(No Model.) 3 Sheets—Sheet 1.

J. W. KERR.

MACHINE FOR COILING SPIRAL SPRINGS.

No. 403,940. Patented May 28, 1889.

Fig. 1.

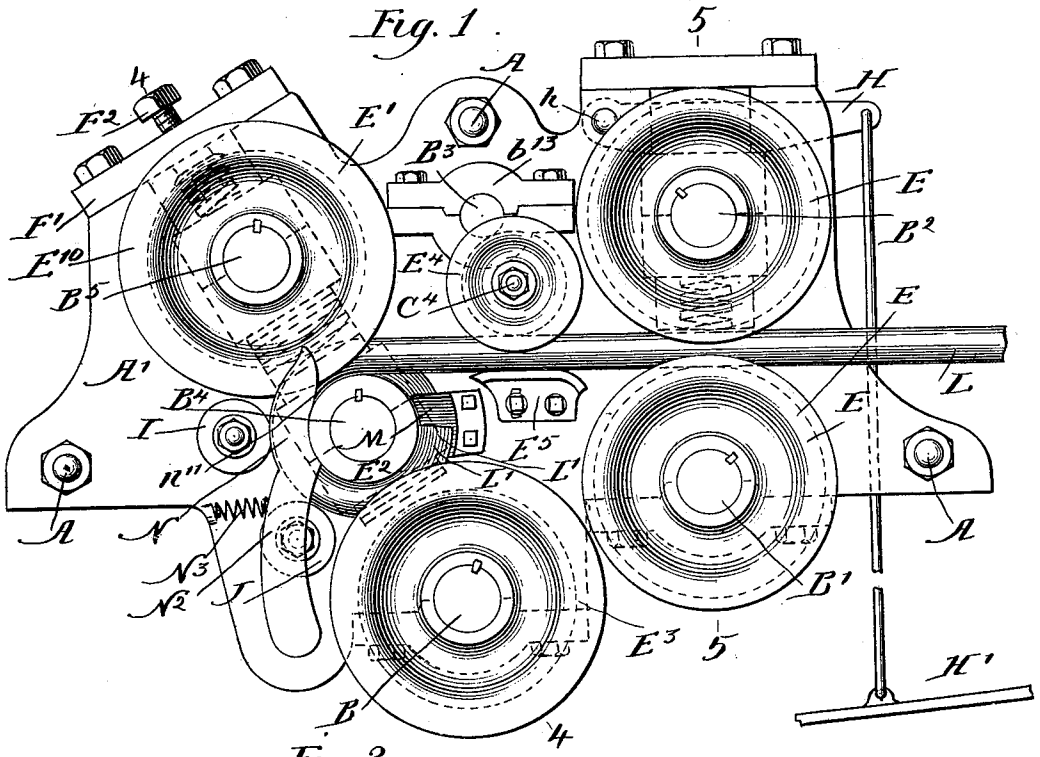
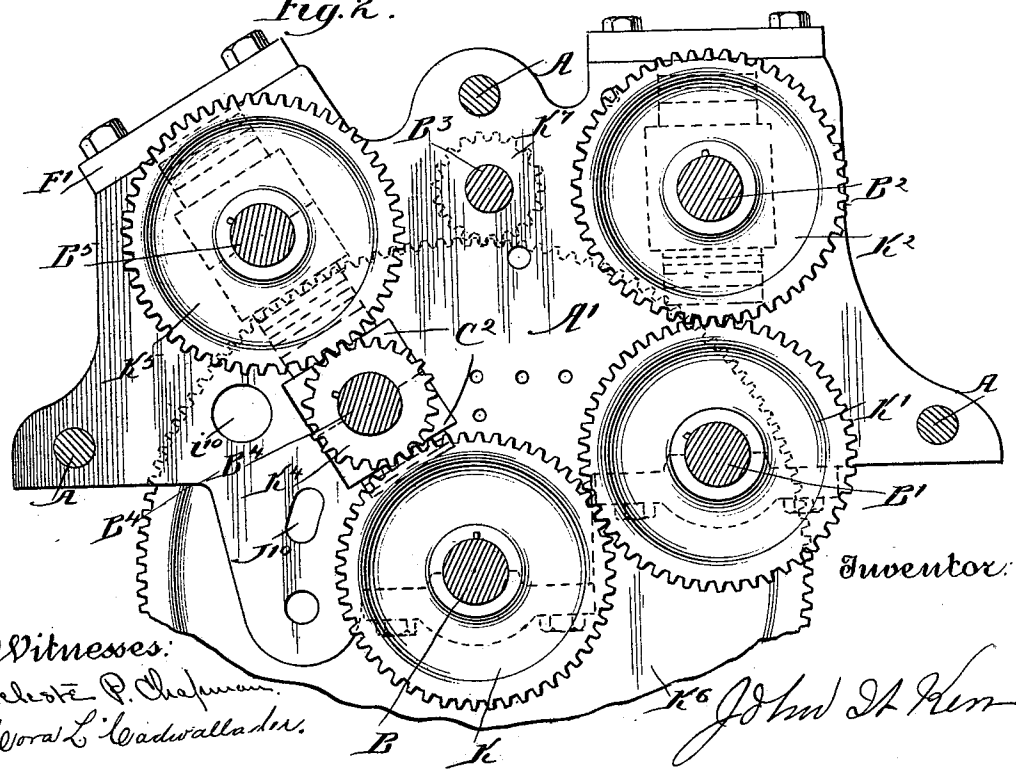


