July 22, 1941. W. E. WUNDERLICH 2,249,996

SPRING-FORMING MACHINE

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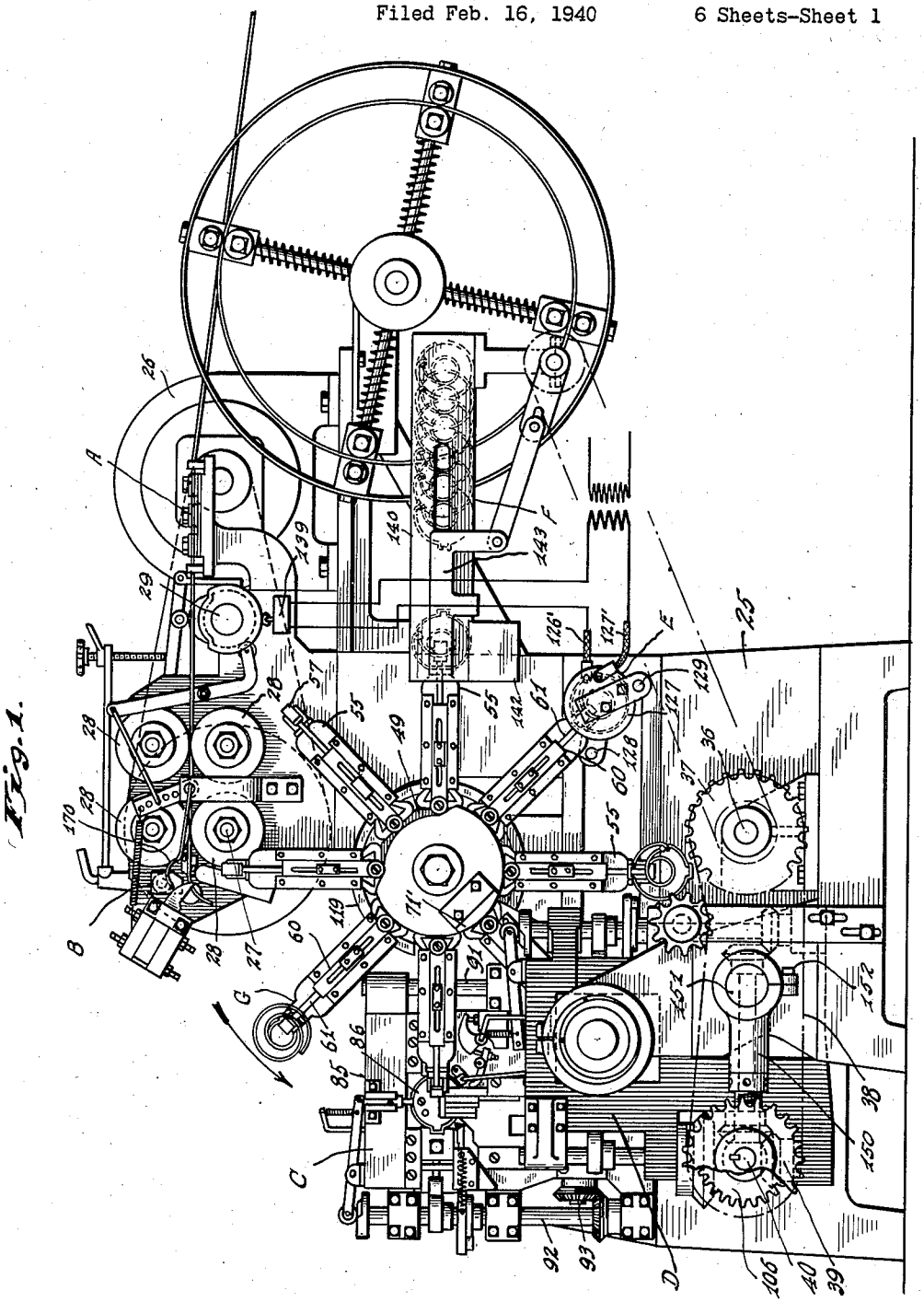


Fig. 1.

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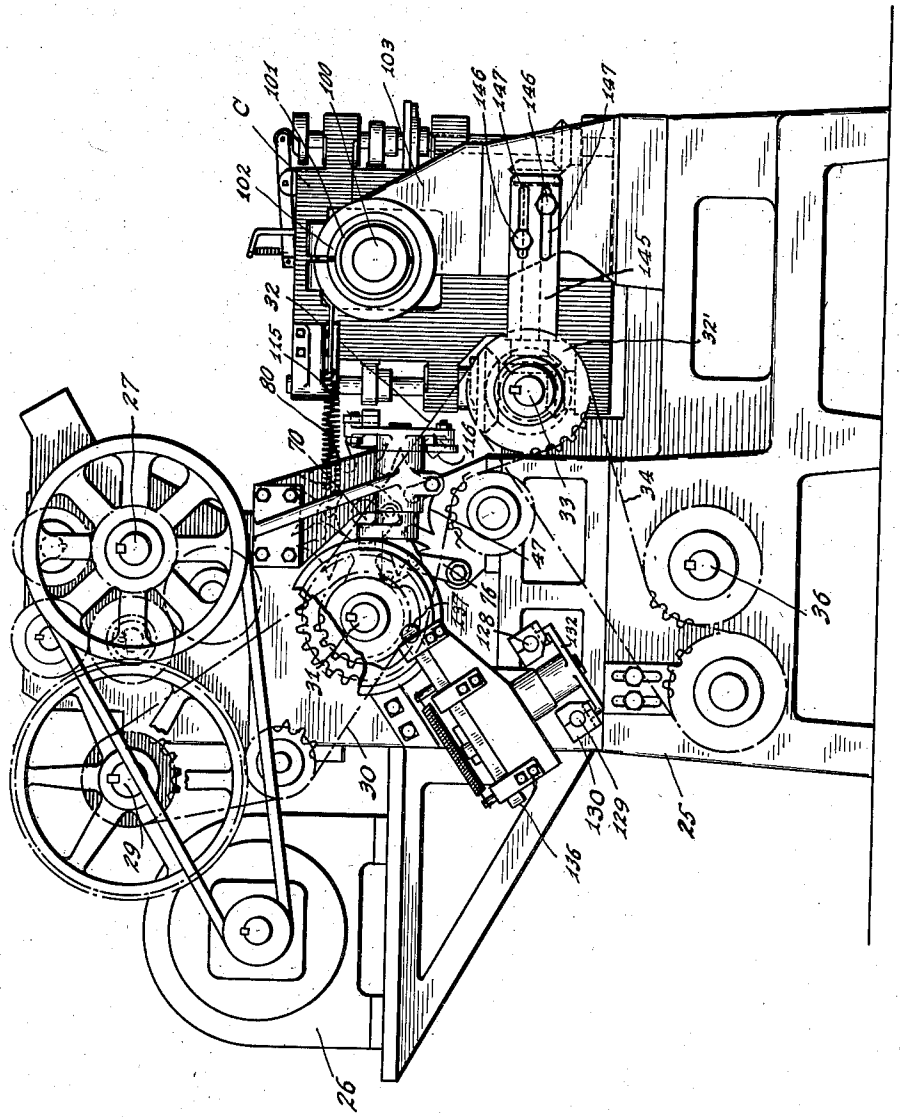


Fig. 2.

