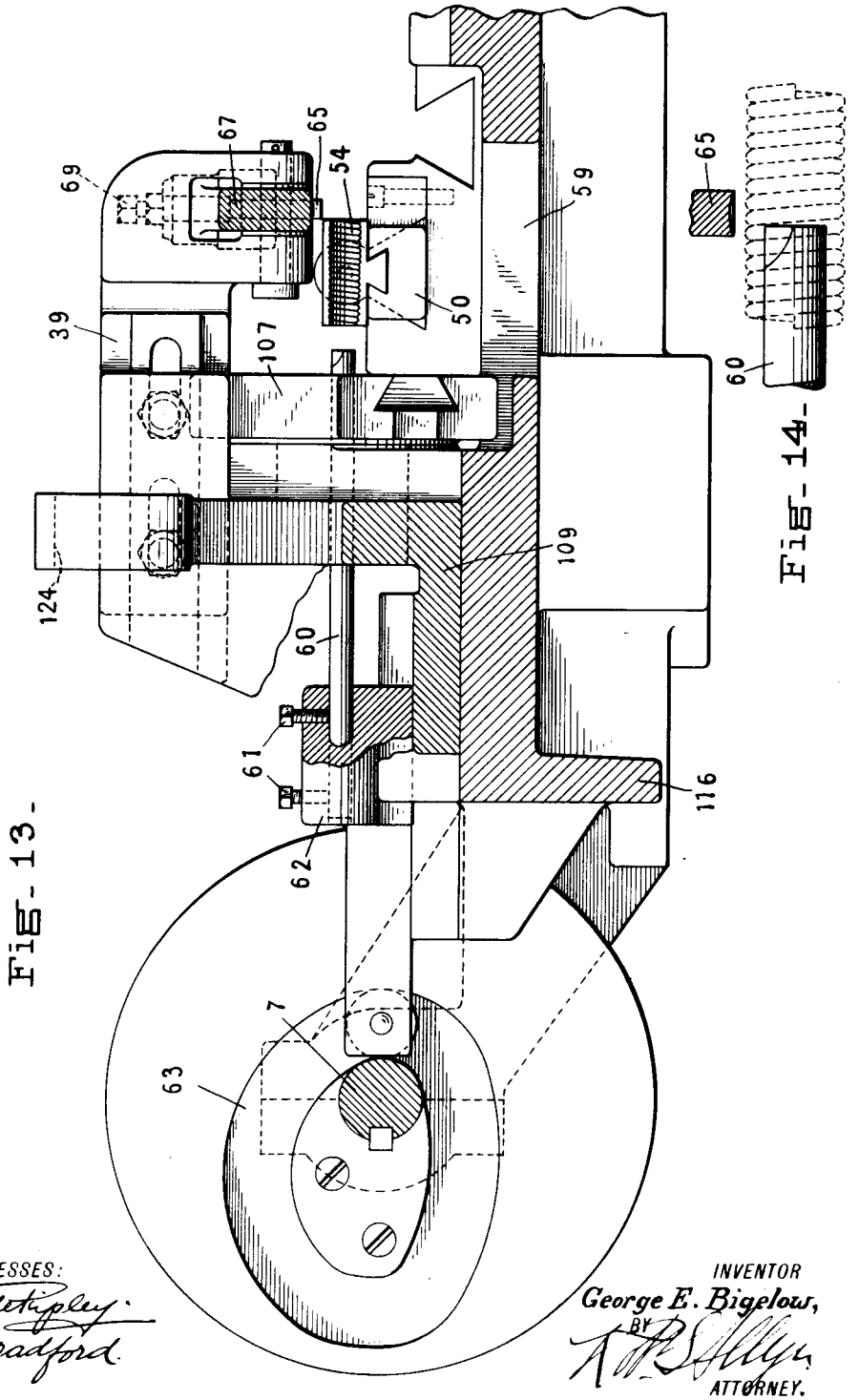

Fig. 13.

Fig. 14.

WITNESSES:

J. Clyde Kipley.

E. E. Bradford.

INVENTOR

George E. Bigelow,

BY

ATTORNEY.

G. E. BIGELOW.

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9 SHEETS—SHEET 7.

Fig. 15.