Fig. 2.



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Fig. 3.

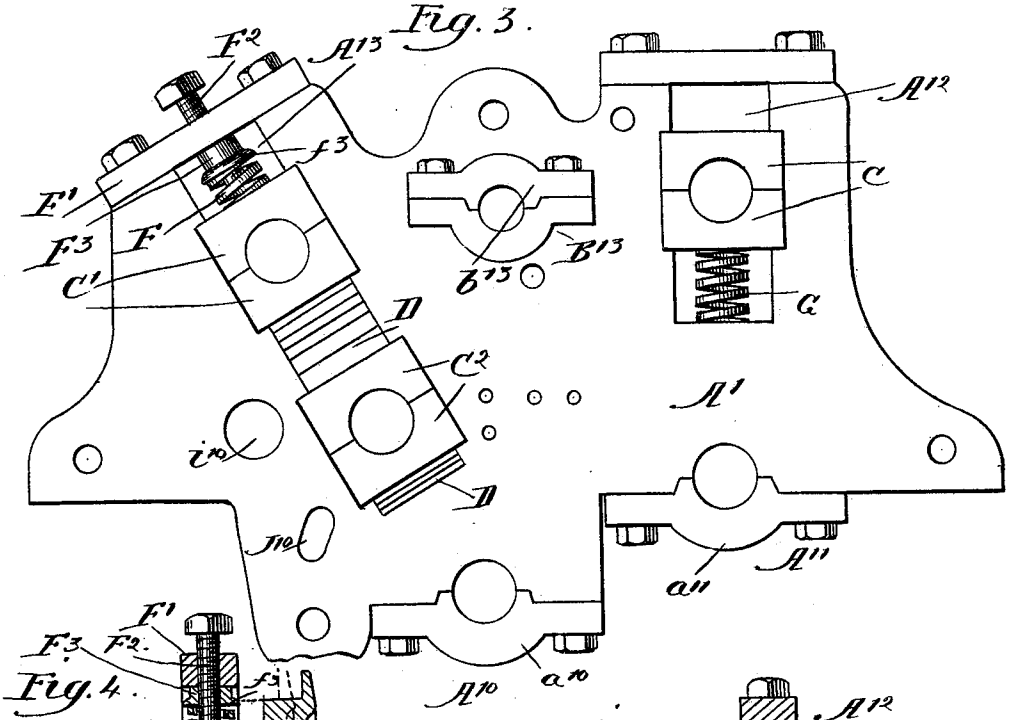


Fig. 4.

