

Jan. 30, 1940.

F. J. HORTON

2,188,406

MACHINE FOR FORMING SPRINGS

Filed Aug. 12, 1935

5 Sheets-Sheet 1

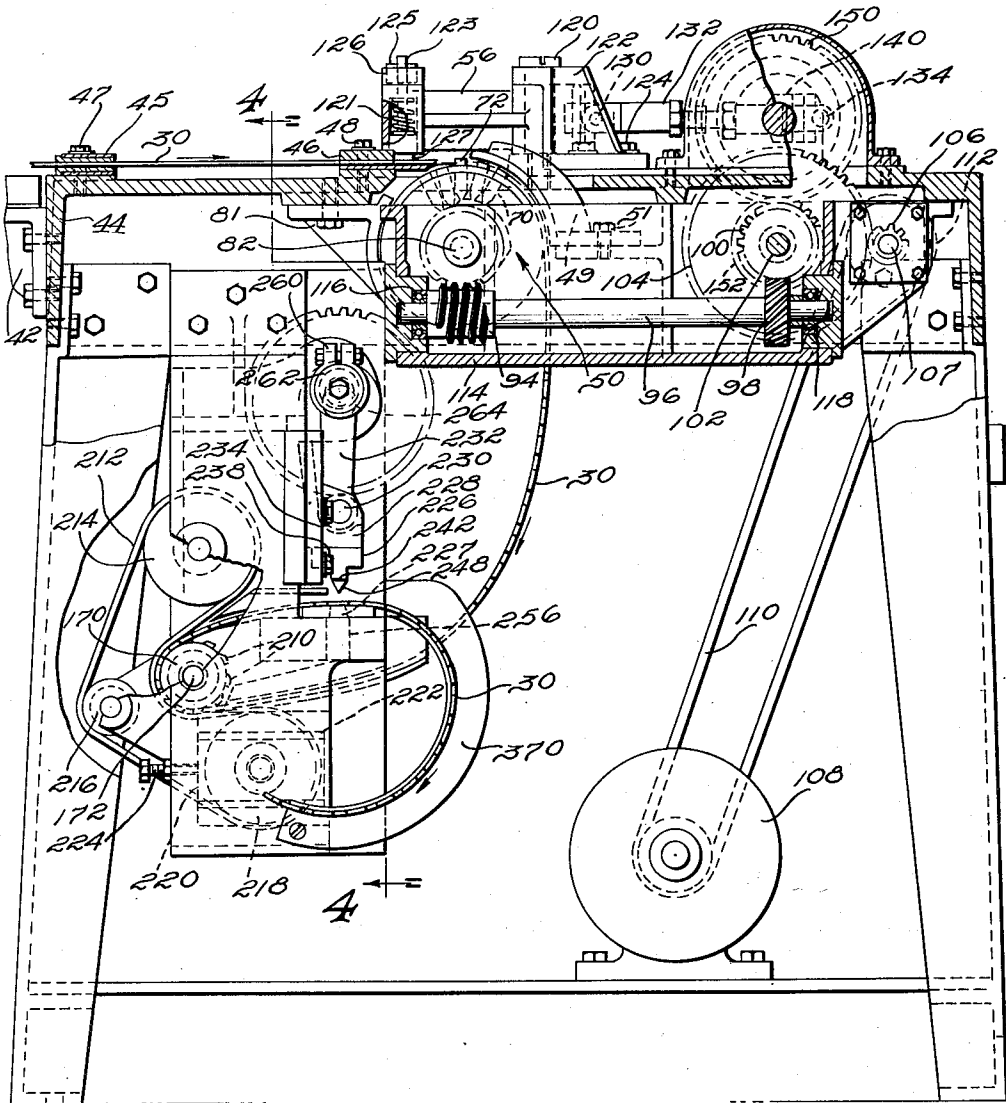


FIG. 1.

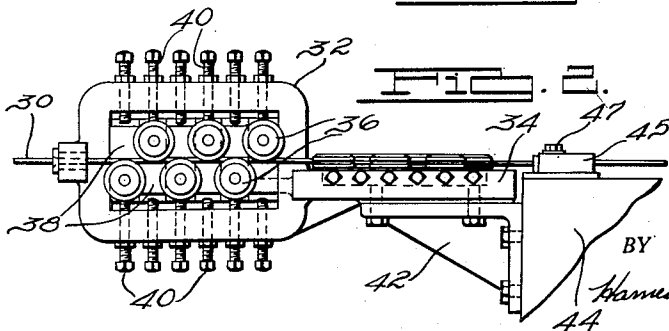


FIG. 2.

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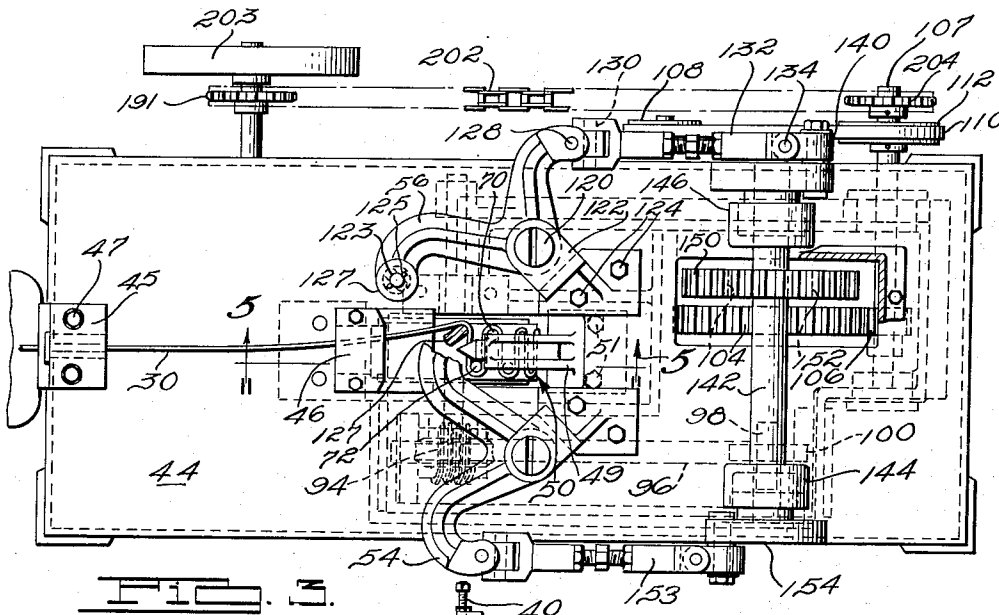
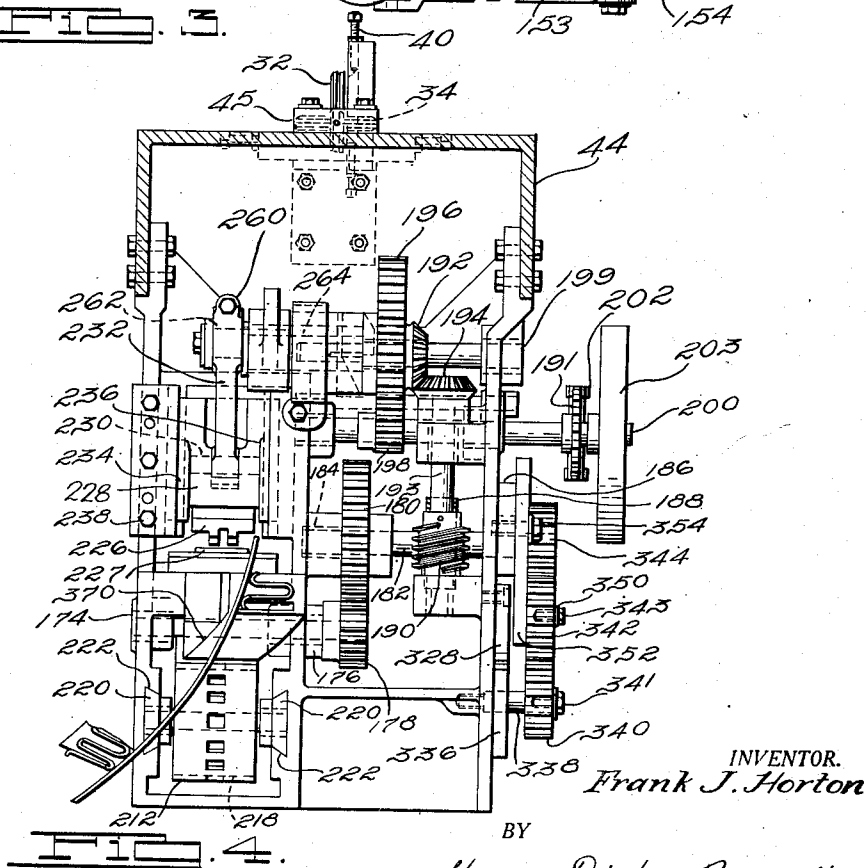
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5 Sheets-Sheet 2