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SPRING-FORMING MACHINE

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Fig. 3.

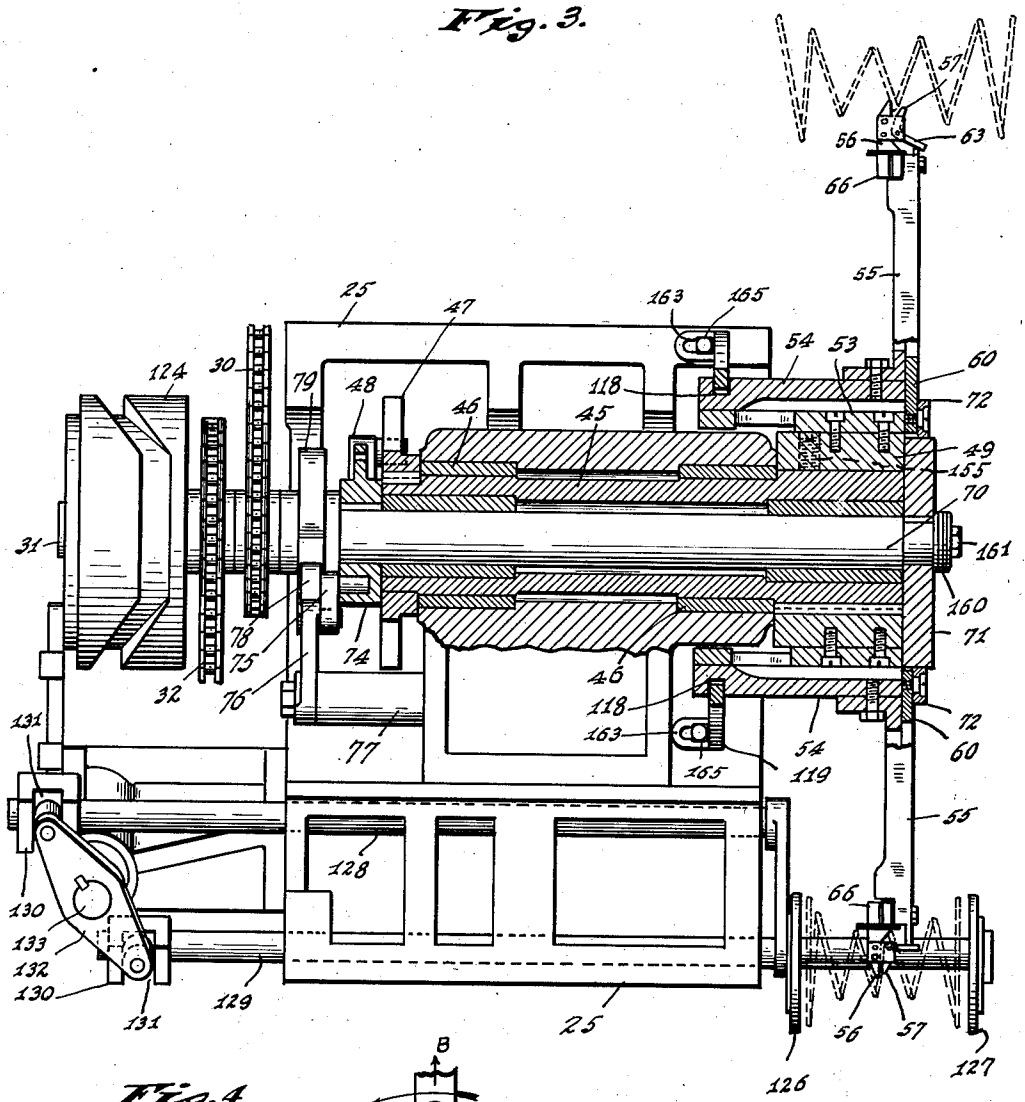
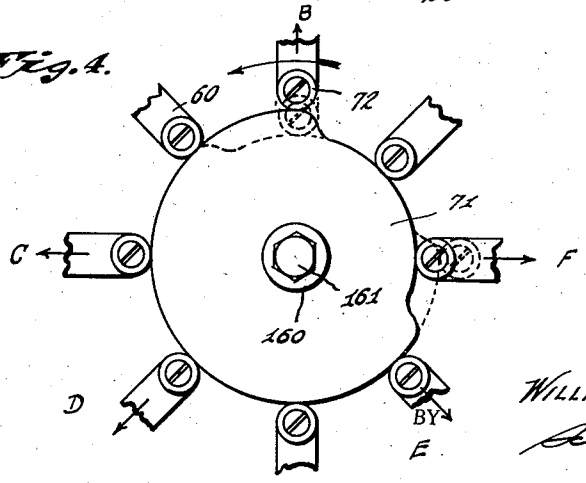


Fig. 4.



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SPRING-FORMING MACHINE

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Fig. 5.

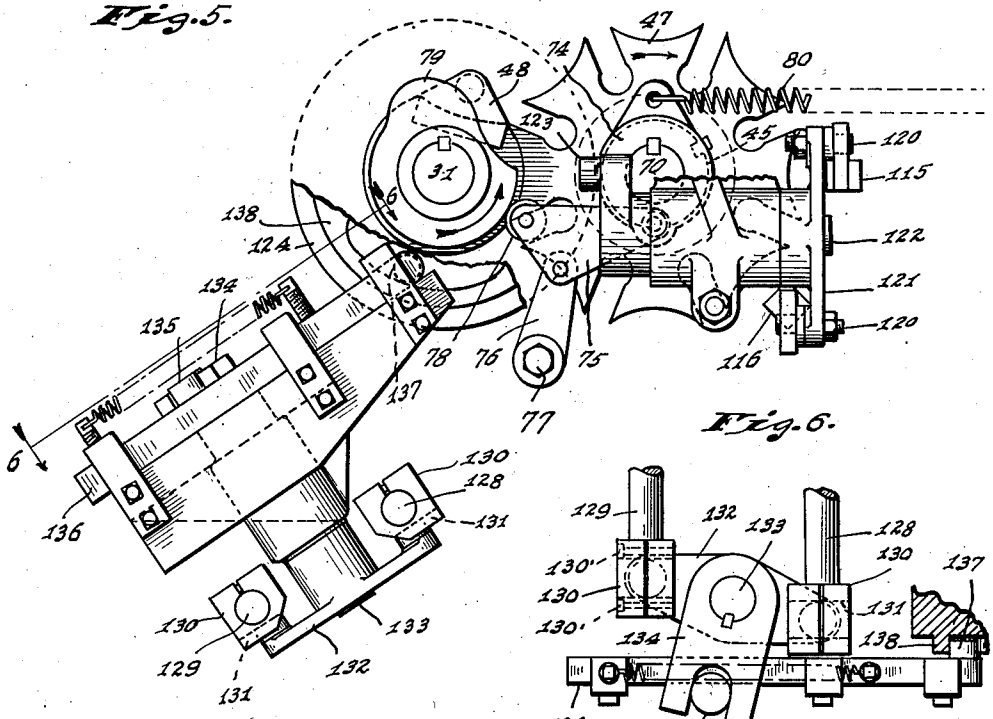


Fig. 6.