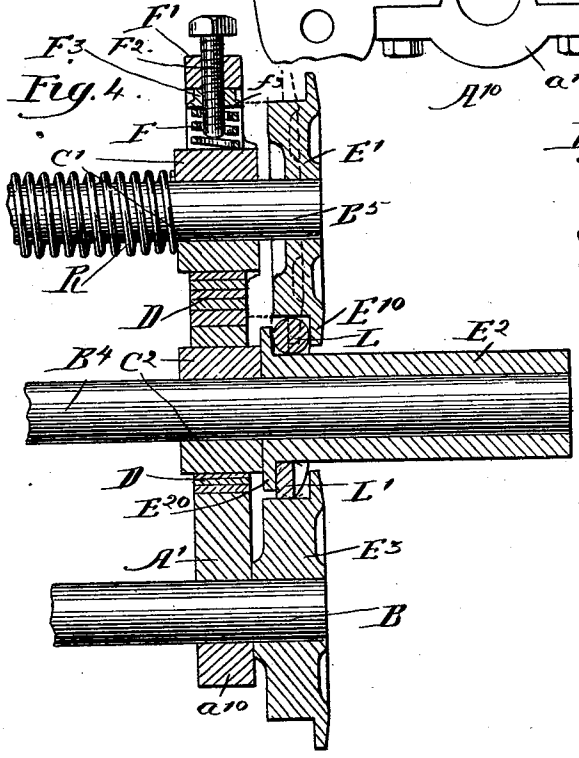
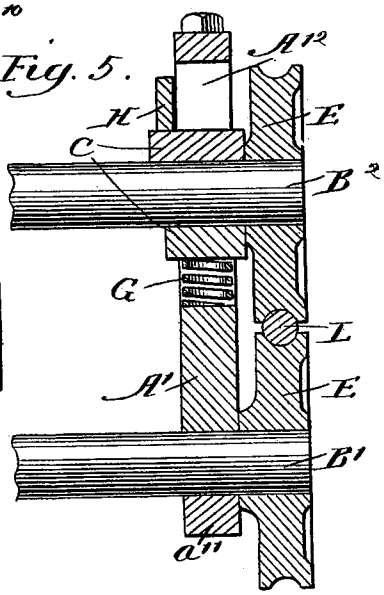


Fig. 5.



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MACHINE FOR COILING SPIRAL SPRINGS.

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Fig. 7.