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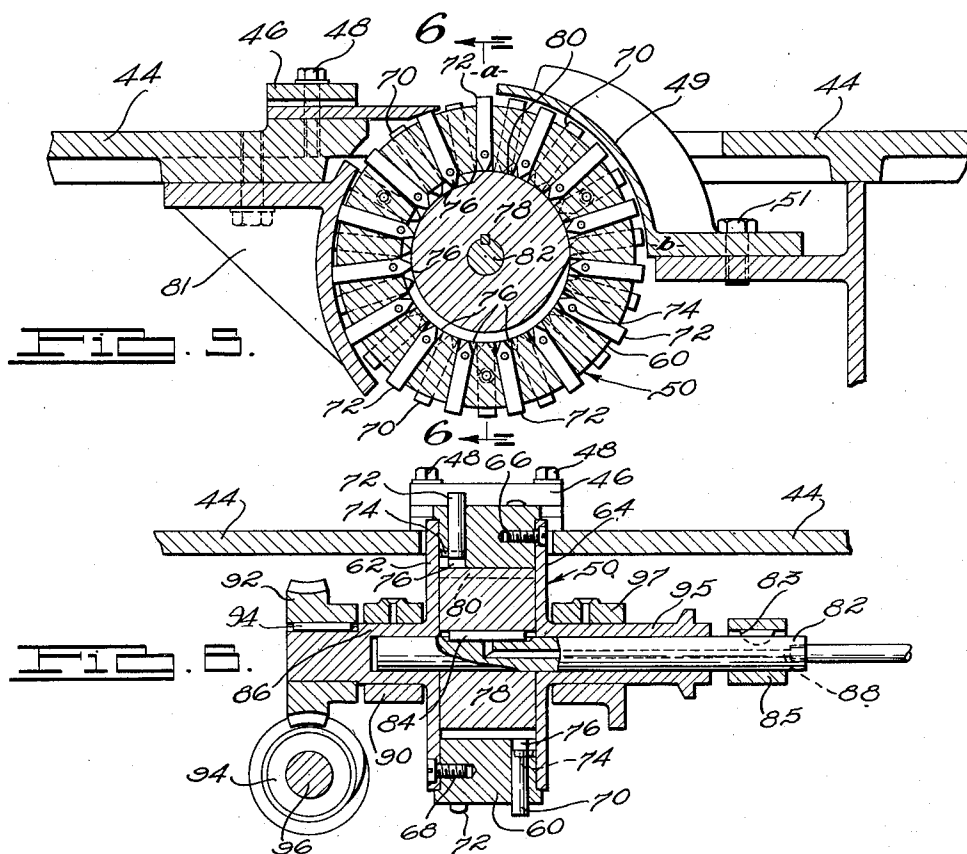
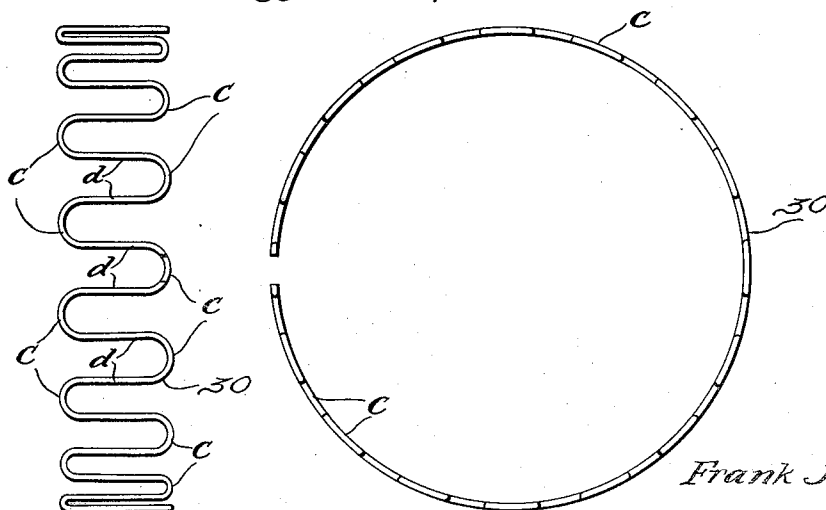
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MACHINE FOR FORMING SPRINGS

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5 Sheets-Sheet 3



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MACHINE FOR FORMING SPRINGS

Filed Aug. 12, 1935

5 Sheets-Sheet 4

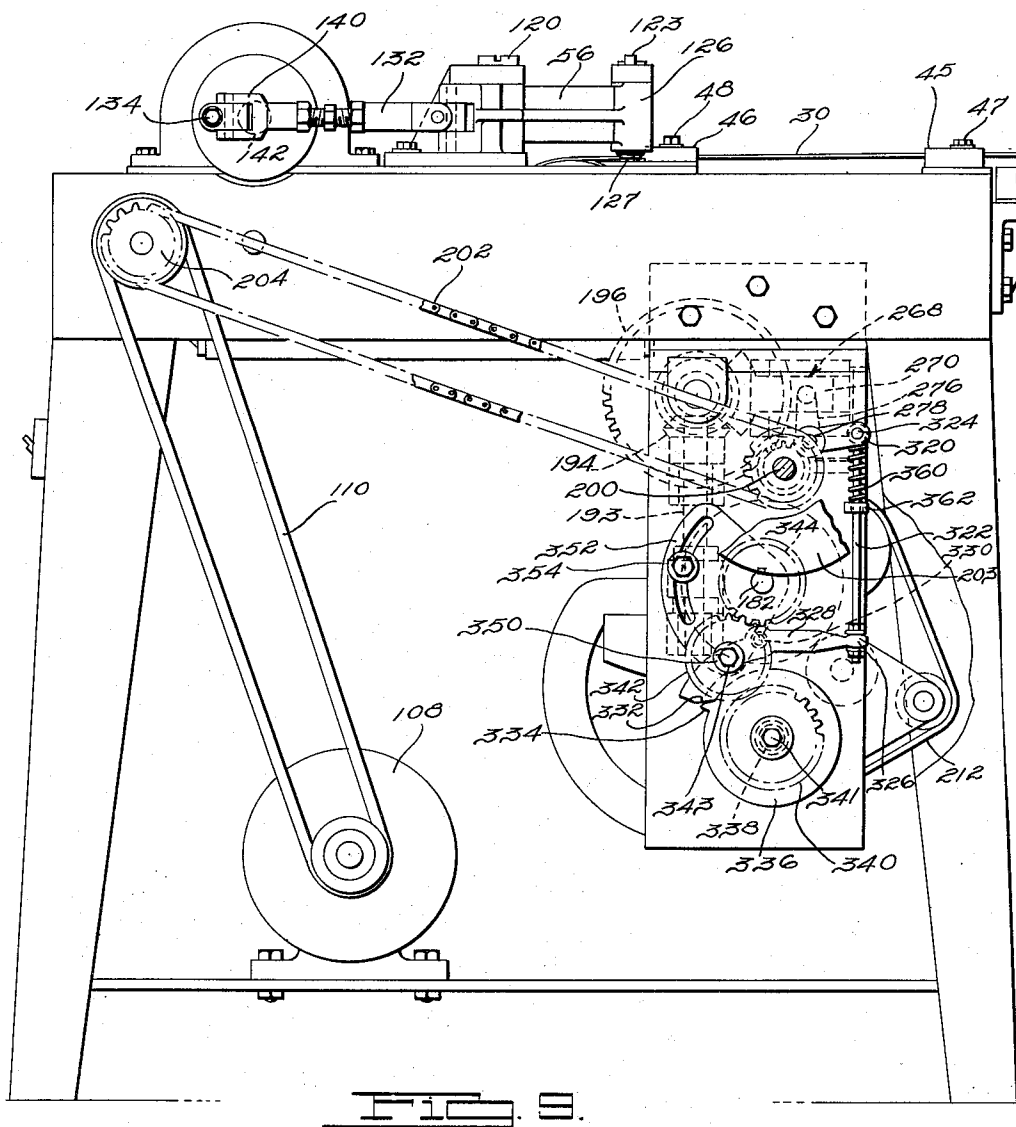


FIG. 9.