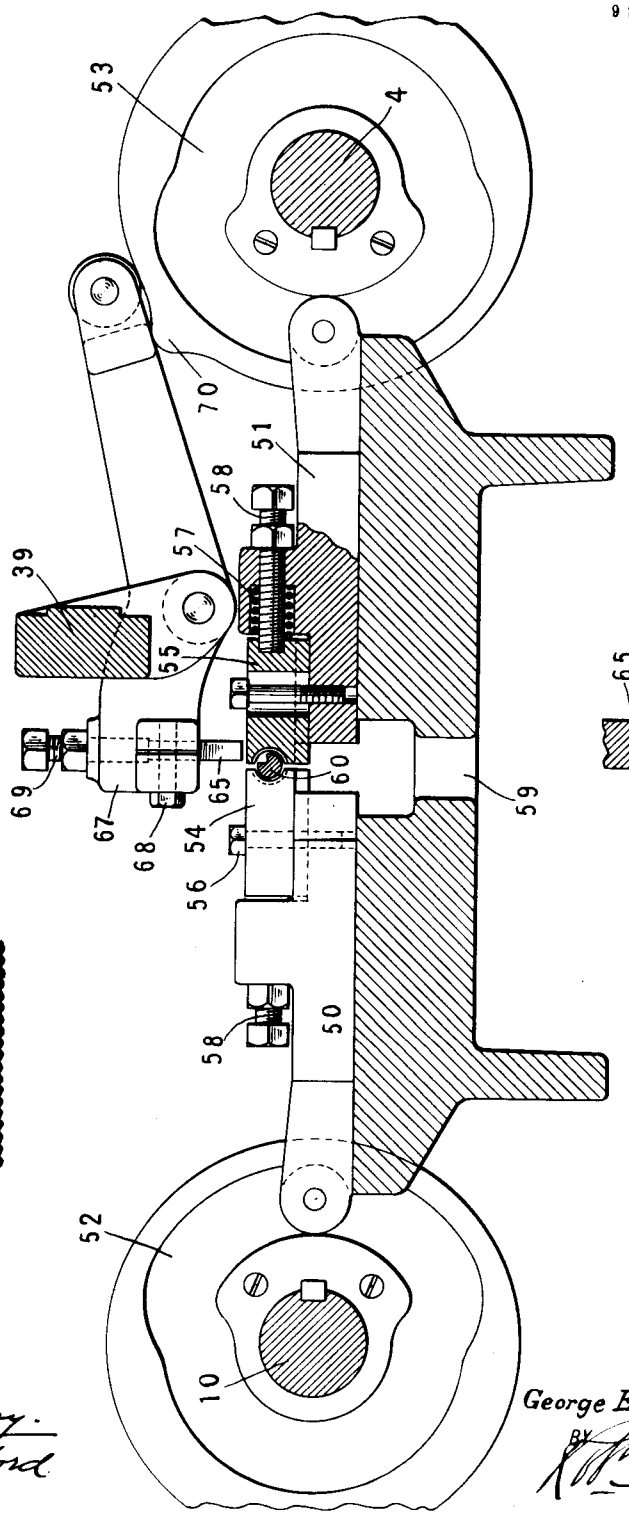

Fig. 16.

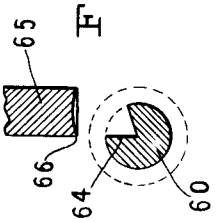

Fig. 17.

WITNESSES:

J. Clyde Kipley.

E. Bradford

INVENTOR

George E. Bigelow.

BY

ATTORNEY

G. E. BIGELOW.

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APPLICATION FILED DEC. 20, 1909.

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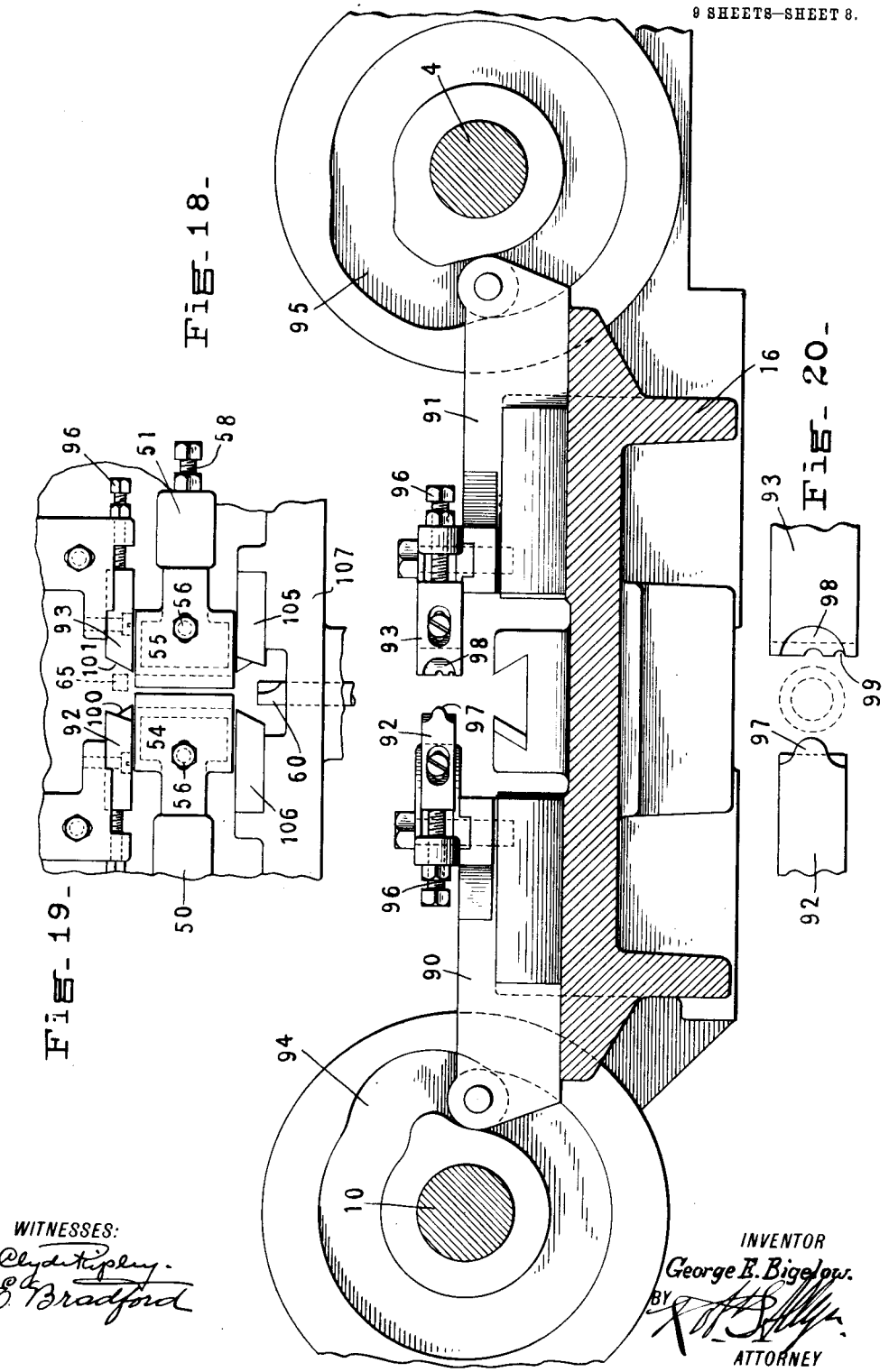
9 SHEETS—SHEET 8.