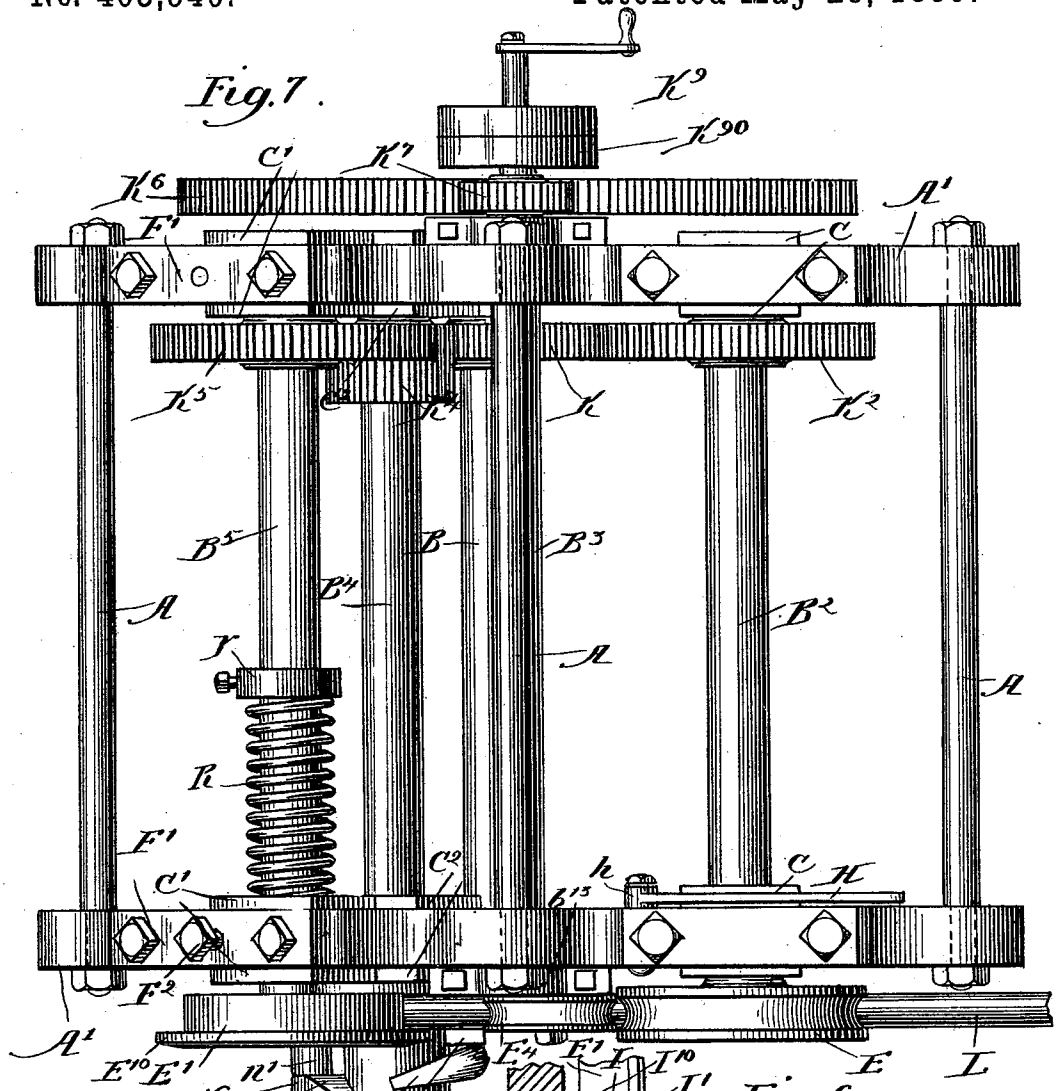


Fig. 6.

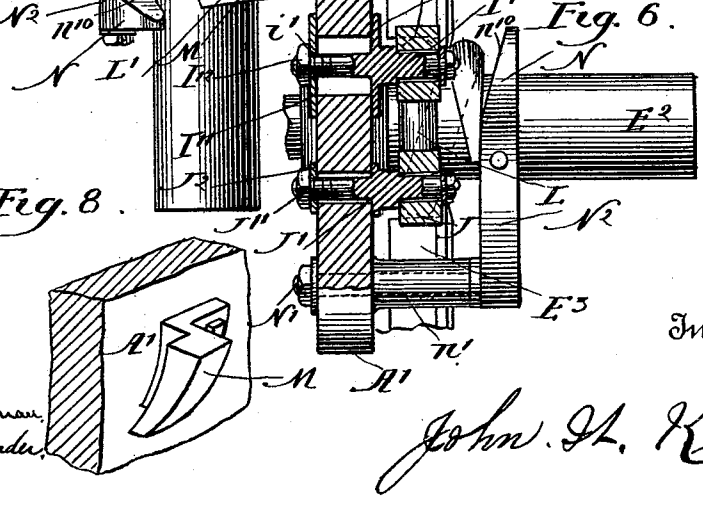


Fig. 8.

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UNITED STATES PATENT OFFICE.

JOHN W. KERR, OF CHICAGO, ILLINOIS, ASSIGNOR OF ONE-HALF TO F. M. ATKINSON, OF SAME PLACE.

MACHINE FOR COILING SPIRAL SPRINGS.

SPECIFICATION forming part of Letters Patent No. 403,940, dated May 28, 1889.

Application filed August 27, 1888. Serial No. 283,827. (No model.)

To all whom it may concern:

Be it known that I, JOHN W. KERR, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Machine for Coiling Spiral Springs, of which the following is a specification.

The purpose of this invention is to provide mechanism for coiling spiral springs, particularly those in which the ends of the wire which forms the spring are tapered so that the end coils may be made to stand at right angles to the axis of the spring, so that the parts between which the spring reacts may rest squarely against it.

In the drawings, Figure 1 is a front elevation. Fig. 2 is a receiving side elevation. Fig. 3 is a side front elevation of the frame stripped of all mechanism. Fig. 4 is a section through the line 4 4 of Fig. 1. Fig. 5 is a section through the line 5 5 of Fig. 1. Fig. 6 is a detail elevation of the cam by means of which the end of the spring is squared with respect to an axis. Fig. 7 is a plan view of the machine, and Fig. 8 is a detail view of a cam which gives the initial pitch.

The frame of this machine is precisely alike at the two ends. It consists of two end brackets, A′ A′, connected by the shouldered bolts A A A. Each end bracket, A′, has the following features: a bearing-box, A^{10}, for the shaft B, which is the driving-shaft, this bearing-box having a cap, a^{10}, applied from below upward; the bearing-box A^{11} for the shaft B′, which has a similar cap, a^{11}; the vertical channel A^{12}, opened at the top and adapted to receive the two-part bearing-box C C. The two sides of this channel are V-shaped, and the bearing-box has on its lateral edges a V-shaped channel, so that it may slide into the channel, the edges of said channel entering the V-shaped channels in the box and guiding it into proper position. In the two-part box C is journaled the shaft B^2. The bracket A′ also has the bearing-box B^{13} for the shaft B^3. This bearing-box has a cap, b^{13}. Toward the further side the bracket A′ has the oblique channel A^{13} opened upwardly, similar to the channel A^{12}, which receives two two-part boxes, C′, for the shaft B^5 and C^2 for the shaft B^4. These boxes are held at such distance as is desired by interposed blocks or sheets D.