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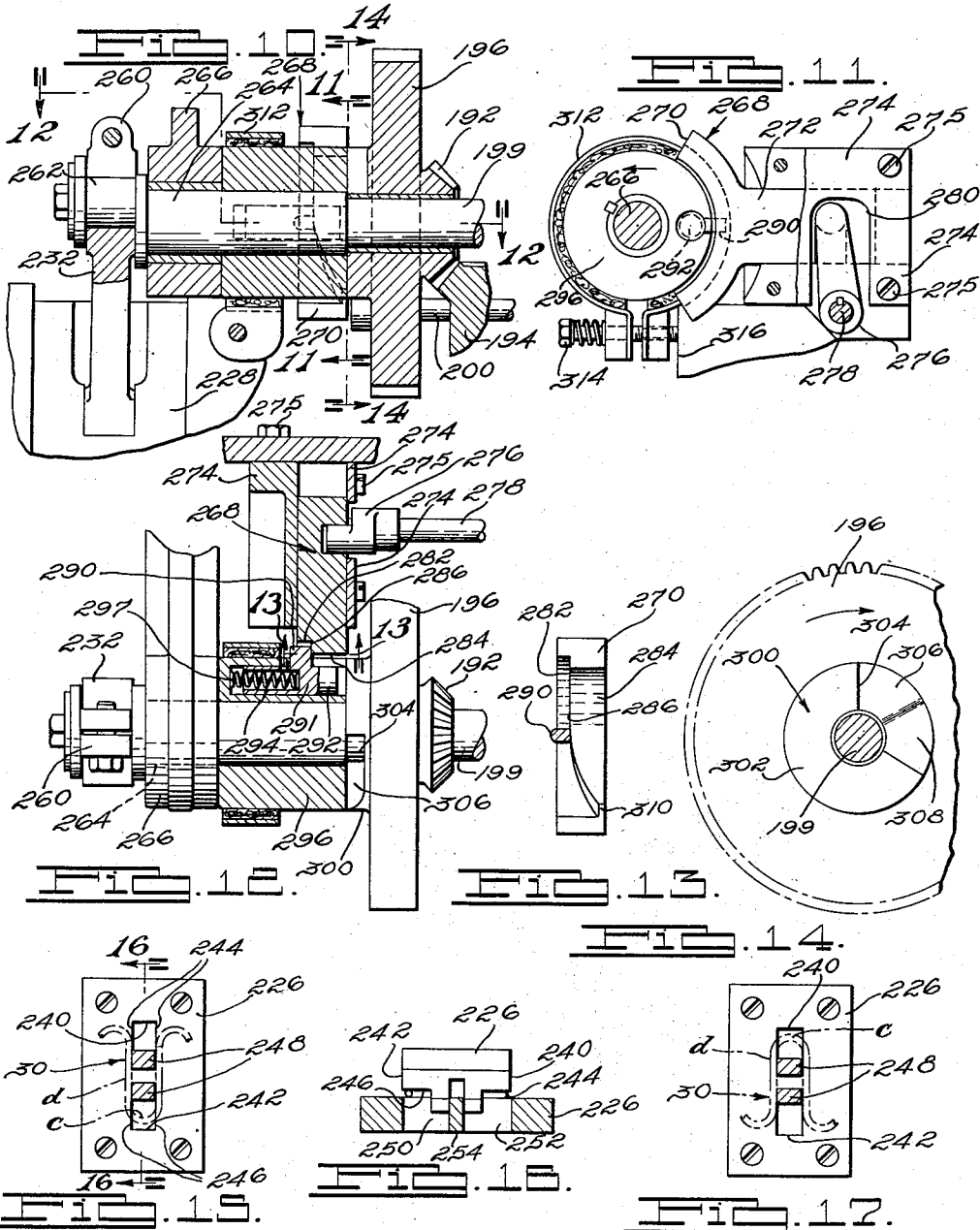
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MACHINE FOR FORMING SPRINGS

Filed Aug. 12, 1935

5 Sheets-Sheet 5



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UNITED STATES PATENT OFFICE

2,188,406

MACHINE FOR FORMING SPRINGS

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Application August 12, 1935, Serial No. 35,705

11 Claims. (Cl. 153—2)

The present invention relates to the formation of springs, and more particularly to the formation of flat springs which are longitudinally arched, and which embody a plurality of sinuous lateral turns.

It is an object of the present invention to provide a method and machine for making springs which include a longitudinal arch of predetermined radius and a plurality of sinuous lateral turns.

It is a further object of the present invention to provide a machine for forming a succession of sinuous lateral turns in spring stock.

It is a further object of the present invention to provide a machine for forming a longitudinal arch of predetermined radius in spring stock.

It is a further object of the present invention to provide a machine as above stated, and embodying mechanism to simultaneously introduce sinuous lateral turns and longitudinal arching into spring stock.

It is a further object of the present invention to provide a machine of the last mentioned type in which the forming mechanism comprises a rotatable forming wheel having extendible fingers spaced in accordance with the desired spacing between lateral turns of the springs, and embodying arms movable axially of the wheel to wind the spring stock about the forming wheel fingers.

It is a further object of the present invention to provide a machine for forming stock into springs, and embodying mechanism to condition the spring stock for treatment by mechanism of the type stated above.

It is a further object of the present invention to provide a wire forming machine embodying supplementary mechanism to modify the radius of the longitudinal spring arch, as preset by the above stated forming mechanism.

It is a further object of the present invention to provide a machine for forming springs in which spring stock is fed continuously through the machine and embodying mechanism to cut the completed spring stock to lengths embodying any selected number of lateral turns.

It is a further object of the present invention to provide spring stock cutting mechanism, for use separately or in combination with a spring forming machine as above stated, embodying cutting knives adapted to cut the spring stock at any desired point along lateral turns formed therein.

It is a further object of the present invention to provide cutting mechanism for cutting to

lengths springs of the above stated type and embodying means to accurately position the spring stock with respect to the cutting edges.

It is a further object of the present invention to provide cutting off mechanism for spring stock of the above stated type, constructed to selectively cut at either end of the lateral turns.

It is a further object of the present invention to provide cutting-off mechanism for spring stock and embodying improved driving mechanism therefor.

It is a further object of the present invention to provide cutting off mechanism of the last mentioned type and embodying an improved form of automatic clutch between the driving source and the cutting head.

It is a further object of the present invention to provide a machine for converting spring stock into longitudinally arched springs having spaced lateral turns, including mechanism for cutting off predetermined lengths of such spring stock, and embodying improved means to operate the forming and cutting off mechanism in timed relation.

It is a further object of the present invention to provide a wire forming machine of the last mentioned type, in embodying means to readily adjust the machine to provide for cutting off different lengths of completed spring stock.

Other objects and advantages of the present invention appear in the following description and in the appended claims.

Claims to the improved cutting off mechanism per se are presented in applicant's copending application, Serial No. 250,612, filed January 12, 1939, and assigned to the same assignee as the present application.