Fig. 7.

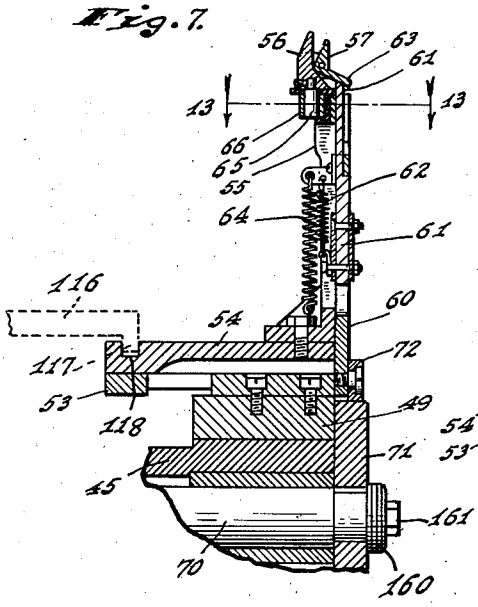
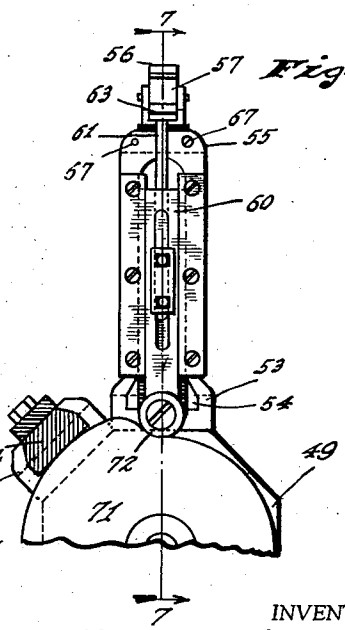


Fig. 8.



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SPRING-FORMING MACHINE

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Fig. 10.

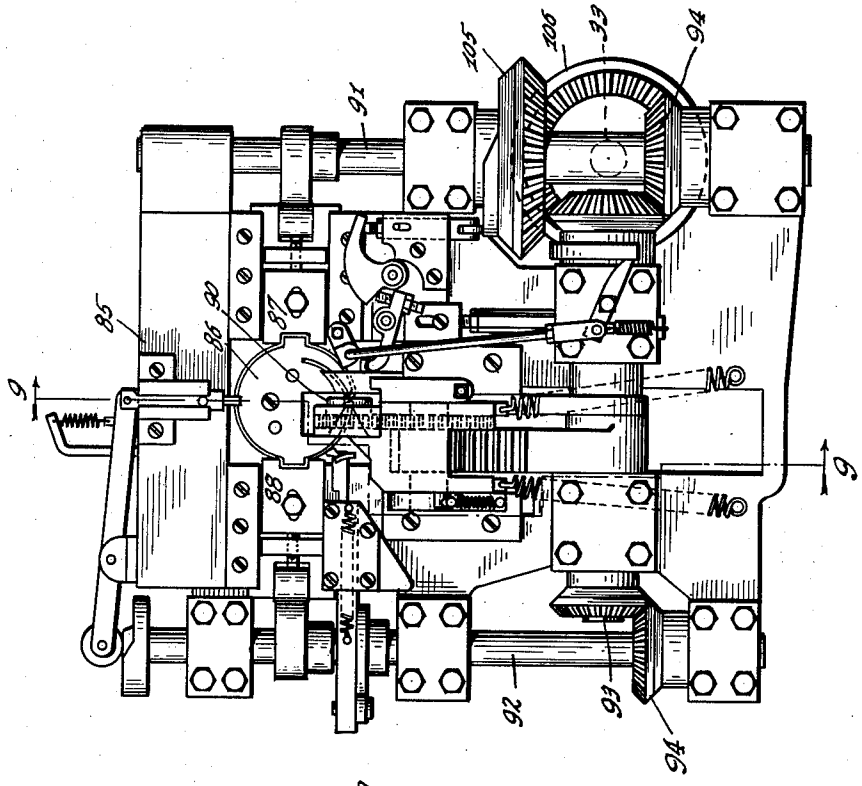
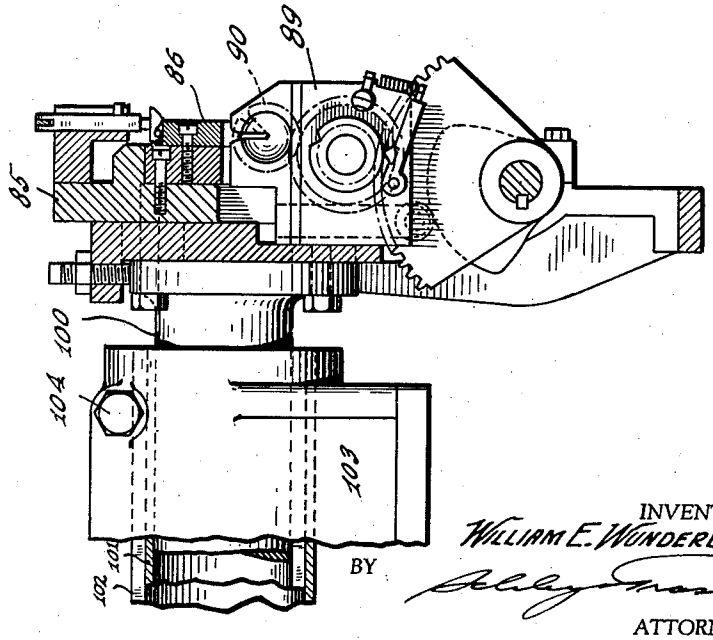


Fig. 9.



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Fig. 11.