Upon the forward end of the shafts B′ and B^2 are made fast the feed-rolls E E, which have peripheral grooves of a size corresponding to the rod or wire to be coiled, so that said rolls will grip the rod when it is properly introduced between them and advance it to the succeeding mechanism, which operates upon it. Upon the forward end of the shaft B^5 there is secured a bending-roll, E′, having the peripheral flange E^{10} forward of the plane of the rear face of the roll a distance equal to the diameter of the largest rod to be coiled by the roll. Upon the forward end of the shaft B^4 is secured a mandrel, E^2, which has a peripheral flange, E^{20}, at its rear end.

The amount of blocking introduced between the boxes C′ and C^2 in the channel A^{13} is only sufficient to hold the roll E′ with its periphery removed from the surface of the mandrel E^2 such distance as to permit the rod which is being coiled to pass between them. Above the box C′, in which the forward end of the shaft B^5 is journaled, there is placed a spring, F, for the purpose of forcing the box and shaft downward toward the mandrel E^2. A convenient mode of providing for the adjustment of this spring to correspond with the amount of blocking which is introduced between the two boxes C′ and C^2 is that illustrated in the drawings, wherein a cross-bar, F′, is secured to the bracket A′ across the upper end of the channel A^{13}, and through said cross-bar a bolt, F^2, is screwed, and onto said bolt below the cross-bar is screwed the nut F^3. Said nut has a flange, f^3, which stops the upper end of the spring F, the lower end of which is stopped upon the upper half of the box C′. The bolt F^2, extending through the nut F^3, enters within the spring F, and the end of it constitutes the positive stop for the box C′ and limits its yielding upward in the channel A^{13}.

Upon the forward end of the shaft B there is made fast the bending-roll E^3, whose periphery is distant from the periphery of the bending-roll E′ a distance equal to the outside diameter of the coil which is to be formed. Blocking may be introduced below the box

C^2 in the channel A^3, as well as between that box and the box C′, for the purpose of adjusting the position of the mandrel properly with respect to the two bending-rolls.

For reasons which will hereinafter appear I prefer to support the box C in the channel A^{12} upon a spring, G, which is located between the bottom of the channel and the under side of the box, tending to resist the depression of the box in the channel, and for the purpose of depressing the same and the shaft journaled in it when desired, I have provided the lever H, pivoted upon the frame at the point *h* and extended out over the upper half of the box C, and connected to the treadle H′ at convenient distance toward the receiving side of the machine, so that it can be operated by the foot of the operator while guiding the bar.

I and J are two bending-rolls journaled upon studs I′ and J′, respectively, which are adjustably secured to the bracket A′. The stud J′ is secured in the slot j^{10} in the bracket A′, said slot being in an arc of a circle about the axis of the shaft B, so that said stud may be adjusted toward and from the mandrel E^2, while remaining at a uniform distance from the bending-roll E^3. The stud I′ is adjusted in an opening, i^{10}, through the bracket A′, said opening being larger than the stem *i*′ of the stud I′, so that the stud may be adjusted not only toward and from the axis of the mandrel E^2, but also toward and from the axis of the bending-roll E′, and when both the mandrel and the bending-roll are changed by the substitution of similar parts of other sizes the stud may be adjusted toward and from the line which connects their axes. This range of adjustment is necessary in view of the changing of either the mandrel or the roll, or in some cases both for the purpose of coiling springs of different sizes and from different sizes of rods, as will be hereinafter more fully explained.

In order to permit the adjustment of the stud I′, as described, and at the same time secure it rigidly in all the desired positions, it is provided on the forward side of the brackets *a*′ with a wide flange, I^{10}, sufficient to completely overlap the opening i^{10} in the frame, and a washer, I^{11}, large enough also to cover said opening, is applied on the rear side of the bracket about the stem of the stud, so that the nut I^{12} on the end of the stem may be made to bind the washer and the flange firmly against the opposite sides of the bracket at whatever position in the opening the stem of the stud may stand. The stud J′ is secured in the slot J^{10} by means of the binding-nut J^{11} and washer J^{12} on the back side of the bracket in the usual manner, a suitable shoulder being provided on the stud to bind against the front side of the frame. On the forward side of the bracket A′, below the bearing-box B^{13}, there projects the stud C^4, on which is journaled a guide-roll, E^4, and upon the forward side of the bracket A′ there is adjustably secured a bracket, E^5, having its upper surface in a line tangential to the bottom of the groove in the periphery of the lower feed-roll, E. The purpose of this bracket is to support the rod as it emerges from the feed-rolls, and the purpose of the guide-roll E^4 is to prevent the rod from bending upward off the supporting-ledge when it encounters the resistance of the bending-roll in the processes hereinafter described.