In the drawings, throughout which corresponding reference characters are used to designate corresponding parts,

Fig. 1 is a view in front elevation of a spring forming machine embodying the present invention;

Fig. 2 is a fragmentary top plan view of a preferred form of auxiliary device for conditioning the spring stock for treatment;

Fig. 3 is a top plan view, with certain of the parts broken away of the structure illustrated in Fig. 1;

Fig. 4 is a view in vertical section taken along the line 4—4 of Fig. 1;

Fig. 5 is a view in vertical section taken along the line 5—5 of Fig. 3;

Fig. 6 is a view in vertical section taken along the line 6—6 of Fig. 5;

Fig. 7 is a top plan view of a completed spring illustrative of the product of the machine of the present invention;

Fig. 8 is a view illustrating a length of spring stock, having the longitudinal curvature and lateral turns provided by the machine of the present invention, and in condition to be cut to length;

Fig. 9 is a view in rear elevation of the structure shown in Fig. 1 and illustrating particularly the timing mechanism and the drive mechanism for the cutting off elements of the present invention;

Fig. 10 is a fragmentary view in vertical section of an improved clutching device which may be used to control the cutting head;

Fig. 11 is a view in vertical section taken along the line 11—11 of Fig. 10;

Fig. 12 is a view in horizontal section taken along the line 12—12 of Fig. 10;

Fig. 13 is a view taken along the line 13—13 of Fig. 12;

Fig. 14 is a view taken along the line 14—14 of Fig. 10;

Fig. 15 is a detailed view of the cutting knives forming part of the cutting off mechanism;

Fig. 16 is a view in vertical section taken along the line 16—16 of Fig. 15; and

Fig. 17 is a view corresponding in general to Fig. 15 and illustrating a cutting off action at opposite ends of lateral turns.

In the form illustrated, the spring forming machine of the present invention is designed particularly to form springs of the type disclosed and claimed in the Kaden Patent No. 2,002,399, granted May 21, 1935. Such springs are of the flat type, are arched longitudinally about a radius which either exceeds or is less than the radius of the spring when put to use, and include a plurality of sinuous lateral turns. Springs of this character have the characteristic of retaining their resiliency and of returning to their original shape, even though temporarily bent in use into an arch of opposed radius. As will be apparent from an understanding of the present invention, however, many of the features thereof are applicable to the formation of springs having other structural features.

In the form illustrated, the improved machine of the present invention comprises, generally, spring stock conditioning elements, elements for forming the spring stock into longitudinally arched, laterally turned formation, elements for modifying or reforming the longitudinal radius of curvature and elements for automatically cutting off the completed spring stock to desired lengths. The spring stock is fed continuously through the above enumerated elements in the order named, which are driven in continuous timed relation.

In the illustrated form of the present invention, the conditioning elements, which are disposed to act upon the unformed spring stock just prior to its delivery to the forming mechanism, comprise a series of grooved rollers between which the spring stock is passed, and which act to straighten the wire and relieve stresses therein. The straighteners may comprise a series of rollers and cooperating opposed blocks spaced in the direction of feed of the spring stock, which straighten the stock. If desired, the rollers may be staggered somewhat so that as the stock passes between them it is subjected to a mild working by being flexed in opposite

directions. Preferably, and as illustrated, one straightening unit is provided to act in one plane and a succeeding unit is provided to act in a plane normal to the first mentioned plane.

After passing through the straightening mechanism, the straight spring stock passes through suitable guides and is then passed partially around the periphery of a forming wheel, in the course of which passage the sinuous lateral turns and the longitudinal arch are formed in it.

The forming wheel preferably comprises a circular member driven in step by step movement by suitable driving mechanism described hereinafter. The forming wheel also includes two series of radially disposed forming fingers, the two series of fingers being spaced axially of the wheel a distance equal to the desired length of lateral turn of the spring stock. The fingers in each series are angularly spaced on the periphery of the wheel a distance double the width of the desired lateral turns in the completed spring stock. The fingers of the two series are staggered with respect to each other, the fingers of one series being provided to form the turns at the other side of the completed spring stock.

Suitable camming mechanism is provided to extend and retract the fingers outwardly from and into the forming wheel. Each finger reaches an initial forming point in the retracted condition, and is there extended to cooperate with the spring stock. Just prior to the extending movement of such finger, one of a pair of folding cams engages the spring stock and folds it axially of the forming wheel to a position past such one finger. The extended finger and cam are in vertical alignment, and the finger retracts the cam against the force of a spring bias. The extended finger retains the spring stock in the position in which it is moved by the cam. The forming wheel is then indexed one more step, bringing the next finger of the other series to the initial forming position. At this time, the other of the folding cams engages the spring stock and folds it axially of the forming wheel but in a direction opposite to that of the first folding movement. This folding movement brings the spring stock past such last mentioned finger which is then extended to retain the wire in the folded position. The next indexing movement of the forming wheel brings another finger of the first series into operating position, at which time the first folding cam folds the spring stock past such finger, after which such finger is extended to retain the stock. In this manner, the folding cams swing back and forth successively in timed relation to the indexing of the forming wheel and wind the spring stock about the successively extended fingers. In the form illustrated, the spacing between the respective fingers and the radius of curvature of the turned portions of the successive turns of the stock is such that the straight portions of the respective turns are parallel to each other although, as will appear from further description, other relationships are possible.

Suitable guide mechanism is provided adjacent the forming wheel to retain the spring stock in engagement with the periphery of the forming wheel, so that the forming wheel is advanced as the spring stock is longitudinally arched about a radius substantially equal to the radius of the forming wheel. This guiding mechanism causes the spring stock to follow the forming wheel

through substantially one-quarter revolution thereof, after which it is released from the forming wheel and is directed by suitable guiding mechanism to a reforming wheel which, in certain applications of the machine, is desirable to still further reduce the longitudinal radius of curvature of the spring stock. After the spring stock is released from the forming wheel, the extended fingers are suitably retracted into the forming wheel, by mechanism illustrated as comprising a cam which forces the fingers inwardly against an outward spring bias.

The reforming or reducing mechanism may be arranged in various ways, and as illustrated, comprises a forming wheel, suitably driven in accurate timed relation to the movement of the first forming wheel, and which is provided with a plurality of spaced tooth-like projections which are spaced to cooperate with the spaces between turns of the spring stock, and advance the stock. Mechanism is provided to cause the spring stock to follow the curvature of the reforming wheel throughout a portion of a revolution thereof.

The continuous length of spring stock, longitudinally arched and laterally folded, as above stated, is fed by the reforming or reducing wheel directly to the cutting-off mechanism, which, as illustrated, comprises a cutter having two pairs of spaced cutting edges, the edges of each pair being spaced apart substantially the width of each lateral turn, and being disposed to cut in a direction parallel to the straight portions of each turn. One pair of cutting edges operates at one side of the spring and the other cutting edge operates at the other side of the spring, so that completed springs having either an odd or an even number of turns may be produced.

The cutting off mechanism is driven in accurate timed relation to the step by step movements of the initial and reducing forming wheels under control of a series of timing gears which are replaceable. The driving mechanism for the cutting head also includes an improved form of cutting head clutch actuated by the timing mechanism, and by which the cutting head may be connected to a continuously rotated member. For each cutting operation, the cutting head is clutched to the driving force long enough to effect a complete reciprocation thereof, after which the clutch automatically releases and is not again rendered effective until the desired number of lateral turns of spring stock, as determined by the timing mechanism, has passed by the cutting head.

Conditioning mechanism

Considering the above mentioned elements in more detail, and referring first to Fig. 2, the spring stock 30 is fed from any suitable source of supply (not shown) to conditioning mechanism comprising a pair of mutually normal straightening units 32 and 34 respectively. Unit 32 is illustrated as comprising two series of parallel rollers 36, disposed in staggered relationships, each roller being opposed by a cooperating presser block 38. The position of the rollers 36 as well as of the blocks 38 is adjustable by adjusting studs 40. Mechanism of this type is well known, and it will be understood that as the stock 30 is fed between the successive rollers, it may either be straightened, or may also be flexed somewhat and, hence, mildly worked. The unit 34 is preferably a duplicate of the unit 32, but is disposed to act upon the stock 30 in a plane normal to that effected by unit 32. Both

units 32 and 34 are supported on a bracket 42 rigidly secured to the frame 44 of the forming machine in any suitable manner. The stock 30 emerges from the units 32 and 34 in substantially straight form, any curvature given the stock by the supply mechanism (not shown) being eliminated therefrom.