WITNESSES:

J. Clyde Ripley.

E. L. Bradford

INVENTOR

George E. Bigelow.

BY

ATTORNEY

G. E. BIGELOW.

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APPLICATION FILED DEC. 20, 1909.

1,065,336.

Patented June 24, 1913.

9 SHEETS—SHEET 9.

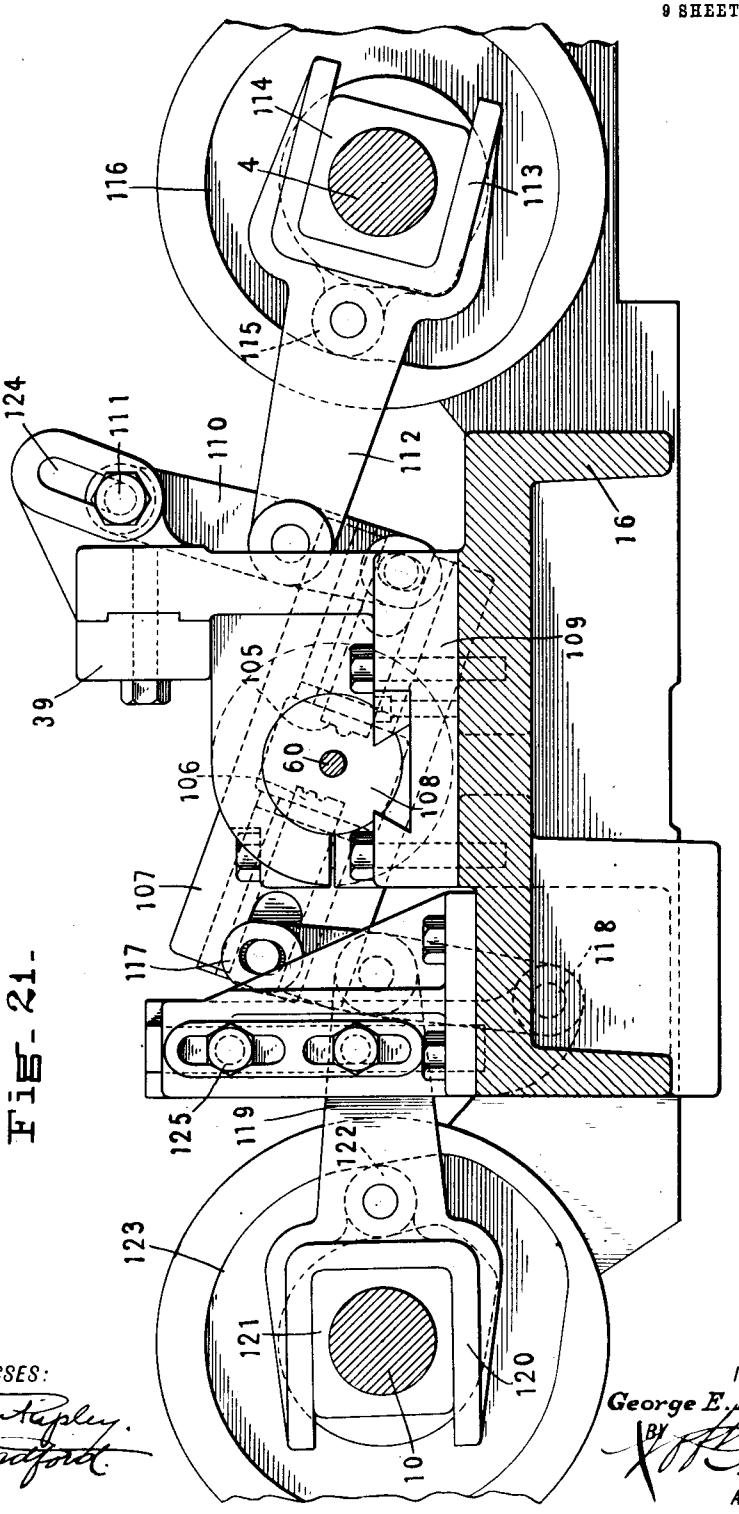

Fig. 21.

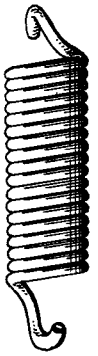

Fig. 22.

WITNESSES:

J. Clyde Ripley.

E. Bradford.

INVENTOR

George E. Bigelow.

BY

ATTORNEY

UNITED STATES PATENT OFFICE.

GEORGE E. BIGELOW, OF WATERBURY, CONNECTICUT, ASSIGNOR TO THE MATTATUCK MANUFACTURING COMPANY, OF WATERBURY, CONNECTICUT, A CORPORATION OF CONNECTICUT.

COIL-SPRING-FORMING MACHINE.

1,065,336. Specification of Letters Patent. Patented June 24, 1913.

Application filed December 20, 1909. Serial No. 534,060.

To all whom it may concern:

Be it known that I, GEORGE E. BIGELOW, a citizen of the United States, residing at Waterbury, in the county of New Haven and State of Connecticut, have invented certain new and useful Improvements in Coil-Spring-Forming Machines, of which the following is a specification.

This invention relates particularly to the manufacture of coiled springs and particularly to those having hooks upon one or both ends.

Wire is coiled helically for various purposes by means of various kinds of mechanism. As wire comes in large coils or bundles it is customary to form the helical coil continuously in suitable lengths. It is customary to cut up this helical coil which for convenience may be termed "coil stock," into proper lengths by means of automatic or hand machines to form the spring "blanks." Then the ends of the wire of the blanks are afterward bent to form hooks.