At the opposite side of the machine the several shafts B B′ B^2 B^4 B^5 carry the gears which constitute the driving-train. These gears K K′ K^2 K^4 K^5 respectively are pinned fast to their respective shafts on the forward side of the rear bracket, A′.

B′ is the driving-shaft, and in addition to the gear K′, secured to it forward of the rear bracket, A′, it has pinned fast to it the main driving-gear K^6, which receives power through the pinion K^7, fixed on its shaft B^3. Upon said shaft may be provided a crank-handle, K^9, or a pulley, K^{90}, to operate the machine by hand or power.

The shaft B^5 is free to move lengthwise in the bearings, and a spring, R, is coiled about it behind the box C′ and stopped against said box and against the collar *r* on the shaft, and tends to hold the roll E′ back close against the bracket A′, for a purpose hereinafter stated.

Further details of this machine will be described in connection with its mode of operation.

It will be noticed that the two brackets A′ A′ are precisely alike, and that the shafts B^2 B^4 B^5, which in the forward bracket have movable boxes in the channels A^{12} and A^{13}, have movable boxes also in similar channels in the rear bracket; but whereas the boxes C and C′ in the forward bracket are yielding, and are provided with springs to give them that character, all the boxes in the rear bracket are blocked fixedly in position, the space in the channels A^{12} and A^{13} on either side of the requisite position of said boxes being filled up with blocks D. The boxes are fitted somewhat loosely in their guides, and the blocking need not be so exactly fitted as to prevent all movement, some movement being necessary, as will appear from the further description of the operation of the machine.

The purpose of making the two sides of the machine-frame precisely alike is to permit the parts to be assembled with their ends reversed—that is, so that the feed and bending rolls might be located at the opposite end from that at which they are herein shown and the driving-gear train at the end at which the said rolls are shown. Its capability of reversal is desirable for the purpose of adapting the machine, when thus changed, to make springs coiled in the reverse direction from that which characterizes springs made by the machine assembled as illustrated.

The operation of this machine is as follows: The rod L to be coiled into the spring is first forged to flatten its ends L′. This is done