After leaving the straighteners, the stock passes through a first guide 45, secured to frame 44 by a stud 47, and through a second guide 46 similarly secured to frame 44 by studs 48 (Fig. 1).

Forming mechanism

Referring particularly to Figs. 1, 3, 5 and 6, the forming mechanism comprises generally the forming wheel designated as a whole 50, mounted for rotation about a horizontal axis, a pair of folding arms 54 and 56 pivotally mounted for swinging movement transverse to the path of movement of stock 30 around wheel 50; and a guide 49 secured to the machine frame by studs 51, which guide serves to retain the laterally folded stock in peripheral engagement with wheel 50 and thereby introduce a longitudinal arch in the stock.

As best shown in Figs. 5 and 6, wheel 50 comprises a ring-like element 60 to which side plates 62 and 64 are suitably secured, as by studs 66 and 68. Two series of regularly spaced radial openings are formed in ring 60, each opening in one series accommodating a finger 70, and each opening in the other series accommodating a finger 72. The fingers 70 and 72 of the two series are staggered, so that in traversing the periphery of wheel 50, the fingers of the two series alternate in regularly spaced relationship. The fingers 70 are disposed on one side of a vertical central plane through wheel 50, and the fingers of 72 are disposed on the other side of such vertical central plane. Each finger 70 and 72 slides relatively freely in the associated radial opening in ring 60, outward movement thereof from ring 60 being limited by a stop pin 74, fitted into each finger and disposed for movement in a cooperating radial recess formed in ring 60. The inner ends of each of the fingers 70 and 72 is chamfered to provide opposite cam surfaces 76, for cooperation with a stationary cam member 78, the periphery of which includes a raised cam portion 80, disposed to be engaged by the cam surfaces 76 of the fingers 70 and 72, and extend such fingers. The relation is such that during the travel of a finger of either series from the position designated *a* in Fig. 5 to a position designated *b* in the same figure, such finger is maintained in an extended position, in which the outer end thereof extends a predetermined distance beyond the periphery of ring 60; and during the remainder of the travel of such finger, it is enabled to occupy a retracted position, in which the outer end is substantially flush with the periphery of ring 60. A suitable retracting cam 81 secured to the machine frame is provided for engagement by the fingers to effect the retracting thereof.

Cam 78 is non-rotatably secured upon a shaft 82, by a key 84. One end of shaft 82 is non-rotatably secured by a key 83 in a support 85 which may form a portion of the machine frame. The other end of shaft 82 is supported in the boss portion 86, forming part of end plate 62. Preferably, and as illustrated, shaft 82 is hollowed out to form a lubricant duct 88.

End plate 62 includes the integrally formed

boss portion 86, mentioned above, which is rotatably supported in the bearing 90, which may form a part of the machine frame and to the outer end of which a worm wheel 92 is non-rotatably secured by a key 94. Plate 50 includes a similar boss portion 95, rotatably supported in a bearing 97 which may also form a portion of the machine frame.

Suitable intermittent or step by step motion is imparted to worm wheel 92 through a worm 94 supported for rotation by a shaft 96 which, as best shown in Figs. 1 and 3, also carries a helical gear 98. Gear 98 mates with a corresponding helical gear 100, supported for rotation by a main drive shaft 102. Shaft 102 also carries a third gear 104, suitably driven by a cooperating pinion 106. Pinion 106 is secured upon a shaft 107, continuously driven by a main driving motor 108 through a suitable belt 110 and pulley 112. Shaft 96 is suitably supported in the machine frame portion 114 within ball bearing unit 116 and 118, and it will be understood that shaft 102 may be correspondingly supported within the machine frame.

The respective teeth of worm gear 94 are given a lead only throughout a portion of the periphery of the worm. With this arrangement, as will be understood, continuous rotation of worm 94 in response to the continuous rotation of drive shaft 102 and the intermediate gearing as above described, effects rotation of worm wheel 92 only during the portion of each revolution of worm gear 94 that the teeth of the latter are given a lead. Accordingly, continuous rotation of worm gear 94 results in an intermittent or step by step movement of worm wheel 92, and consequently of the forming wheel 50.

It will be understood that the driving relation between forming wheel 50 and drive shaft 102, is such that each step by step movement of forming wheel 50 moves a finger such as 72 of one series one step from the initial position shown as *a* in Fig. 5, and brings the next finger, such as 70, of the other series to such initial position.

Referring particularly to Figs. 1 and 3, folding arm 56 is of the bell crank type, pivotally connected by a pin 120 to a standard 122, which may be secured to the machine frame portion 44 in any suitable manner, as by the studs 124. The outer end of one of the arms of bell crank 56 is provided with a boss portion 126 in which a cam 127 is slidably supported, and is biased downwardly to an extended position by a spring 121. The shank 123 of cam 127 extends upwardly through an opening formed in the top of boss portion 126, and receives a locking pin 125 which is disposed in a groove in the upper surface of boss 126. Pin 125 prevents rotation, limits downward movement, of cam 127. Cam 127 functions, as later described, to wind the stock about the fingers 72. The outer end of the other arm of bell crank 56 is forked and is universally connected to the forked end of a connecting rod 132 of suitably adjustable length by pins 128 and 130. The other end of connecting rod 132 is pivotally connected by pin 134 to crank arm 140, which is secured for rotation by the outer end of a shaft 142, the opposite ends of which are suitably journaled in the machine frame within the bearing bosses 144 and 146. Shaft 142 carries a gear 150 which mates with a smaller gear 152, carried on the previously described continuously driven main drive shaft 102.

With this construction, it will be understood that in response to the continuous rotation of

shaft 102 and crank arm 140, bell crank 56 is intermittently swung inwardly from the position illustrated in Fig. 3 to a position in vertical alignment with the initial forming position of the fingers 72. The timing relationship is such that bell crank 56 is brought to the inner or operating position and begins return movement from such position, just slightly in advance of the movement of a finger 72 into the initial forming position.

The other bell crank arm 54 is identical in construction with bell crank 56 and includes the forming cam 150. Arm 54 is universally connected to a connecting rod 153 which is in turn universally connected to a crank arm 154, continuously driven by shaft 142. It will be noted that crank arms 140 and 154 associated with bell crank 56 and 54 respectively are spaced 180° apart, so that arms 54 and 56 swing inwardly and outwardly in alternate relationship. The timing of arm 54 is such, accordingly, that cam 150 is brought to the position illustrated in Fig. 3 and is slightly retracted therefrom, just slightly in advance of the movement of a finger 70 to the initial position designated *a* in Fig. 5.

With reference to the operation of the forming elements, as above described, a forming operation of spring stock 30 is begun by feeding such stock through the previously described roller leveler elements 32 and 34, through the guides 45 and 46, and bringing the leading straight end of the stock between and past sufficient of the extended fingers 70 and 72 of forming wheel 50, to prevent withdrawal of the stock from between the fingers in response to the operation of the first of the forming cams 127 and 150 to operate and form an initial bend. In the form illustrated, the stock is drawn from the supply source and through the roller leveler units 32 and 34 by the action of the forming mechanism. Preferably, therefore, in beginning a forming operation, the roller leveler adjusting screws 40 are withdrawn sufficiently so that the straight stock 30 may be freely passed through these units and connected to the forming mechanism. After the machine has been placed in operation, the roller levelers may be tightened down. It will be understood that the initial output of the machine may be discarded by cutting it away at a point between the forming mechanism and the cutting off mechanism.