It is my object to automatically feed the coil stock, cut off the end to form a blank and then automatically bend the wire of the ends of the blanks into hooks. The cut-off and bending in former machines has been more or less irregular and uncertain and I have therefore particularly sought to give accurate feed to the coil stock so as to cut off blanks of uniform length and I have also sought to effect positive and accurate bending of the ends of the wire or "hooking" as it is sometimes called. It will be understood that the "springs" herein referred to are subsequently in most cases tempered. This tempering tightens the helical coil of the springs and causes a relative rotation of the hooks at the opposite ends of the wire. In order therefore that the hooks in the finished tempered spring shall be parallel it is necessary that they should be slightly displaced relative to each other before tempering. It is a further object of my invention to automatically form the hooks at angles to each other so that the subsequent tempering will bring them into a common longitudinal plane.

The details of the invention in one form are illustrated in the accompanying nine sheets of drawings and more fully described in the following specification. Briefly described however, in order to facilitate understanding of the drawings I would state that the coil stock as brought to the machine is gripped by means of a special feeding chuck and advanced to the cut-off position and released. Just beyond this position the end of the stock is clasped by a pair of laterally movable holders and a mandrel or cutting arbor is inserted the length of the desired blank. A cut-off punch or cutter is then brought down and co-acting with the end of the arbor as an abutment inside the coil, it severs the wire to form a spring blank. The arbor is then withdrawn from the blank and the coil stock is clamped by a jaw and slide and retracted a short distance from the cutter. When the arbor is withdrawn and the stock has been retracted, two sets or pairs of dies are brought into action to bend the ends of the wire coil blank to form the hooks. The dies are then retracted and the holders release the spring and allow it to drop into a suitable container. Just about the time the chuck reaches its backward position the retracting clamp is released so that the stock is free to be moved forward as soon as the chuck grips it for the forward feed stroke. As the coil stock is fed forward it is rotated on its axis, through a small angle, so that the next cut of the wire is slightly out of alinement longitudinally from the cut end at the front end of the blank. The bending dies at the opposite ends of the spring blank are arranged to travel on lines inclined relative to each other at an angle substantially equal to the angle through which the coil stock was rotated. This forms the hooks at an angle to each other and with substantially the same length of wire in each hook, as will be more fully understood hereinafter.

Figure 1 is a plan view of a machine embodying the improvements of my invention, the feeding chuck being shown in its retracted position and the severed blank held in position for forming the hooks. Fig. 2 is a side view showing the stock feeding mechanism. Fig. 3 is a side view of the plate for causing rotation of the feeding chuck. Fig. 4 is a vertical section of the stock feeding and retracting means. Fig. 5 is a longitudinal horizontal section of the feeding chuck on the plane of the line 4—4 of Fig. 7. Fig. 6 is a detail vertical section of a chuck jaw. Fig. 7 is a transverse sec-

tion of the machine showing an end view of the feeding chuck. Fig. 8 is an end view of the coil stock illustrating the angle of rotation of the stock during the feeding movement. Fig. 9 is a detail view of the guide roller and carrying plate which is attached to the feeding chuck for co-acting with the guide plate of Fig. 3. Fig. 10 is a transverse section of the machine showing the means for feeding and retracting the coil stock. Fig. 11 is a vertical transverse section of the stock retracting slide and clamp. Fig. 12 is a detail sectional view of the guide for the front pair of bending dies. Fig. 13 is a longitudinal vertical sectional view of the machine showing the holding and cut-off mechanism. Fig. 14 is a detail longitudinal vertical section showing fragments of the cutter and arbor on a larger scale. Fig. 15 is a transverse sectional view of the machine showing the blank holding and cut-off mechanism. Fig. 16 is a vertical transverse section of the cutter and arbor. Fig. 17 is a plan view of the severed blank showing that the ends of the wire of the coil are not in longitudinal alinement. Fig. 18 is a transverse sectional view of the machine showing the bending dies which form the hooks at the rear end of the blank. Fig. 19 is a plan view of the blank holders and bending dies. Fig. 20 is an end view of a blank with the bending dies ready to operate. Fig. 21 is a transverse sectional view of the machine showing the bending dies which form the hooks on the front end of the blank and the mechanism for operating same. Fig. 22 is a plan view of the product of the machine.

The machine is driven by power of any suitable type applied through shaft 1 and gears 2 and 3 to shaft 4 (see Fig. 7). The latter shaft through bevel gears 5 and 6 drives cross shaft 7 which through bevel gears 8 and 9 drives shaft 10 which in turn through bevel gears 11 and 12 drives shaft 13. Shaft 4 carries a series of suitable cams which operate one of the blank holding jaws, the cut-off punch, the clamp for retraction of the coil stock and one die of each pair of the hooking or bending dies. The cutting arbor which serves as one part of the cut-off mechanism is operated from cross shaft 7. Shaft 10 carries suitable cams for operating one of the blank holding jaws and one die of each pair of hook bending dies. The stock feeding chuck is operated from shaft 13 and this in turn moves the retracting clamp back and forth allowing a certain play or lost motion as will be hereinafter set forth.