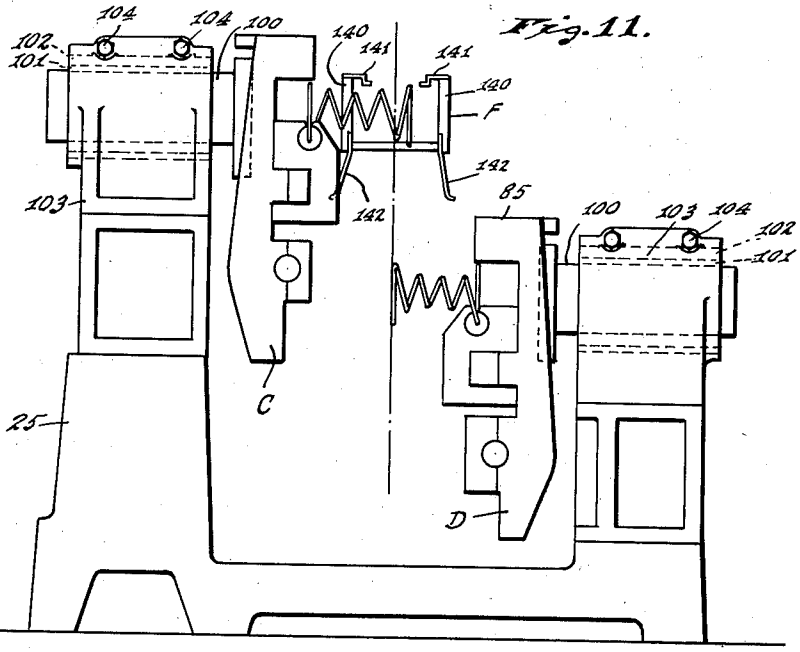


Fig. 12.

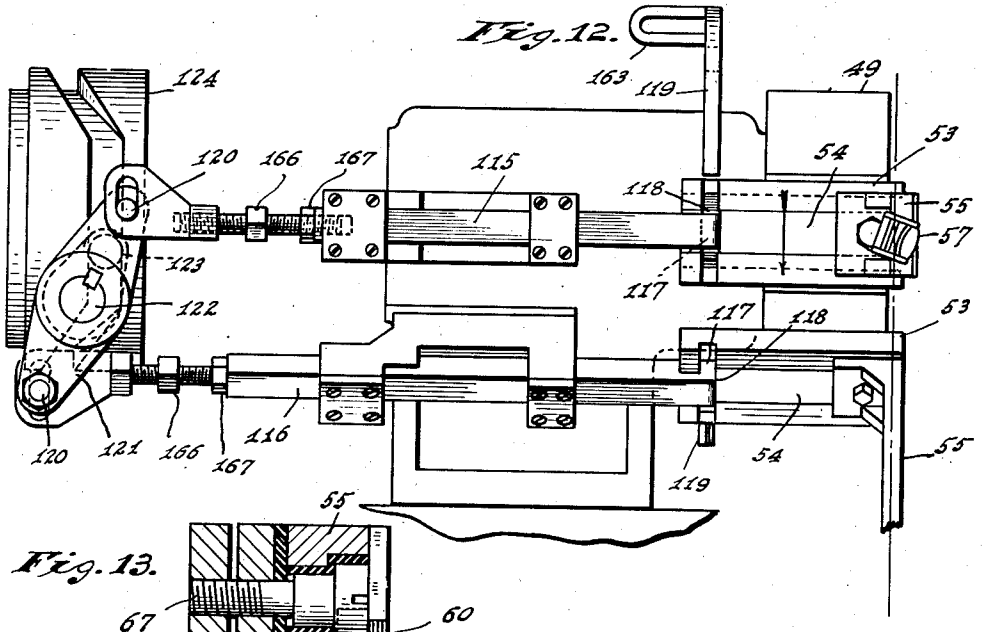
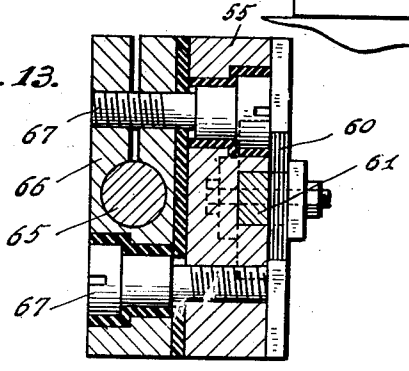


Fig. 13.



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Patented July 22, 1941 2,249,996

UNITED STATES PATENT OFFICE

2,249,996

SPRING-FORMING MACHINE

William E. Wunderlich, Muncie, Ind., assignor to The Moore Company, Muncie, Ind., a corporation of Indiana

Application February 16, 1940, Serial No. 319,301

13 Claims. (Cl. 140—101)

My invention relates to a machine for use in producing open-wound wire springs of the type used as resilient load-supporting elements in bed springs, mattresses, and upholstery. It is the object of my invention to produce a machine which will be relatively simple in construction and which will form springs at a high rate of production. A further object of my invention is to produce a machine which will be flexible so as to accommodate for variations in the form of the springs produced.

In carrying out my invention in its preferred form I provide a rotatable spring-carrier having a series of spaced pairs of jaws adapted to grip the wire of the springs. This carrier is supported for intermittent movement, and is so arranged that each spring, when formed and severed from the stock wire, is gripped in a pair of jaws and moved by the intermittent movement of the carrier successively past stations at which end turns are knotted and crimped to the desired shape, past a station at which an electric current is caused to flow through the spring to heat and normalize it, and to a station at which the finished spring is discharged. Each pair of spring-gripping jaws is mounted for movement as a unit axially of the carrier for the purpose of moving the spring into association with each of the knotting and crimping mechanisms after the spring has been brought into alinement therewith by movement of the carrier. The knotting and crumping mechanisms are adjustably supported in the frame of the machine in order to provide for different positions of the knots and offsets in the end turns of the spring.

Machines have heretofore been developed for the production of open-wound springs with knotted end turns; but so far as I am aware, in all such prior machines the springs were not moved axially of the rotatable carrier to effect the association of the springs with the knotters, but instead the knotters were bodily moved axially of the rotatable carrier into association with the springs. In some instances, the knotters were disposed in alinement with each other and moved simultaneously into association with opposite ends of the springs. In my invention, the knotters are stationary and on opposite sides of the path of travel of the springs and the association of the springs with the knotters is brought about by moving the springs axially of the rotatable carrier by means of spring gripping jaws which are bodily movable. As a result of this, I have eliminated the relatively heavy and complicated mechanism necessary for bodily moving the knotters into association with the springs and have accordingly reduced the power necessary for bringing about the association of the springs and the knotters.

The accompanying drawings illustrate my invention: Figs. 1 and 2 are front and rear elevations respectively of the complete machine; Fig. 3 is an axial section through the carrier; Fig. 4 is a front elevation of the jaw-operating cam; Fig. 5 is a fragmental rear elevation on an enlarged scale showing details of the carrier-moving and associated mechanisms; Fig. 6 is a section on the line 6—6 of Fig. 5; Fig. 7 is an axial section through one of the arms of the carrier; Fig. 8 is a fragmental front elevation of the carrier; Fig. 9 is a vertical section through a knotting and crimping head on the line 9—9 of Fig. 10; Fig. 10 is a front elevation of the crimping head; Fig. 11 is a simplified end elevation of the complete machine; Fig. 12 is an elevation showing the mechanism employed to move springs into association with the knotter after they have been brought into alinement therewith; and Fig. 13 is a section on the line 13—13 of Fig. 7.