It will also be understood that the machine normally operates upon a continuous length of wire and that an unusual starting operation of the above described character is necessary only where a free end is introduced to the machine. It has been found desirable in the practice of the present invention, accordingly, to interrupt the operation of the machine prior to the exhaustion of one supply, so that the free end of such supply may be suitably connected as by butt welding to the leading end of the next supply of straight stock.

Upon the starting of the machine, and with the straight spring stock 30 passing between guide 49 and the periphery of wheel 50, and between the two rows of fingers 70 and 72, it may be assumed that bell crank 54 rotates to the position illustrated in Fig. 3, during the course of which movement the spring stock 30 is engaged and a portion thereof carried with cam 150. Shortly after the arrival of cam 150 at the position illustrated in Fig. 3, and before a substantial retracting or return movement thereof has occurred, an indexing movement of wheel 50 oc-

curs bringing a pin 70 to the initial position designated *a* in Fig. 5. In the course of this indexing movement such pin 70 is moved to the extended position by cam portion 80. This extending movement of pin 70 occurs while it is under and in alignment with cam 150, and forces cam 150 to slide upwardly within the end of arm 54. The extending movement of pin 70 also brings it into position in which it is effective to retain the stock 30 in the position in which it is moved by cam 150, thus forming the initial lateral turn in the stock.

During this initial bending movement the free end of spring stock 30 may be expected to swing to a position in which it bears against the inner side of the finger 70 next in advance of the finger just moved to extended position. The free end is preferably set far enough around wheel 50 so that in forming the initial turn the free end is prevented from moving from between the fingers.

The return movement of arm 54 is accompanied by an inward, counter clockwise rotation of the other arm 56, in the course of which the cam 127 associated therewith engages and forms a turn in stock 30 similar to the turn previously formed by cam 150, but opposite thereto. Just prior to the beginning of a retracting movement of cam 127, an indexing movement of wheel 50 occurs, in the course of which a finger 72 is moved to a position underneath cam 127 and is simultaneously extended, forcing cam 127 upwardly within its supporting boss 126. The thus extended finger 72 retains the turn in stock 30 formed therein by the movement of cam 127.

During the return or clockwise motion of cam 127 which is begun, as described, during the extending movement of the finger 72, an inward movement of cam 150 is again in progress, as a consequence of which a turn is again formed in the straight stock 30, and at the conclusion of which another or succeeding finger 70 is moved to the initial position, and is extended to retain the turn.

It will be evident, therefore, that the cams 150 and 127 form alternate and opposite turns in the stock 30, and that at the conclusion of each cam movement a finger 70 or 72 is moved to the initial position and extended to retain the stock in folded formation.

The guide 49 serves to retain the stock 30 down upon the fingers 70 and 72 and causes the folded stock 30 to follow the curvature of the surface of wheel 50. Simultaneously with the formation of the lateral turns in stock 30, therefore, a longitudinal arch is also introduced therein, the radius of which is determined by the radius of wheel 50. The laterally folded and longitudinally arched stock, having the curved turn ends *c* (Fig. 7) and the straight turn portions *d* is permitted to leave the surface of forming wheel 50 at the point designated *b* in Fig. 5, at which point the guard 49 terminates. The stock tends, as will be understood, to assume a substantial circular form as shown in Fig. 8. As shown in Fig. 1, the thus released stock is next led through the reforming and cutting off mechanism.

As will be evident, the length of each lateral turn is equal to the axial spacing between the successive series of forming fingers. Also the radius of curvature of the curved portion of each turn is determined by diameters of the forming fingers and by diameters of the forming cams 150 and 127. Similarly, it will be evident that the spacing along the length of the spring stock between each successive lateral fold is determined

by the peripheral spacing between the fingers of the respective series.

Reforming mechanism

As stated above, the illustrated embodiment of the present invention provides a reforming mechanism for the purpose of reducing the radius of curvature of the longitudinal arch of the spring stock, as formed therein by the above described forming mechanism. In the form illustrated, the reforming mechanism also has the function of providing a positive feed of the spring stock to the cutting off mechanism, the feed thus provided being in timed relation to the movements of the above described initial forming mechanism.

Referring particularly to Figs. 1 and 4, the reforming and indexing wheel 170 is secured to a shaft 172, which is suitably journaled in the frame portions 174 and 176, and the outer end of which also carries a spur gear 178. Gear 178 mates with a gear 180, which is secured to a shaft 182. Shaft 182 is suitably journaled in the frame portions 184 and 186, and carries a worm wheel 188 which meshes with an indexing worm gear 190 which is similar in construction to the previously described indexing worm gear 94, associated with forming wheel 50. Worm gear 190 is continuously driven from sprocket 191 through the mating bevel gears 192 and 194 and the mating spur gears 196 and 198. Gear 194 is secured to the shaft 193, which also carries worm gear 190. Gears 192 and 196 are secured upon the same shaft 199, which is suitably journaled in the machine frame, and spur gear 198 and sprocket 191 are secured upon a common shaft 200 suitably journaled in the machine frame. Sprocket 191 is continuously driven by motor 108 through chain 202 and a cooperating sprocket 204, which, as best shown in Fig. 3, is mounted on the end of the previously described shaft 107. A fly wheel 203 is preferably mounted on the outer end of shaft 200 to stabilize the operation during a cutting action, described later.

Through this system of gearing, the continuous rotation of shaft 200 results in an intermittent or step by step movement of reforming and indexing wheel 170. The relationship is such that reforming and indexing wheel 170, and the previously described forming wheel 50 are indexed at the same rate. It will be noted that a positive drive is provided between both indexing wheel 50 and shaft 107, and indexing and reforming wheel 170 and shaft 107 (Fig. 3).

The periphery of indexing wheel 170 includes a plurality of tooth-like projections 210, the width of and spacing between each of which is determined between the spacing between adjacent lateral turns in the spring stock. The projections 210 are positioned near the axial center of the periphery of wheel 170, and the peripheral portions on each side of the projection 210 are cut away below the level of projection 210, to accommodate the turned end portions of the lateral turns in the spring stock.

The spring stock 30 is retained in engagement with and caused to follow the peripheral curvature of indexing wheel 170 during its passage therearound by a belt 212, which passes partially around wheel 170 overlying the stock 30, and which also passes around three idler pulleys 214, 216 and 218. Belt 212 is illustrated as formed of a single piece with openings cut therein to accommodate the teeth 210 on wheel 170. Alternatively, a pair of spaced belts may be used, and it will be also understood, that while friction is

relied upon in the illustrated form, to drive belt 212, a toothed belt may be used. The idler pulleys 214 and 216 are suitably, rotatably supported within the machine frame, and the idler pulley 218 is slidably mounted on a slide 220 which rides in guides 222 formed in the machine frame. An adjusting stud 224 is provided to fix the position of slide 220 with respect to the machine frame. Pulley 218 is so positioned that its periphery is engaged by the stock 30 before reaching the indexing wheel 170. As will be evident particularly from Fig. 1, by sliding idler pulley 218 to the right or to the left, an adjustment of the point on the periphery of indexing wheel 170 at which stock 30 first engages it may be made. This adjustment correspondingly determines the portion of the periphery of wheel 170 which the stock is caused to follow and thus constitutes an adjustment to determine the degree of change in the radius of curvature of the longitudinal arch in stock 30 which is effected by passing it over the indexing wheel 170.

Cutting off mechanism

Referring to Figs. 1 and 4, the stock 30 is fed by the indexing and reforming wheel 170 and the associated parts, directly over an anvil 227 associated with the cutter 226. Cutter 226 is secured to a block 228 which is guided in a vertically reciprocating path between guides 234 and 236 which may form part of the machine frame. Block 228 is pivotally connected to a pitman 232 by pin 230. The guide 234 is secured to the frame by stud 238 and is thus conveniently removable therefrom. As described hereinafter, the driving mechanism for cutter 226 is arranged to provide intermittent cutting movement thereof in timed relation to the passage of stock 30 over anvil 227. The spacing between cutting movements is determined by the length of spring stock desired in each spring section, measured in lateral turns of spring stock.