without widening the bar at the flattened part. The bar, being suitably heated, is introduced by the operator between the feed-rolls E E. These rolls are normally held apart by the spring G, so that the rod may be introduced without spreading them or receiving any pressure from them. This the operator does, holding the rod so that the flat surface of its tapered ends is vertical, and in this position the rod is passed on between the supporting-ledge E^5 and the guide-roll E^4, and by sufficient pressure endwise it is forced between the upper surface of the mandrel E^2 and the lower end of the bending-roll E′, its flattened and tapered end entering between the flanges E^{10} and E^{20}, and being thereby held with its flat sides in the plane of the coil to be formed. It will be noticed that the axes of the said mandrel and bending-roll are in a plane which is inclined with respect to the plane of the axes of the feed-rolls E, so that the rod which is to be coiled, if passed straight through over the mandrel and under the bending-roll E′ without being bent, having its lower surface tangent to the mandrel and to the lower feed-roll and its upper surface tangent to the upper feed-roll and the bending-roll, would contact the bending-roll considerably beyond its point of contact with the mandrel, and that the distance, therefore, between the upper surface of the mandrel and the lower edge of the bending-roll E′, measured along the line connecting the centers of said wheels, would be more than the diameter of the rod. If now the bending-roll is forced toward the mandrel until the distance between their proximate peripheries only equals the diameter of the rod, it is evident that the rod must be bent around the mandrel from the point where it is first tangent thereto to a point in the line connecting the axes of the mandrel and bending-roll, and that the maximum curvature which the rod can receive as it passes between the mandrel and bending-roll will be the curvature of the mandrel itself, and that from that maximum the curvature induced may be varied to zero—that is, the rod being left straight—by adjusting the bending-roll toward the mandrel a greater or less distance from the position at which it would permit the rod to pass through tangent to it without bending. In practice it is found desirable to have the mandrel very slightly less in diameter than the interior diameter of the coil when made—that is, to give the rod slightly less curvature than the mandrel; but the actual curvature is determined by setting the bolt F^2 through the cross-bar F′ a greater or less distance, so that its lower end will limit the play of the box C′, and thereby of the shaft B^5 and of the roll E′, at such point as may be desired. The spring F constantly tends to force the shaft E′ toward the mandrel, and at starting the edge of the flange E^{10} of the bending-roll will rest upon the mandrel. As the operator now forces the rod between the mandrel and the bending-roll E′, the bending-roll, yielding away from the mandrel somewhat to permit the rod to enter between them, will, nevertheless, bend the point of the rod even before the box C′ reaches the limit of its play by contacting the end of the bolt F^2, because the spring F is advisedly made sufficiently strong to initiate the bending of the rod when it is in the heated, and therefore softened, condition in which it is when such work is best performed; but the spring is not designed to be so strong as to completely bend the rod to the mandrel as it passes over it, and the bending-roll E′ will therefore yield away from the mandrel as the rod enters between them until the box C′ collides with the end of the bolt F^2, and the position of the bending-roll E′ is thereby rendered positive. The rod has now received sufficient initial curvature, so that its end will pass under the end of the guiding-roll I′, which is so adjusted by means of the devices hereinabove described that it will further the bending of the rod in the arc desired, so that the end of the rod will next pass under the guiding-roll J′, and its curvature being further slightly increased by said roll, if it has not already conformed to the arc intended, it passes onto the bending-roll E^3. It will be noticed that from the point of contact of the rod with the bending-roll E′ its point of contact with the bending-roll E^3 is a half-circle about the axis of the mandrel. The curvature of the coil is therefore now completely determined and measured by the distance between the peripheries of the said bending-rolls E′ and E^3, that distance being the exterior diameter of the coil. It is therefore now apparent that the guiding-rolls I′ J′ should have been adjusted so that their peripheries are removed from the axis of the mandrel a distance equal to half the distance between the peripheries of the bending-rolls E′ and E^3 when the former is forced back until its box is stopped by the bolt F^2. The mandrel E^2 should be set so that its upper surface is removed from the periphery of the bending-roll E′ a sufficient distance to give to the bar an initial curvature as it passes between said mandrel and roll great enough at least to cause its end to pass readily by the guiding-roll I′. It is not necessary to so closely adjust the mandrel and bending-roll as to give the rod its complete and final curvature when it passes between said roll and mandrel. The spring R permits the roll E′ to yield outward as the tapering rod enters behind the flange E^{10}. If no further devices were provided, the rod thus coiled in the half-circle would continue to pass on around the mandrel as the coil was completed, and would therefore, of course, collide with the incoming rod when the circuit was completed. The prevention of this result consists in the pitch given to the coil, and this is primarily effected after it passes the bending-roll E^3 by means of the pitch-block M. This block is a wedge-shaped piece se-