The machine illustrated in the drawings comprises a frame 25 upon which are supported wire-straightening mechanism A, spring-forming and cut-off mechanism B, a pair of knotting and crimping heads C and D, normalizing apparatus E, and a discharge rack F. Also supported from the base 25 is an intermittently rotatable carrier G having a series of radiating arms provided at their outer ends with spring-gripping jaws. In the particular machine shown in the drawings there are eight of such radiating arms, but my invention is not limited to any particular number.

The wire-straightening mechanism A and the spring-forming and cut-off mechanism B may take any desired form; and I have not illustrated details of these mechanisms because suitable ones are well known and in common use. In its broader aspects, my invention is not concerned with details of the knotting and crimping heads C and D, the normalizing apparatus E, or the discharge mechanism F.

Power for operating the various mechanisms incorporated in the machine is conveniently derived from a single source, shown in the drawing as an electric motor 26. The motor 26, through a belt drive, drives a shaft 27 on which one of the feed rolls 28 for the stock wire is mounted; and, through suitable gearing, the shaft 27 in turn drives a shaft 29. The shaft 29 carries cams

which actuate the spring-forming mechanism in well known manner to form springs of the desired shape.

A chain drive 30 serves to interconnect the shaft 29 with a shaft 31 which operates the carrier G and the parts carried thereby in a manner to be described hereinafter. A second chain drive 32 interconnects the shaft 31 with a sprocket 32' keyed to a shaft 33 which operates the knotting and crimping head C. A third chain drive, including a chain 34 and a drive-sprocket rigid with the sprocket 32', drives a shaft 36 which extends forwardly through the machine and carries at its front end a sprocket 37 connected by a chain 38 with a sprocket 39 keyed to a shaft 40 which operates the second knotting and crimping head D.

Each of the chain drives just described has a one-to-one ratio so that the shafts 29, 31, 33, and 40 all rotate at the same speed, making one revolution for each spring which the machine forms, as will become apparent. The chain drives are arranged so that the shafts 29, 31, and 33 rotate in one direction, while the shafts 36 and 40 rotate in the opposite direction. Each chain drive includes an adjustable idler for the purpose of regulating the tension in the chain.

It is to be understood that the particular means shown in the drawings for supplying power to the various mechanisms is subject to extensive variation and that the details of such means form no part of my invention in its broader aspects.

The spring carrier G (see Fig. 3) comprises a central hollow shaft 45 rotatably supported in bearings 46 from the frame 25. To the rear end of the shaft 45 there is fixed the driven element 47 of a Geneva movement whose driving element 48 is rotatable with the shaft 31. Since, as above mentioned, the spring carrier illustrated in the drawing has eight radiating arms, the Geneva movement 47–48 is so arranged as to produce one-eighth of a revolution of the shaft 45 for each complete revolution of the shaft 31.

At the front of the machine, the shaft 45 projects forwardly beyond the front bearing 46 and has rotatable with it an octagonal head 49 on each face of which there is mounted a guide 53 receiving an axially slidable member 54. Secured to each of the members 54 is an arm 55 which projects radially outwardly from the member 54 and which, at its outer end, supports a pair of wire-gripping jaws 56 and 57, the former being normally stationary and the latter being movable toward and away from it to effect the gripping and release of the springs.

The movable jaw 57 is operated by a slide 60 (Figs. 3, 7, and 8) which is radially slidable in the associated arm 55. Desirably, the slide 60 does not directly engage the movable jaw 57 but instead has slidably mounted within it a jaw-actuating rod 61 which is urged radially outward by a spring 62 acting between the slide 60 and the rod 61. The rod 61 is disposed to engage a projection 63 on the jaw 57, so that as the slide is moved radially outward it will stress the spring 62 and cause the rod 61 to swing the jaw 57 toward the fixed jaw 56. Each slide 60 is resiliently urged radially inward of the arm 55, as by a spring 64.

As springs formed in the machine may not always have the same pitch, and as the jaws 56–57 should hold the spring with its axis parallel to that of the shaft 45, it is desirable that the jaws 56–57 be angularly adjustable. To this end, the movable jaw 57 is pivotally supported from the jaw 56 and the latter is fixed to a circular shank 65 which is rotatable about its axis in a split bearing-block 66 mounted on the outer end of the arm 55. (See Fig. 13.) The bearing block 66 is held in place on the arm by screws 67 at least one of which is disposed to pass transversely across the split in the bearing block so that when tightened it will clamp the shank 65 and hold it in fixed position about its axis.

For the purpose of moving the slide 60 to control the operation of the jaws 56–57, I mount within the hollow shaft 45 a shaft 70 which projects at both ends beyond the shaft 45 and which has secured to its front end a cam 71 positioned to be engaged by a roller 72 mounted on the inner end of each of the slides 60. Upon the rear end of the shaft 70 there is rigidly mounted a collar 74 connected at an eccentric point to an oscillatable member 75 supported by the outer end of a freely swinging lever 76 which is pivotally mounted on a stud 77 secured to the frame of the machine or some other stationary point. The member 75 carries a cam-following roller 78 which co-operates with a cam 79 rotatable with the shaft 31. A spring 80, acting between the collar 74 and a fixed point, operates to hold the cam-follower 78 against the cam 79.

Each of the knotting and crimping heads C and D may take any desired form, that shown in the drawings corresponding in general to the head forming the subject matter of my prior Patent No. 1,867,128 granted July 12, 1932. As will be clear from Figs. 9 and 10, each head comprises a base 85 on the front face of which there is mounted a die 86 of a contour corresponding to the shape to be given the end coil of the spring. The particular die illustrated in the drawings has diametrically opposite projections with which form-slides 87 and 88 respectively co-operate to form outwardly extending offsets on the end coil of the spring. A vertically slidable carriage 89 carries a rotatable, slotted knotter gear 90 which twists the extreme end portion of the spring wire about the end turn of the spring. At the sides of the base-plate there are mounted two vertical shafts 91, and 92, and at the bottom of the base-plate there is mounted a horizontal shaft 93 connected to each of the vertical shafts through mitre gearing 94. These shafts 91, 92, and 93 operate the slides 87 and 88, the carriage 89, the twister gear 90 and certain accessory mechanisms which form no part of my invention.

For the purpose of operating the twisting and crimping head, one of the shafts, here shown as the shaft 91, has rotatable with it a bevel gear 105 meshing with a gear 106 which, in the case of the head C, is rigidly connected to the front end of the shaft 33. The gearing 105–106 has a one-to-one ratio so that each of the shafts 91, 92, and 93 will make one revolution for each revolution of the shaft 33.

When a spring is to be presented to the knotting and crimping head, the form-slides 87 and 88 and the carriage 89 are retracted to permit the end coil of the spring to be received over the die 86. After the spring has been presented, the form slides 87 and 88 are moved inwardly to form the offsets in the end coil of the spring and the carriage 89 is advanced so that the end coil of the spring will be received in the slot of the knotter gear, whereupon the knotter gear is rotated to form the knot in known manner. As a final operation, the form slides 87 and 88 and the carriage 89 are retracted to their orig-

inal positions to permit the spring to be removed from the head.