Referring further to Figs. 1 and 4, and also to the detail Figs. 15, 16 and 17, cutter 226 includes the two spaced downwardly projecting cutting portions 240 and 242, the opposite lateral faces 244 and 246 of which, respectively, are ground to provide cutting edges. The cutter 226 also includes the two spaced downwardly projecting guide portions 248. Anvil 227, suitably supported on the machine frame in a horizontal position, is provided with the openings 250 and 252 which accommodate the cutting and guide portions of cutter 226. These openings are separated by a guide 254 which serves to guide the downward movement of cutter 226. As shown in Fig. 1, the machine frame may be apertured at 256 to provide a chute to permit the cut-away portions of stock 30 to fall to a collecting vessel.

As shown by the comparative views, Fig. 15 and Fig. 17, the cutting portion 240 is disposed to cut away the curved portion c at one side of stock 30, and the cutter portion 242 is disposed to cut away the curved portion c at the other side of stock 30. As will be understood accordingly, in cutting sections of spring stock having an even number of turns, the successive cutting actions will be effected by one of the cutting portions 240 and 242, and the other cutting portion will be ineffective. In forming sections of spring stock having an odd number of lateral turns, the cutting portions 240 and 242 will be alternately effective. During an effective cutting movement, each of the cutting portions 240 and 242 cuts through the spring stock 30 at two points each

near the end of adjacent spaced portions d of the stock, so that the completed sections of spring stock all terminate in straight sections. During an ineffective cutting movement, the cutting portion 240 and 242 passes between the spaced portions d, but does not engage the spring stock 30 on either side. As the cutter 226 advances downwardly to effect a cutting action, the guides 248 which extend below the cutting edges, first enter between adjacent straight portions of the stock and center it with respect to the cutting edges.

With reference to the driving mechanism for cutter 226, and referring particularly to Figs. 1, 10 and 4, the previously mentioned pitman 232 is provided at its upper end with a split bearing 260, which rotatably receives the eccentric 262 which is formed at one end of the horizontal shaft 264. Shaft 264 is supported in a bearing 266 which may be formed in the machine frame, and may be selectively clutched to the previously mentioned continuously rotating gear 196.

Referring to Figs. 10 through 14, the clutch comprises a clutch bar 268 having a forward curved portion 270 and a rearwardly extending shank 272, which is guided for horizontal reciprocating movement between guides 274 which may be secured to the machine frame by studs 275. A lever 276 which is keyed to a shaft 278 is disposed to enter a recess 280 formed in slide 272 to impart the reciprocating movement to clutch bar 268 in response to the timing mechanism as described below.

The forward concave portion 270 of clutch 268 is provided with the two concentric concave recesses 282 and 284, which meet to form a shoulder 286, which is normal to the axis of bar 268, but which is curved as shown in Fig. 13 to provide a cam action for the abutment 290 which extends outwardly from the locking pin 291. Locking pin 291, which includes the dog 292 and the shank 294, is slidably received in a longitudinal recess formed in sleeve 296. Sleeve 296 is also longitudinally slotted to accommodate the abutment 290. The shank 294 of locking pin 291 is cored out to receive and form a seat for one end of a biasing spring 297, the other end of which is seated against the inner end of the recess formed in sleeve 296.

The shoulder or hub portion 300 of gear 196 is provided with a plane surface 302 in which is cut the cam shoulder 304, the face of which is parallel with the axis of hub 300. The portion 306 which adjoins cam shoulder 304 is parallel with the surface 302 and the portion 308 is a graduated cam surface which rises from the level of the surface 306 to the level of the surface 302.

The parts are shown in Fig. 12 in the unclutched or released position, in which dog 292 of locking pin 291 is retained in the retracted position by the engagement between abutment 290 and the cam surface 286 formed in the clutch bar 268. With the parts in this relation, the continuous rotation of gear 196 and the hub 300 thereof is ineffective to impart rotation to sleeve 296. Withdrawal of the clutch bar 268, as controlled by the timing mechanism described below, however, moves cam shoulder 286 out of the path of abutment 290, releasing locking pin 291, the dog 292 of which accordingly is moved to the right as viewed in Fig. 12 to a position in which it engages the flat portion 302 on the surface of hub 300. Rotation of hub 300 occurs in a clockwise direction as viewed in Fig. 14, so that dog 292 is first traversed by the flat portion 302 and then by the graduated portion 308, which per-

mits dog 292 to move to the right as viewed in Fig. 12 into the path of the cam 304, the further rotation of driving gear 196 also drives sleeve 296 and consequently, shaft 264, upon which sleeve 296 is secured. The rotation of shaft 264, as will be understood, effects a cutting movement of the cutter 226.

The withdrawal of the clutch bar 268 is momentary only. At the time of the return of clutch bar 268 to the position illustrated in Fig. 12, however, abutment 290 associated with locking pin 291 is out of the range of the cam shoulder 286, so that such return movement of clutch bar 268 does not affect the position of locking pin 291. Toward the conclusion of one complete revolution of sleeve 296 and locking pin 291, however, abutment 290 moves into engagement with the inwardly curved portion 310 of cam shoulder 286. Further rotation of abutment 290 causes it to ride along the shoulder 286 and gradually withdraw locking pin 291 from engagement with the vertical cam shoulder 304 associated with hub 300. The parts are so related that the release of locking pin 291 occurs after sleeve 296 has made substantially one complete revolution. Sleeve 296 and consequently the cutter head 226 and the associated parts are brought promptly to rest upon the release of the locking pin 291 by a continuously applied brake 312 which encircles sleeve 296, and is non-rotatably secured by the engagement between the adjusting stud 314 and a portion 316 of the machine frame.

Referring particularly to Figs. 4 and 9, the previously described crank 276 which effects the reciprocation of the clutch bar 268 is suitably supported in the machine frame on shaft 278 which also carries a connecting crank arm 320 to which a downwardly extending connecting rod 322 is pivotally connected by pin 324. The lower end of rod 322 is universally connected to a boss 326 formed at the end of a rock bar 328, which is pivotally supported within the machine frame on a shaft 330. The other end of rock bar 328 is formed to provide the inwardly extending lug 332 which is disposed to co-operate with a cam 334 formed on the periphery of a timing wheel 336. Forming wheel 336 is supported for rotation by a shaft 338 which also carries a timing gear 340. Timing gear 340 meshes with a cooperating gear 342, which in turn meshes with a third gear 344. Gear 344 is keyed to the previously described shaft 182 which is given step by step movement by the worm gear 190 (Fig. 4). It will be recalled that the reforming and indexing wheel 170 is also directly driven in response to the step by step movements of shaft 182, so that the timing mechanism and the indexing wheel are driven synchronously. It will also be recalled that shaft 182 is driven in timed relation to the step by step movement of the initial forming wheel 50.

The shaft 350, upon which the intermediate timing gear 342 is supported is carried on a triangular plate 352, the position of which is adjustable and which may be locked in any desired position by a locking stud 354. The timing gears 340 and 342 are retained on their associated shafts by nuts 341 and 343 and are thus readily removable. It will be understood that by removing both gears and repositioning the adjusting plate 352, gears of different gear ratios may be substituted for the gears 340 and 342.

In operation, each successive step by step movement of shaft 182 which is effective to move index wheel 170 far enough to advance spring

stock 30 through the machine the width of one lateral turn, and which accompanies a corresponding movement of the initial forming wheel 50, moves timing wheel 336 through a predetermined angle, depending upon the gear ratios of the gears 340, 342 and 344. After a selected number of such step by step movements, which represent the passage past the cutting off mechanism of a selected length of spring stock, the sloping forward edge of cam 334, associated with timing wheel 336, is moved into engagement with the lug 332 associated with rock bar 328. This action pulls rod 322 downwardly, as viewed in Fig. 9, and effects, through cranks 278 and 320 a retracting or withdrawing movement of clutch bar 268. As cam 342 moves past lug 332, rock bar 328 is released, and push rod 322 is permitted to resume its illustrated position under the influence of the restoring spring 350, one end of which bears against crank 320 and the lower end of which is seated against a stationary support 362. The momentary withdrawal of clutch bar 268, however, as previously described, is effective to clutch the cutting mechanism to the continuously rotated drive gear 196 to effect a complete reciprocation of cutter head 226, during which the stock 30 is cut off. As will be evident, the initiation of the clutching action occurs during the progress of a step by step movement of the timing mechanism, and consequently of the indexing wheel 170, so that the stock 30 is in movement at the time. The completion of the step by step movement, however, occurs before the cutter head 226 enters into engagement with the stock, so that the stock is at rest at the time of such engagement. Similarly, the cutting action is completed and the ascending movement of the cutter head begun before the next step by step movement is initiated.