Stock feeding, (see Figs. 1 to 10.)—The coil stock 14 is fed forward intermittently by means of what for convenience I will term a "chuck" which is mounted to reciprocate. The carriage 15 is guided in longitudinal ways in the bed or frame 16 of the machine. A bushing 17 screwed into the rear of the carriage affords a bearing for the feed tube 18. A collar or nut 19 on the bushing serves to prevent its working loose from the carriage. 20 and 21 are collars secured onto the end of the feed tube and between which is located the yoke 22 which fits loosely on the hub of collar 20. The trunnions 23, 23 of this yoke 22 are engaged by the arms at the upper end of lever 24. This lever is pivoted or hinged at the bottom of the machine (not shown) and is connected by rod 25 to crank plate 26 in the usual manner of adjustable crank connections so that the throw of the lever may be adjusted. The crank plate 26 is carried by gear 27 which meshes with gear 28 on shaft 13. In this way the rotation of shaft 13 causes oscillation of the lever 24 and longitudinal reciprocation of the feed shaft 18. By adjusting the collars 20 and 21 on the feed tube 18 the position of the tube may be varied. The body 30 of the chuck is mounted in the collar 31 of the carriage 15. For the purpose of facilitating assembling and taking apart, the upper part of the collar 31 may be made removable and bolted or otherwise secured in place in any suitable manner. Similarly the rear end 32 of the carriage may be bolted or otherwise secured in place. To reinforce the parts I prefer to connect the front and rear of the top of the carriage by means of a bolt 33. The chuck body 30 I prefer to form in two parts bolted or otherwise suitably secured together. Arranged within the chuck body is a pair of jaws 34, 34 which are radially movable to a limited extent so as to permit them to grip the coil stock and to be released at the proper moments. Each jaw has a pin 35 which passes through an inclined slot 36 in the end of a bar 37 which extends through the jaw. The two bars 37, 37 are secured to flanges 38, 38 on the end of the feed tube 18. As the feed tube 18 is moved forward (that is to the left as viewed in Fig. 1) the bars 37, 37 which project forwardly from the front end force the jaws 34, 34 inwardly and thus grip the stock and feed it forwardly. As soon as the jaws grip the stock further forward movement of the bars 37, 37 and the feed tube 18 independent of the chuck body 30 and carriage 15 is prevented and the parts move forwardly together. When the feed tube 18 starts backward the inertia of the chuck carriage and body causes them to lag behind and thus the jaws 34, 34 are disengaged or retracted from the stock and the chuck moves back free of the stock.

Rotation of the stock, (see Figs. 1 to 10.)—As before mentioned the stock is given a partial rotation during its forward movement. The plate 40 is bolted or other-

wise suitably secured to the rear end of the chuck body 30. This plate carries a roller 41 which projects into an inclined slot 42 in guide plate 43. The chuck body 30 is mounted in the collar 31 of the carriage so that it can rotate. As the chuck is moved forward the roller 41 is guided in the slot 42 and this causes the chuck to oscillate through a small angle as the chuck is reciprocated. As the jaws of the chuck only grip the stock when moving forwardly, obviously the stock is only rotated when being fed forwardly. As herein shown, the rotation, as viewed in the direction of feed, is left handed or anti-clockwise and takes place intermittently between the cut off strokes. In order to be able to vary the angle of rotation and thus vary the relative position of the opposite ends of the wire of the blank I have made the plate 43 adjustable. Its hub 44 is clamped by nut 45 to the support 46. Stud 47 carried by plate 43 projects through a slot 48 in the support 46 and thus the plate may be clamped adjustably in position by a nut 49.

Stock and blank holding, (see Figs. 1, 13, 15 and 19.)—Slides 50 and 51 are reciprocated by means of cams 52 and 53 respectively on shafts 10 and 4. Each slide carries a jaw such as 54 and 55 having their faces preferably cut so as to securely grip the end of the coil stock when it is fed between them. Each jaw preferably has a slight freedom of motion longitudinally of its slide and is guided for instance by means of a bolt 56 passing through a slot in the jaw and a spring 57 adjustable by means of a set screw or bolt 58 presses the jaw inward. The holders thus give a yielding grip upon the stock. The cams 52 and 53 are so timed as to grip the end of the coil stock when it is fed forward to the proper position. The holders 54 and 55 retain their grip upon the coil end while it is being cut off and also while the ends of the severed blank are being bent into hook form. The holders are then retracted and permit the product to fall through the opening 59 into a suitable container. Different sized holders may be substituted for different sizes of springs.

Cutting off the stock, (see Figs. 1, 8, and 13 to 17.)—When the coil stock is fed between the holding jaws 54 and 55 an arbor or mandrel 60 is inserted. This arbor is removably and adjustably clamped as for instance by one or more set screws 61 to slide 62 which is longitudinally reciprocable by means of cam 63 on shaft 7. The end of the arbor is cut away so as to provide a vertical cutting shoulder 64 and the longitudinal position of the arbor is adjusted so that its end projects beyond the rear ends of the holding jaws 54 and 55 substantially the diameter of the wire of the coil stock. The diameter of the arbor is substantially the same as the internal diameter of the coil stock. Above the end of the arbor is located a cutter or punch 65 having a shoulder or cutting edge 66 adapted to co-act with the cutting arbor to sever the coil stock. The lower end of the cutter is preferably concave as indicated in Figs. 14 and 16. This cutter 65 is clamped to lever 67 by means of one or more bolts or screws such as 68 and has an adjustable abutment 69 so that the vertical position of the cutter may be varied to take up wear or otherwise. The cam 70 on shaft 4 is so timed as to operate lever 67 and cutter 65 immediately after the end of the coil stock is grasped by the holding jaws 54 and 55 and the cutting arbor 60 has been inserted ready for cutting off. The cutting arbor 60 and the holding jaws 54 and 55 coöperate to properly support the coil stock during the severing operation. As soon as the blank is severed the cutting arbor is retracted by the cam 63. Lever 67 is carried by the longitudinally adjustable arm 39 so that the longitudinal position of the cutter 65 may be altered for different sizes of wire or lengths of blanks desired.