In order that it may be in proper alinement with a spring presented to it, the head C is supported from the frame so that its position may be adjusted transversely of the spring axis. Also, in order to vary the relative angular dispositions of the offsets and knots in opposite end coils of the springs, the head may be supported for adjustment about its own axis. One method of securing this adjustability is indicated in Fig. 9, where the base 85 of the head is shown as firmly secured to a cylindrical shank 100 with the die 86 coaxial with such shank. The shank 100 is surrounded by a split eccentric sleeve 101 which is disposed in a second split eccentric sleeve 102 mounted in the cylindrical bore of a support 103 secured to the frame 25. The support 103 is split and provided with clamp screws 104 which, on being tightened, will compress the split sleeves 101 and 102 to hold the shank 100 and the head in fixed position. By rotational adjustment of the two sleeves the head may be moved transversely to any desired position within the range permitted by the eccentricity of the sleeves, and by turning the shank 100 in the inner sleeve the angular dispositions of the knots and offsets about the axis of the spring may be varied. By axial movement of the shank 100, the head can be disposed in proper position axially of the spring.

The head D may be identical with the head C in all respects, and the respective head-mountings may also be the same; but the gear 106 associated with the head D is rigidly mounted on the rear end of the shaft 40. (Fig. 1.)

The head C is mounted rearwardly and the head D forwardly of the path of travel of springs carried by the carrier G, each head facing toward the springs. (See Fig. 11.) It is because of this reversed disposition of the two heads that the chain was arranged to rotate the shaft 36 in a reverse direction.

Each of the heads C and D is disposed far enough out of the path of travel of the springs carried by the carrier G to permit the springs to clear the heads as the carrier rotates. Accordingly, it is necessary to associate with the carrier means by which each spring may successively be moved rearwardly into association with the head C and then, after indexing of the carrier, forwardly into association with the head D. For this purpose, I mount on the frame 25 of the machine a longitudinally reciprocable rod 115 disposed in line with the slide 54 which is supporting a spring opposite the head C. A similar rod 116 is supported from the frame 25 in line with the slide 54 which is supporting a spring opposite the head D. At its front end, each of the rods 115 and 116 is provided with an inwardly projecting transverse rib or flange 117 adapted to be received in a slot 118 extending transversely of the associated slide 54. At their rear ends, the rods 115 and 116 are provided with transverse slots which respectively receive pins 120 mounted on opposite ends of an oscillatable arm 121. The arm 121 is secured to a shaft 122 which has mounted upon it a cam-follower 123 received in the groove of a box cam 124 that is rigidly secured to the shaft 31. Normally the two rods 115 and 116 occupy the respective positions illustrated in Fig. 12, the ribs 117 on their front ends being disposed to be received in the grooves 118 of the slides 54 as the carrier intermittently rotates. Immediately after each indexing movement of the carrier, however, the cam 124 swings the shaft 122 and with it the arm 121 in a counterclockwise direction to move rearwardly the rod 115 and the slide 54 in line with it and forwardly the rod 116 and the slide 54 which it engages. By these movements of the rods 115 and 116, the spring opposite the head C is moved rearwardly into association with that head, while the spring opposite the head D is moved forwardly into association with the head D. To retain the slides 54 in normal position when they are not associated with the rods 115 and 116 I provide a stationary ring 119 supported from the frame of the machine in position to be received in the slots 118 of the slides as the carrier rotates. The ring 119 is interrupted at the rods 115 and 116 so as not to interfere therewith.

The normalizing apparatus previously referred to consists of two metal pads 126 and 127 which are electrically insulated from each other, and desirably also from the frame of the machine, and which are carried respectively on the forward ends of two rods 128 and 129. The rods 128 and 129 extend rearwardly through the frame 25 of the machine and are longitudinally reciprocable therein. At its rear end each of the rods 128 and 129 has mounted upon it a head 130 which is split longitudinally and provided with clamp screws 130' by means of which it can be secured in any desired position along its associated rod. The heads 130 are provided respectively with transverse grooves 131 which receive pins on the opposite ends of an oscillating arm 132. As will be clear from Figs. 5 and 6 the arm 132 is secured to the lower end of a shaft 133 suitably supported from the frame 25 of the machine and having rigidly secured to it at its upper end an operating arm 134. The arm 134 is slotted for the reception of a pin 135 mounted on a reciprocating member 136 which carries a cam-follower 137 co-operating with a cam 138 rotatable with the shaft 31.

The two pads 126 and 127, which are mounted in alinement in opposed relation, are normally spaced from each other by a distance somewhat greater than the length of the springs which the machine is to form, as will be clear from Fig. 3, and are so disposed about the axis of the carrier as to receive a spring between them when the carrier is at rest. At the completion of each indexing movement of the carrier, the cam 138 actuates the reciprocating member 136 and rocks the arm 132 to cause the two pads 126 and 127 to move toward each other to engage the opposite ends of the spring between them. The two pads are connected through cables 126' and 127' and a switch 139 (Fig. 1) with a source of electric current; so that current sufficient to heat the spring to normalizing temperature will flow, under control of the switch 139, through the spring after it has been compressed between the pads. The switch 139 is desirably automatically operated to control the period during which current flows through the spring, the drawings showing the switch as actuated by a cam on the shaft 29.

The spring-receiving and stacking mechanism F, the specific form of which constitutes no part of my invention, is desirably located at the station next to the normalizing apparatus E in the direction of carrier rotation. The receiving and stacking mechanism shown in the drawing comprises a pair of opposed plates 140 (see Fig. 11) spaced apart a distance somewhat less than the length of the springs formed in the machine and provided with guides 141 extending outwardly

from the carrier G. At their inner ends the plates 140 have wings 142 which diverge downwardly on opposite sides of the path traversed by springs in the carrier G so as to engage the ends of the successively presented springs and compress them to an over-all length equal to the distance between the plates 140 in order that they will be supported by pressure on their ends when the jaws 56–57 which hold them are released. A reciprocable member 143 (Fig. 1), driven in any convenient manner, operates to move each spring outwardly into the guides 141, after it has been released, to make room for the next spring.