As will be understood, the cut off lengths of completed spring stock may be discharged from the machine in any suitable manner. Illustrative guide mechanism 370 is illustrated in Figs. 1, 4 and 9 in position to receive the completed stock. As will be noted guide 370 follows substantially the free curvature of the completed stock, so that such stock falls freely therethrough.

Operation as a whole

To summarize the operation of the machine as a whole, the straight spring stock 30 is fed through the straighteners 32 and 34 (Fig. 2), by the successive swinging movements of the folding arms 54 and 56. The folding arms 54 and 56 alternately swing inwardly and outwardly, carrying the cams 127 and 150 associated therewith (Fig. 3) into engagement with the spring stock 30 and forming opposite turns therein. The forming wheel 50 moves in step by step timed relation to the swinging movements of folding arms 54 and 56 and the completion of a folding movement by either cam 127 or 150 is followed by an outward movement of a cooperating finger 72 or 70 to retain the stock in the folded position. The successive step by step movements of the forming wheel 50 carry the folded stock around the periphery thereof as retained by the stationary guide 49, so that as the stock 30 is passed around wheel 50, the lateral turns and the longitudinal arch are simultaneously formed therein.

The laterally turned and longitudinally arched stock is permitted to fall away from the initial forming wheel 50, after which the extended fingers are automatically retracted by cam 81 in readiness for the next action thereof. The re-

leased stock is led around the reforming and indexing wheel 170, the longitudinal radius of curvature being reduced, if desired, in accordance with the positioning of the guide wheel 218 (Figs. 1 and 4). The reforming and indexing wheel 170 is driven in timed relation to the movement of the initial forming wheel 50, and feeds the stock directly between the cut off anvil 227 and the cutter 226.

10 After the passage past the cutter 226 of a selected length of completed spring stock, including either an odd or an even number of lateral turns, the timing mechanism including gears 240, 242 and 244 (Fig. 9) effects a withdrawing movement 15 of clutch bar 268 (Figs. 10 through 14). This withdrawing movement releases clutch pin 281, which accordingly moves dog 292 into the path of the continuously driven cam hub 300. Further movement of shoulder 300 permits locking 20 dog 292 to move into the path of the clutching cam shoulder 304. Upon the engagement of shoulder 304 with dog 292, the cutter head shaft 264 is driven by the continuously rotating gear 196 and causes cutter 226 to descend, cut off the 25 stock 30 and rise to its initial position. At the conclusion of such cutting movement, dog 292 is cammed out of engagement with shoulder 304 by the cooperation between abutment 290 and the cam shoulder 286 formed in clutch bar 268. Upon such release, the cutter head shaft 264 is promptly brought to rest by the continuously acting 30 brake 312.

Although a specific embodiment of the present invention has been described, it will be evident 35 that various changes in the form, number and arrangement of parts may be made therein within the spirit and scope of the present invention, as defined in the appended claims.

What I claim is:

40 1. A spring forming machine comprising, in combination, a first forming element operable to form a longitudinal arch of predetermined diameter in spring stock, a second forming element operable to modify said longitudinal arch, means 45 for operating said first and second elements in timed relation, and cutting off means operable in timed relation to said forming elements and positioned to cut said stock into sections of predetermined length after it is acted upon by 50 said second forming element.

2. A machine for forming springs from spring stock comprising, in combination, an intermittently rotated forming member, folding cam means intermittently movable into cooperative 55 relation with said forming member to introduce sinuous lateral turns in said stock, and means for retaining said turned stock in peripheral engagement with said member to introduce a longitudinal arch therein.

3. A spring forming machine comprising, in combination, intermittently movable arm means for forming successive lateral turns in spring stock, an intermittently movable forming wheel 60 rotatable past said arm means for retaining said turns in said stock, and means for retaining said turned stock in peripheral engagement with said member to introduce a longitudinal arch therein.

4. A spring forming machine comprising, in combination, a rotatably supported forming 70 wheel, two series of fingers extending radially from the periphery of said forming wheel, an arm associated with each of said series and movable transversely to the plane of rotation of said wheel for cooperating with said fingers to form a 75 series of sinuous, lateral turns in spring stock, and

means for operating said arms in successive alternate relation and in timed relation to said wheel.

5. A spring forming machine for forming a succession of sinuous, lateral turns and a longitudinal arch in spring stock comprising a pair of alternately movable folding arms for forming said turns, an intermittently operable rotary member associated with said arms for retaining the said turns in said stock, and means for retaining said turned stock in peripheral engagement with said member to introduce a longitudinal arch therein.

6. A spring forming machine, comprising, in combination, a movably mounted feed member having an arcuate surface for advancing spring stock through the machine, means cooperating with said feed member to form a succession of lateral turns in the stock, and means stationarily mounted adjacent said arcuate surface acting to retain the turned stock in engagement with said arcuate surface so as to form a longitudinal arch in the stock.

7. A spring forming machine, comprising, in combination, an intermittently rotatable feed member having an arcuate surface for advancing spring stock through the machine, intermittently operable folding cam means for cooperating with the feed member to form a succession of lateral turns in the stock, and means for retaining the turned stock in engagement with the arcuate surface so as to form a longitudinal arch therein.

8. A spring forming machine, comprising, in combination, a movably mounted feed member having an arcuate surface for advancing spring stock through the machine, means cooperating with said feed member to form a succession of lateral turns in the stock, means stationarily mounted adjacent said arcuate surface acting to retain the turned stock in engagement with said arcuate surface so as to form a longitudinal arch in the stock, and a forming element operable in timed relation to said feed member and positioned to receive the turned stock and modify said longitudinal arch therein.

9. A spring forming machine, comprising, in combination, a movably mounted feed member having an arcuate surface for advancing spring stock through the machine, means cooperating with said feed member to form a succession of lateral turns in the stock, means stationarily mounted adjacent said arcuate surface acting to retain the turned stock in engagement with said arcuate surface so as to form a longitudinal arch in the stock, and cut off mechanism operable in timed relation to the operation of said feed member and disposed to cut said turned stock into predetermined lengths, each cutting operation being effected adjacent the fold between successive said lateral turns.

10. A spring forming machine, comprising, in combination, an intermittently rotatable feed member having an arcuate surface for advancing spring stock through the machine, intermittently operable folding cam means for cooperating with the feed member to form a succession of lateral turns in the stock, means for retaining the turned stock in engagement with the arcuate surface so as to form a longitudinal arch therein, and a forming element operable in timed relation to said feed member and positioned to receive the turned stock and modify said longitudinal arch therein.

11. A spring forming machine, comprising, in combination, an intermittently rotatable feed member having an arcuate surface for advancing 75

spring stock through the machine, intermittently operable folding cam means for cooperating with the feed member to form a succession of lateral turns in the stock, means for retaining the turned
5 stock in engagement with the arcuate surface so as to form a longitudinal arch therein, and cut

off mechanism operable in timed relation to the operation of said feed member and disposed to cut said turned stock into predetermined lengths, each cutting operation being effected adjacent the fold between successive said lateral turns. 5

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Disclaimer

2,188,406.—*Frank J. Horton*, Detroit, Mich. MACHINE FOR FORMING SPRINGS.
Patent dated Jan. 30, 1940. Disclaimer filed Feb. 3, 1950, by the assignee,
No-Sag Spring Company.

Hereby enters this disclaimer to claims 9 and 11 of said patent.
(*Official Gazette February 28, 1950*).