Retracting the coil stock, (see Figs. 1, 4, 10, and 11.)—As soon as the blank has been severed, the coil stock is retracted or drawn backward a short distance so as to permit the bending dies to be brought into operation at the rear end of the blank. The retracting slide 71 has a central passage 72 for the coil stock and is reciprocable longitudinally. The slide is moved forward by means of the chuck body 30 which engages the stop 73 of the slide on its forward movement. This stop is preferably adjustable so as to vary the movement of the slide. The clamping jaw 74 which projects downwardly into the passage 72 in the slide is pressed upward by means of one or more springs such as 75. On its upper face rests a roller 76 carried by arm 77 pivoted at 78. On the same pivot is a lever 79 one arm of which carries an adjustable set screw or bolt 80 engaging the arm 77 and the other arm of which rests upon the cam 81. This cam is timed so that when the coil stock and the slide 71 are moved forward by the feeding chuck the long arm of the lever 79 will be raised and this forces the short arm of the lever and the roller bearing arm 77 downwardly so as to cause the lower face of the jaw 74 to clamp or grip the coil stock at substantially the moment the feeding chuck reaches the extreme forward extent of its feed stroke. A bell crank lever 82 has one arm slotted to engage the pin 83 in the lower part of the retracting slide 71. The other arm carries a roller 84 adapted to co-act with the incline or cam 85 which is carried by the carriage 15 of the feed chuck.

When the feeding chuck moves to the left as viewed in Fig. 1 the retracting slide 71 is engaged and moved to the left and this tilts the bell crank lever 82 so that the roller 84 is moved back of the projection of the cam 85. When the feeding chuck carriage moves backward on its return stroke the cam 85 forces the roller 84 outward and this tilts the lever 82, retracts the slide 71 and the coil stock which has been meanwhile grasped by the jaw 74. The amount of the retraction will of course depend upon the relative proportions of the arms of the lever 82 and the shape and dimensions of the cam 85. In order to be able to vary the retracting action I have clamped the cam 85 to the chuck carriage by means of one or more bolts such as 86 and have provided an adjustable stop or take-up screw 87 (see Fig. 1). In order to facilitate the retraction of the coil stock, which is sometimes of considerable length, I prefer to provide one or more rollers such as 88, in Fig. 2, on which the stock rests as it is fed forward and retracted intermittently.

Bending or forming the hooks, (see Figs. 1, 12 and 18 to 21.)—While of course the hook on the front end of the blank might be formed without retracting the stock I prefer to form the hooks on both ends of the blank simultaneously while the coil stock is retracted. The slides 90 and 91 carry the bending dies 92 and 93 respectively for forming the hook on the rear of the blank. These slides are operated by cams 94 and 95 on shafts 10 and 4. Each die may be adjusted in any suitable manner for instance by a set screw or bolt 96. One die has a wedge-shaped point 97 which is rounded as viewed from the side and adapted to be inserted under the end coil of the blank. The other die has a curved recess 98 to engage the part of the coil opposite the free end and hold it in position while the wedge 97 is bending the end over. The notch 99 is provided for the wire of the coil at the point where it is bent over. The shoulders 100 and 101 are inclined somewhat so as to coöperate in grasping and properly setting the hook as it is bent out. These bending dies may be adjusted on their slides longitudinally of the machine to correspond with different lengths of blanks and of course different sizes and shapes of dies may be substituted when desired. As before mentioned in order to compensate for the distortion of the spring due to tempering and hardening, the hooks on the opposite ends are formed out of line in this machine. In order to accomplish this and have the hooks of equal size and uniform I rotate the stock after one blank has been cut off through an angle such as the angle X in Fig. 8 so that the front end of the wire is not in line longitudinally with the rear end of the wire of the blank. When the stock is cut off, the rear end of the wire of the blank being directly over the axis of the blank the rear hook forming dies are operated horizontally. The front end of the wire of the blank being displaced through the angle X, I operate the front hook forming dies 105 and 106 inclined at an angle to the horizontal corresponding to the angle X (see Fig. 21). These dies 105 and 106 are the same as the dies 92 and 93 respectively and are supported by holders which slide in the support or guide member 107. This support has a hub 108 secured in the frame part 109 in any suitable manner. The die 105 is reciprocated in the guide member by means of swinging link 110 pivoted at 111. The driver 112 is connected to link 110 and has its rear outer end bifurcated or forked at 113 and embraces a block 114 somewhat loosely mounted upon shaft 4. The roller 115 carried by the driver fits operably in the groove of cam 116. Rotation of the shaft 4 thus causes reciprocation of the die member 105. Die member 106 is operated in a similar manner through link 117 pivoted at 118 and connected to driver 119 which is bifurcated at 120 and embraces the block 121 on shaft 10. The driver roller 122 works in the groove of cam 123. To provide for forming the hooks on the front end of blanks in which, what may be called, the "tempering correction" angle X is greater or less than the one shown, the guide 107 may be adjusted on its axis to a greater or lesser angle of inclination. Corresponding with this adjustment the pivotal axis 111 on link 110 is adjusted up or down in the slot 124 of the machine frame and the pivotal axis 118 of link 117 is adjusted up or down and clamped by means of one or more bolts such as 125. The coiled stock 14 is started by hand into the tube 18, between the jaws 34, 34, under the clamp 74 and between the holders 54 and 55. The machine is then started and the arbor 60 moves forward into the end of the coil and the holders 54 and 55 grasp the end of the coil. The cutter 65 then descends and severs the blank from the end of the stock. The cutter 65 then rises, the arbor 60 is retracted toward the left (Fig. 1), and the two sets of dies 92, 93 and 105, 106 are forced inwardly to bend the ends of the blank into hooked form as shown in Fig. 22. The dies are then retracted and the holders 54 and 55 separated so that the product is released and drops out of the machine. As the blank is severed from the end of the stock, the main portion of the stock is retracted a short distance by the clamp 74 and slide 71 so as to clear the end of the stock from in front of the dies 92 and 93. The retraction is through a distance less than the required feed. While the operation just described is taking place the chuck 30 is moving toward the right. When it starts

backward toward the left the jaws 34, 34 of the chuck grasp the stock and give it a partial rotation through the angle X (Fig. 8) as it is fed forward to the holders 54 and 55, when the machine is ready to repeat the operation above described.