The shape and function of the cam 71, which closes the jaws 56–57 at the winding mechanism B, maintains them closed until they reach the spring-receiving and stacking mechanism F, and then opens them, is perhaps best apparent from Figs. 1 and 4. The lobe of the cam has a circular periphery concentric with the carrier axis and an angular extent somewhat less than the interval between the coiling mechanism B and the spring-receiving and stacking mechanism F in the direction of carrier rotation. The normal or intermediate position of the cam is illustrated in Fig. 1, the retracted position in dotted-lines in Fig. 4, and the advanced position in full lines in Fig. 4. Throughout the major portion of the interval during which the carrier is at rest, the cam 71 occupies the normal or intermediate position in which it permits the jaws 56-57 at the coiler B and at the spring-receiving and stacking mechanism F to be open while maintaining closed the jaws at intermediate stations. As the coiling of each spring is completed, the cam 71 is advanced to the full line position shown in Fig. 4 to close the jaws 56–57 on the newly coiled spring, such advance of the cam being insufficient to open the jaws at the normalizing apparatus E. When the carrier indexes, the cam 71 moves with it to the dotted-line position shown in Fig. 4 to maintain closed the jaws which are carrying a spring from the normalizing apparatus E into association with the stacking mechanism F. After indexing movement of the carrier has been completed, the cam 79 advances the jaw-operating cam 71 to its intermediate position (Fig. 1) to release the jaws 56–57 at the stacking mechanism; and the cam 71 remains in such intermediate position until the coiler has completed a new spring, whereupon the sequence of operations just described is repeated.

The movement of each of the slidable members 54 in presenting a spring to each of the heads C and D carries the cam-following roller 72 on the slide 60 out of the plane of the cam 71; and it is necessary that the machine be so constructed as to prevent the jaws 56–57 on the axially displaced slidable members from opening to release their grip on the spring. To prevent release of the jaws upon rearward movement of the slidable members, I dispose the guides 53 so that the bottoms of their slide-receiving grooves are flush with the periphery of the lobe on the cam 71 (Fig. 8), and I dispose the guides 53 axially of the carrier so that the rollers 72 will engage them before leaving the cam 71. To prevent release of the jaws upon forward movement of each slide at the head D, I provide the cam 71, in the vicinity of the head D, with a forwardly extending projection 71' (Fig. 1) having an axial extent sufficient to support the roll 72 throughout its entire forward movement.

The sprockets 32' and 39, through which the respective heads C and D are driven, are desirably not mounted directly upon such heads; and because of the adjustability of the heads, it is therefore necessary to provide for adjustment of the sprockets. As shown in Fig. 2, the sprocket 32' and the drive sprocket of the chain drive 34, which are rigidly connected together, are rotatably mounted in the outer end of an arm 145 which is secured on the rear face of the frame 25 by means of screws 146. The screws 146 pass through slots 147 in the arm 145, such slots being long enough and wide enough to permit the sprockets supported by the arm 145 to be disposed in alinement with the driving gear 106 of the head C in any position which that gear may occupy in the adjustment of the head. The shaft 33 driven by the sprocket 32' is axially slidable therein, in order to accommodate for axial adjustments of the head C.

The sprocket 39, which drives the shaft 40 conveying power to the head D, is shown (Fig. 1) as mounted on the end of an arm 150 pivotally supported on a boss 151 projecting forwardly from the frame 25. Clamp screws 152 are provided to clamp the arm 150 in any desired position of adjustment about the boss 151, and the arm 150 is made adjustable in length in order to vary the distance between the axis of the sprocket 39 and the boss 151. To accommodate for axial adjustment of the head D the drive shaft 40 therefor, while rotatable with the sprocket 39, is axially slidable therein.

The idlers respectively associated with the chains 32, 34, and 38 have a range of adjustment sufficient to maintain proper tension in the chains irrespective of the positions in which the sprockets 32' and 39 are disposed.

Since the jaws 56–57 grip the wire of an individual turn of each spring, and since the length and pitch of springs made on the machine may vary, it is desirable that the carrier G be axially adjustable. In order to secure this result, I make the carrier head 49 axially slidable on the shaft 45, holding it in any desired position of adjustment thereon as by means of one or more set screws 155 (see Fig. 3). This axial adjustability of the head necessitates the axial adjustability of other portions of the machine, such as the cam 71, the slide-holding ring 119, the slide-operating rods 115 and 116, and the pad-moving rods 128 and 129.

Axial adjustment of the cam 71 may be obtained through the provision of collars 160 (Fig. 3) disposed on the farwardly projecting end of the shaft 70 between the front face of the cam and the head of a screw 161 which holds the cam in place on the shaft against the outer end face of the head 49. By removing one or more of the washers 160, the cam can be advanced on the shaft 70 with the carrier head 49 to any desired position.

Axial adjustment of the slide-holding ring 119 may be obtained by supporting it from the frame 25 through the medium of one or more ears 163 (Fig. 3) which project axially from the ring 119 and are provided with elongated slots through each of which there passes a screw 165 holding the ring in place on the frame 25.

Variation in the effective length of each of the rods 115 and 116, which is necessary if the carrier is to be axially adjustable, may be secured by making each of such rods in two sections interconnected by a screw 166 mounted in one rod-section through left-hand threads and in the other rod-section through right-hand threads.

A lock nut 167 mounted on one end of the screw 166 and co-operating with one of the sections of the associated rod serves to maintain the screw 166 in any desired condition of adjustment.

As previously pointed out, each of the pad-moving rods 128 and 129 is longitudinally adjustable relative to the associated block 130. This adjustment permits the pads 126 and 127 to be disposed in proper relation to the carrier G irrespective of its axial position, and also makes possible control of the pressure exerted upon the springs while they are being normalized.

In operation, wire is fed to the machine by the feed rolls 28, is coiled into the desired spring-shape, and cut off in known manner. During the spring-coiling operation the carrier G is at rest with one of its arms directed toward the spring being coiled and with the jaws 56—57 open and prepared to grip the wire of the spring near the midpoint thereof. As the spring is completed, the shaft 70 will be oscillated by the cam 79 and the consequent movement of the cam 71 will raise the slide 60 and cause the jaws 56—57 to grip the newly formed spring. For the purpose of locating the spring in proper position in the jaws 56—57, I may provide a normally retracted spring-support 170 (Fig. 1) which is automatically operated, as by a cam on the shaft 29, so as to swing downwardly into spring-supporting position just prior to closing of the jaws 56—57. Immediately after closing of the jaws 56 and 57, the spring may be severed from the stock wire.

In the arrangement illustrated in the drawings, two successive indexing movements of the carrier G are required to carry the spring from its initial position to a position in alinement with the head C, but such an arrangement is not necessary. As the carrier comes to rest with the spring in line with the head C, the cam 124 and rod 115 operate to move the carrier arm 55 bodily rearwardly to move the spring into association with the head C, the various parts of which are then actuated to form the desired knot and offsets in the rear end turn of the spring. Before the next indexing movement of the carrier occurs, the cam 124 operates to restore the rod 115 and arm 55 to normal position.

The next indexing movement of the carrier moves the spring from alinement with the head C into alinement with the head D; and when the cam 124 subsequently oscillates the arm 121, the rod 116 is moved forwardly to bodily translate the associated slide 54 and move the arm 55 whereby to bring the spring into association with the head D, the various parts of which operate to form the desired knot and offsets in the forward end of the spring.