Among other advantages I am able to operate this machine at a high rate of speed and nevertheless to produce a uniform product. It will be seen that I have made provision for adjustment to take care of springs of different lengths and diameters and wire of different gages. The mechanism also permits me to vary the tempering correction angle when necessary for instance by reason of the variations in the quality of steel or of the particular degree of tempering required.

I have only illustrated one form of the invention but I wish it understood that I do not limit my claims except as therein specifically stated and that I contemplate a broad range of equivalents.

What I claim is:—

1. In a coil-spring forming machine, jaws for feeding the coil stock, means for severing a blank therefrom, means for retracting the stock, and means for forming hooks on both ends of the blank and mechanism for bringing said means in operation successively, substantially as described.

2. In a coil-spring forming machine, jaws for feeding the coil stock, means for severing a blank therefrom, means for retracting the stock, means for varying the retraction, and means for forming hooks on both ends of the blank and mechanism for bringing the feeding, severing, retracting and forming means into operation successively, substantially as described.

3. In a coil-spring forming machine, jaws for feeding the coil stock, means for severing a blank therefrom, means for retracting the stock, means for forming a hook on the rear end of the blank and mechanism for bringing said means into operation successively, substantially as described.

4. In a coil-spring forming machine, jaws for feeding the coil stock, means for severing a blank therefrom, means for retracting the stock, and a pair of mechanically operated dies for forming a hook upon one end of the blank and mechanism for bringing said means into operation successively, substantially as described.

5. In a coil-spring forming machine, jaws for feeding coil stock, means for severing a blank therefrom, and a pair of mechanically operated dies for forming a hook upon the front end of the blank and mechanism for bringing said means into operation successively, substantially as described.

6. In a coil-spring forming machine, jaws for feeding coil stock, means for severing a blank therefrom, means for retracting the stock, and two pairs of mechanically operated dies for forming hooks upon the ends of the blank and mechanism for bringing said means into operation successively, substantially as described.

7. In a coil-spring forming machine, means for holding the end of a piece of stock stationary, means for severing a blank from the end while thus held, and dies for bending one end of the blank while so held and mechanism for bringing said means into operation successively, substantially as described.

8. In a coil spring forming machine, means for holding the end of the coil stock stationary, means for severing the end while thus held, and dies for bending the ends of the blank while so held and mechanism for bringing said means into operation successively, substantially as described.

9. In a coil spring forming machine, means for holding the end of a piece of stock, means for severing a blank from the end while thus held, and dies for bending the two ends of the blank into hooks lying in planes at an angle to each other.

10. In a coil spring forming machine, jaws for feeding coil stock, means for holding the end thereof stationary, and a pair of mechanically operated dies for bending one end of the coil when grasped by said holders and mechanism for bringing said means into operation successively, substantially as described.

11. In a coil spring forming machine, jaws for feeding coil stock, means for holding the end thereof stationary, and a pair of mechanically operated dies for bending the front end of the coil when held by said means and mechanism for bringing said means into operation successively, substantially as described.

12. In a coil-spring forming machine, a pair of gripping jaws, a pair of cutters and two pairs of bending jaws, and mechanism for bringing said elements into operation successively, substantially as described.

13. In a coil spring forming machine, means for holding a blank and two pairs of dies for bending the ends thereof into hooks, the plane of operation of one pair of dies being inclined relative to the plane of operation of the other pair of dies.

14. In a coil spring forming machine, means for holding a blank and two pairs of dies for bending the ends thereof into hooks, one pair of dies being adjustable relative to the plane of operation of the other pair of dies.

15. In a coil-spring forming machine, two pairs of dies for bending the ends of a blank into hooks, the plane of operation of one pair of dies being inclined relative to the plane of operation of the other pair of dies, and means for varying the inclination.

16. In a coil-spring forming machine, a

chuck for grasping coiled stock, means for advancing and rotating said chuck for feeding and rotating coiled stock, means for severing the blank from said stock, and mechanism for bringing said means into operation successively.

17. In a coil spring forming machine, a chuck for feeding and rotating coiled stock, means for varying the degree of rotation, and means for severing a blank from said stock and mechanism for bringing said chuck and said severing means into operation successively.

18. In a coil spring forming machine, a chuck for feeding and rotating coiled stock, means for adjusting the length of feed, and means for severing a blank from said stock and mechanism for bringing said chuck and said severing means into operation successively.

19. In a coil spring forming machine, a chuck for feeding the coil stock longitudinally and rotating it and means for severing a blank from the end and mechanism for bringing said means into operation successively.

20. In a coil-spring machine, a reciprocating slide, rotatable feeding jaws carried thereby, and means for rotating said jaws.

21. In a coil-spring machine, a reciprocating slide, rotatable feeding jaws carried thereby, means for rotating said jaws, and means for varying the angle of rotation.

22. In a coil-spring machine, a reciprocating slide, a rotatable feeding body carried thereby, a roller carried by said body, and an adjustable guide plate arranged alongside of said slide for said roller.

23. In a coil-spring machine, a reciprocable carriage, a reciprocating feed tube, gripping jaws radially movable in said carriage relative to said tube, and means of connection between said tube and said jaws.

24. In a coil-spring machine, a reciprocating feed tube, a slide operated thereby, a pair of radially movable gripping jaws carried by said slide, and rods connected to said tube and operatively engaging said jaws.

25. In a coil-spring machine, a stock feeding chuck, an oscillating lever for reciprocating said chuck, cut-off mechanism, and means for adjusting the throw of said lever.

26. In a coil-spring machine, a feed tube, adjustable collars thereon, an operating lever connected to said tube between said collars, and a stock feeding chuck connected to said tube.

27. In a coil-spring machine, a reciprocating carriage, a body rotatably carried thereby, gripping jaws carried by said body, means for operating said jaws, and means for rotating said body.

28. In a coil spring machine, a bending die, a swinging arm connected thereto, a shaft, a cam rotatable therewith, a guide block loosely mounted on said shaft adjacent said cam, a driver having one end guided by said block and the other end connected with said arm, and a guide roller carried by said driver and coacting with said cam.

29. In a spring forming machine, a feeding chuck and a retracting clamp operated thereby.

30. In a machine of the character described, stock feeding means and a retracting clamp operated thereby but having a lesser range of action.

31. In a machine of the character described, stock feeding means, a stock retracting clamp reciprocated thereby, and means for adjusting the time when the retraction occurs relative to the stroke of the feeding means.

32. In a coil-spring forming machine, a feeding chuck, a retracting clamp, and an adjustable abutment carried thereby and engaged by said chuck.

33. In a machine of the character described, a stock feeding chuck, a retracting clamp, a lever connected therewith, and a cam carried by said chuck for moving said lever.

34. In a machine of the character described, a stock feeding chuck, a retracting clamp, a lever connected therewith, and an adjustable cam carried by said chuck for moving said lever.

35. In a machine of the character described, a rotating stock feeding chuck and non-rotating stock retracting means, and means for operating one of said devices from the other.

36. In a machine of the character described, stock feeding means, and stock retracting means operated forwardly by said feeding means, and means for moving said retracting means backwardly after the feeding means has partially completed its return stroke.

37. In a coil-spring forming machine, a stock feeding chuck, means for retracting the stock including a gripping jaw, means for operating said jaw, means for operating said chuck, said retracting means being moved forwardly and backwardly by said chuck.

38. In a coil-spring forming machine, a chuck for feeding the coil stock including a gripping jaw, means for operating said jaw and said chuck, and a retracting device moved forwardly and backwardly by said chuck.

39. In a coil-spring forming machine, a chuck for feeding the coil stock, means for retracting said stock including a gripping jaw, means for operating said jaw, and means for operating said chuck.

40. In a coil-spring forming machine, means for feeding stock, a cutting arbor,

means for reciprocating said arbor, and a cutter for severing the stock when on said arbor.

41. In a coil-spring forming machine, means for feeding stock, a cutting arbor, means for operating the said arbor, and a cutter having a concave end for severing the stock when on said arbor.

42. In a coil-spring forming machine, means for feeding stock, a cutting arbor, means for reciprocating the said arbor, and a pivoted cutter for severing the stock when on said arbor.

43. In a coil-spring forming machine, means for holding a blank, a cutting arbor, means for inserting and retracting said arbor, and a cutter for coöperating with said arbor to cut said blank when so held.

44. In a coil-spring forming machine, a cutting arbor, means for inserting and retracting said arbor, and a cutter for coöperating with said arbor to cut said blank.

45. In a coil-spring forming machine, means for holding a blank, an adjustable cutting arbor, means for inserting and retracting said arbor, and a cutter for coöperating with said arbor to cut said blank when so held.

46. In a coil machine, means for feeding coiled stock, an arbor in alinement therewith, a cutter coöperating with said arbor to sever a coil, holders for gripping the stock while on the arbor, means for retracting the arbor, and jaws for bending the ends of the severed coil while held by the holders.

47. In a coil-spring machine, a cutting punch, a cutting arbor, and means for feeding coil stock, said punch and arbor being both adjustable longitudinally of the direction of feed of the stock.

48. In a machine of the character described, stock holding means, a cutting arbor, means for inserting said arbor, and a cutter coöperating therewith when the stock is grasped by said holding means.

49. In a coil-spring machine, a horizontal cutting arbor, means for moving it longitudinally, a vertically operating cutter, and laterally operating bending dies.

50. In a coil-spring machine, a pair of slides, grooved coil holding jaws carried thereby, springs pressing said jaws toward each other, means for adjusting said jaws away from each other, and means for operating said slides.

51. In a coil-spring machine, stock feeding means, and stock retracting means comprising a reciprocating slide, a clamp jaw carried thereby, a roller engaging the top of said clamping jaw, and means for pressing said roller downward when the slide is retracted.

52. In a coil-spring machine, blank holding means and a pair of bending dies at each end thereof, one pair of dies being adjustable about the axis of the holding means.

53. In a coil-spring machine, blank holding means, an angularly adjustable guide adjacent one end thereof, and bending dies mounted in said guide.

54. In a coil-spring machine, an angularly adjustable guide, bending dies mounted to slide therein, a swinging arm connected to each die and having its pivotal axis adjustable, and a driver connected to each arm.

55. In a coil-spring forming machine, two side and end shafts, feeding means driven from one end shaft, a cutting arbor driven from the other end shaft, and holding, cutting, and bending means operated from the side shafts.

56. In a coil spring forming machine, a chuck for grasping coiled stock and moving it longitudinally and means for moving said chuck longitudinally and means for giving said chuck a partial backward rotation.

57. In a coil spring machine, a coil feeding device, an arbor, means for moving said arbor longitudinally of the coil, bending jaws, and means for bringing said mechanism successively into operation.

58. In a coil spring machine, a coil feeding device, an arbor, means for moving the arbor longitudinally of the coil, means for cutting off the coil blank, bending jaws, and means for operating the said mechanisms.

59. In a machine of the character described the combination of a pair of jaws for gripping the coil, coöperating cutter elements for severing a blank from the stock, two pairs of reciprocating bending jaws for forming the hooks on the ends of the blank, and means for operating said gripping jaws, said cutter elements and said bending jaws automatically.

GEORGE E. BIGELOW.

Witnesses:
WM. M. SAUNDERS,
EDWARD J. RAY.