In the arrangement shown in the drawings, two indexing movements of the carrier are necessary to carry the spring from the head D to the normalizing apparatus E; but this two-step separation of the head D and the normalizing apparatus E, while convenient, is not essential. While the carrier is at rest with the spring in association with the normalizing apparatus, the cam 138 operates in the manner previously described to move the pads 126 and 127 toward each other into engagement with the spring between them, and an electric current passed through the spring heats it to normalizing temperature. Before the next indexing movement of the carrier occurs, the cam 138 separates the pads 126 and 127 so that the spring will be free to move.

By proper adjustment of the spring coiling mechanism B in known manner considerable variations in form, including variations in length, pitch, and diameter, may be imparted to the springs coiled thereby. Since the jaws 56—57 grip only a portion of one turn of each spring, the distance between the axis of the spring and the axis of the carrier G will depend on the diameter of the spring-turn gripped by the jaws. Whatever that distance may be, the eccentric sleeves 101 and 102 through which each of the heads C and D is mounted may be adjusted so that each head may be brought into coaxial relation with the springs presented to it. The pads 126 and 127 may be made large enough to accommodate them for different radial dispositions of the springs presented for normalizing.

Variations in length or pitch of the springs which the machine produces may make it necessary to adjust the carrier G axially on the shaft 45 in order that the jaws 56—57 at the spring-coiling station will be disposed in position to grip a spring-turn between them. Adjustment of the jaws about the axis of the shank 65 permits the spring-axis to be brought into co-planar relationship with the carrier axis, irrespective of the pitch of the spring.

Through the angular adjustment of each head C about its axis it is possible to regulate the relative dispositions about the spring-axis of the offsets and knots in the opposite end coils of the spring and to compensate for torsional changes in the spring which result from the normalizing operation.

I claim as my invention:

1. In a machine of the type described, a rotatable spring-carrier having an annular series of equally spaced radiating arms each equipped at its outer end with spring-gripping jaws, spring winding mechanism and two stationary knotters disposed at stations spaced about the axis of said carrier, means for intermittently rotating said carrier to convey springs gripped in said jaws from said winding mechanism successively to the first knotter, to the second knotter, and to a discharge station located between the second knotter and said winding mechanism, said knotters being disposed on opposite sides of the path of travel of springs carried by said carrier and far enough removed therefrom to clear such springs as the carrier moves, means associated with said two knotters for bodily moving carrier-arms thereat axially in opposite directions to bring the springs carried by said arms into operative relation with said knotters respectively, and mechanism operative in timed relation with said carrier for closing the jaws on the arm at said winding mechanism as such mechanism completes the winding of a spring, for maintaining the jaws closed until the discharge station is reached, and for thereupon opening the jaws.

2. The invention set forth in claim 1 with the addition that each of said knotters is mounted for adjustment toward and away from the path of springs carried by said carrier.

3. The invention set forth in claim 1 with the addition that each of said knotters is mounted for adjustment in a plane parallel to the path of springs carried by said carrier.

4. The invention set forth in claim 1 with the addition that each of said knotters is mounted for angular adjustment about the axis of a spring associated therewith.

5. In a device of the type described, a spring winding mechanism, a pair of stationary knotters for successively forming knots in the opposite end coils of each spring wound by said winding mech-

anism, and a rotatable conveyor for moving each spring from said winding mechanism, a portion thereof being axially bodily movable for carrying each of said springs successively from one knotter to the other knotter, said knotters being disposed on opposite sides of the path traversed by the springs in their movement by said conveyor, said knotters and conveyor each being adjustable perpendicularly to the path of spring movement.

6. The invention set forth in claim 5 with the addition that said conveyor is provided with an annular series of spring-gripping jaws.

7. In a device of the type described, a frame, spring winding mechanism on said frame, a rotatable carrier mounted in said frame and disposed with its axis parallel to that of springs wound by said winding mechanism, a stationary knotter, spring-gripping jaws mounted on said carrier, means for intermittently rotating said carrier to convey a spring from said winding mechanism to said knotter and therebeyond to a discharge station, means operable in timed relation to said carrier-rotating means for closing said jaws upon a spring at the winding mechanism, for holding the jaws closed until the spring reaches the discharge station, and for then opening the jaws, said knotter being disposed at one side of the path followed by the spring in rotational movement of the carrier and being adjustable parallel to such path, and means for bodily moving said jaws and a spring carried thereby axially of the carrier into association with said knotter.

8. The invention set forth in claim 7 with the addition of means supported from said frame for retaining said jaws in fixed position axially of the carrier except when they are disposed at said knotter.

9. In a machine for producing helical springs, a frame, a spring-coiler on said frame, a rotatable conveyor for conveying coiled springs from said coiler, said conveyor being rotatable about an axis substantially parallel to the axes of springs formed by said spring-coiler, a pair of stationary mechanisms for forming the opposite end turns of springs coiled by said coiler, said mechanisms being disposed at points spaced along the path of travel of springs moved by said conveyor and being disposed on opposite sides of such path of travel, and means for moving said conveyor intermittently to bring each spring successively into alinement with said forming mechanisms and for bodily moving a portion of the conveyor axially so that the spring is in engagement with the forming mechansm, each of said forming mechanisms being supported from said frame for angular adjustment about the axis of a spring brought into alinement with it in the movement of said conveyor.

10. In a machine for producing helical springs, a frame, a spring-coiler on said frame, a rotatable conveyor for conveying coiled springs from said coiler, said conveyor being rotatable about an axis substantially parallel to the axes of springs formed by said spring-coiler, stationary mechanism for forming an end turn of each spring coiled by said coiler, said mechanism being spaced from said coiler, and means for moving said conveyor intermittently to bring each spring into alinement with said forming mechanism and for bodily moving a portion of the conveyor axially so that the spring is in engagement with the mechanism, said forming mechanism being supported from said frame for adjustment about the axis of a spring brought into alinement with it in the movement of said conveyor.

11. The invention set forth in claim 10 with the addition of means, disposed in the path of spring travel beyond said forming mechanism, for heating each spring to normalizing temperature.

12. In a machine for forming helical springs, a spring-coiler, a rotatable carrier having an annular series of pairs of spring-gripping jaws, means for rotating said carrier intermittently to convey springs from said carrier to a discharge station, and jaw-operating means for opening the jaws at the discharge station immediately after the carrier comes to rest following each movement and for later closing the jaws at the coiler, said jaw-operating means including a cam co-axial with said carrier and means operative in timed relation with said carrier-moving means for moving said cam forwardly with said carrier and then for moving said cam in the opposite direction while the carrier is at rest.

13. In a device of the type described, a spring winding mechanism, a pair of stationary knotters for successively forming knots in the opposite end coils of each spring wound by said winding mechanism, and a rotatable conveyor for moving each spring from said winding mechanism, a portion thereof being axially bodily movable for carrying each of said springs successively from one knotter to the other knotter, said knotters and conveyor each being adjustable perpendicularly to the path of spring movement.

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