cured to the frame in the track of the coiled rod, and widening from the lower edge upward, so that as the end of the rod strikes the block it is deflected outward an amount equal to the pitch desired. Being thus deflected, the coiled rod passes on up over the mandrel while the second circuit is being wound from the rod. Further, to insure the accuracy of the pitch—in fact, as the principal means of producing it in subsequent parts of the process—I make the flange E^{10} of a thickness equal to the interval desired between successive coils of the spring, and as the end of the spring which has been first deflected by the pitch-block M passes up over the mandrel E^2 it is laid outside the flange E^{10}, which separates it from the second coil which is being formed on the back side of said flange. The entire rod might now be fed into the machine, and when the farther end had passed out from between the mandrel and the bending-roll E^3 the entire spring would lie formed on the mandrel completely coiled and ready to be removed; but when thus constructed the initial coil would have the same pitch as all succeeding coils, and therefore stand oblique to the axis of the coil. In order to prevent this result and cause the initial coil to have its outer surface in a plane at right angles to the axis of the coil, I provide, located upon the farther side of the mandrel, the cam N. This cam is formed or secured upon the arm N^2 of a rock-shaft, N′, journaled in the frame at n'. A spring, N^3, is provided tending to rock the shaft N′, carrying the arm N^2 and the cam N toward the mandrel E^2. The cam N has the face n^{10} on the rear side—that is, the side toward the bracket A′—located in the track of the flattened end of the rod as it first emerges from between the roll E′ and the mandrel. The rock-shaft N′ is adjusted longitudinally in its bearings n' to bring the cam-face n^{10} in such position that its upper end will engage the initial flattened end of the rod as it emerges from between the mandrel and the bending-roll E′, and the said cam-face slopes from its upper point toward the plane of the bending-roll E′, its lower end being distant from the vertical plane of the rear face of the flange E^{10} an amount of not more than one-half the deflection given to the coil by the pitch-block. The pitch, therefore, that is given to the coil by the deflecting-block M, and continued by the thickness of the flange E^{10}, will be taken out of the rod by the cam N, by means of its face n^{10}, as the end which has first been deflected passes by it in the subsequent stage of coiling. The position of the lower edge of the cam-face n^{10} being fixed as respects its distance from the vertical plane of the coil formed by the bending-roll E′, the first coil thus formed, as it passes by said point, having first been bent by the deflecting-block and flange E^{10} outward from that plane, will be forced back to a plane at right angles to the axis of the mandrel, which is substantially the axis of the spring. By locating the cam N^2 so that this point (which will be called the "heel" of the cam-face n^{10}) is distant from the rear surface of the flange E^{10}, as described, an amount not more than one-half the deflection caused by the pitch-block—that is to say, not more than half the sum of the diameter of the rod and thickness of the flange E^{10}—it is rendered certain that the end of the spring—that is, the outer surface of the first coil formed—will conform to a plane at right angles to the axis throughout at least one-half the circumference of the coil. How much more than one-half of the first coil may be thus made to form a square end for the spring will depend upon the relation between the diameter of the rod and the interval produced between the coils and the extent to which the end of the rod is flattened and tapered, and it will be possible, by making the interval between successive coils as great as the diameter of the rod and flattening the end of the spring, to taper it to zero, to cause the entire first coil to constitute the square end of the spring, which will be done by setting the cam N with the heel of its face n^{10} in the vertical plane of the rear face of the flange E^{10}. When the initial end of the first coil whose pitch has been thus corrected comes around to the cammed end N, which stands outward from the plane of the flange E^{20} a distance equal to at least the full diameter of the rod which is being coiled, its flat outer edge will not become engaged by the cam-face n^{10}, but on the contrary the end of the coil will collide with the end of the cam N and rock the cam away from the end of the mandrel, and will pass on underneath it as it continues to revolve on around the mandrel, and this will be the course of all succeeding coils until the end of the rod is reached and the spring is completed. In order to insure the result described by the collision of the end of the spring with the end of the cam N, that end may be cut away or beveled on the under side forming the face n^{11}. This will not be necessary in all cases, but may be done as a precaution. As the final flattened end of the rod enters between the mandrel and the bending-roll E′, the flanges E^{10} and E^{20} serve the same purpose in respect to that end as they did in respect to the initial flattened end, guiding it so that its flat surface stands in the plane of the coil.

When the last coil is wound, the spring will lie freely on the mandrel and may be removed by slipping it off over the end. The last coil cannot be flattened—that is, have its outer surface brought at right angles to the axis—as was done with respect to the first coil, because the machine has lost control of the rod when it has finished winding that coil, and the squaring of that end of the spring will be effected by hand with a suitable tool, bending the coil down onto the next preceding coil.

It will be obvious that the flanges E^{10} and E^{20} may serve a precisely analogous purpose

in a precisely similar way if such a machine were used for coiling a flat-surfaced rod square or oblong in cross-section, and that in that case it would be necessary to provide a spring to permit the bending-roll to yield as the tapered end of the rod enters between the flanges E^{10} and E^{20}, and that said flanges might remain at a fixed distance apart.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is as follows:

1. In combination with a bending-roll having the flange E^{10}, the mandrel-roll having the flange E^{20}, said flanges having flat faces opposed to each other, the shaft of one of said rolls being longitudinally movable in its bearings to allow the flanges to separate, and a spring acting against such movable shaft to cause the flanges to approach, substantially as set forth.

2. In combination with the mandrel and the bending-rolls and the pitch-producing devices, the cam N, located beyond the mandrel, having the face n^{10}, as it extends around the mandrel in the direction of the rotation of the latter, sloping toward the vertical plane of the periphery of the bending-roll E′, substantially as and for the purpose set forth.

3. In combination with the mandrel, the bending-roll E′, and the pitch-producing devices, the cam N, having the cam-face n^{10} to engage the end of the first coil, said face sloping toward the plane of the periphery of the bending-roll, its upper end being removed from the rear face of the flange E^{10} a distance as great as the sum of the thickness of the end of the rod and the deflection caused by the deflecting devices, and its lower end being removed from said plane a distance not more than half the deflection caused by the deflecting devices, substantially as and for the purpose set forth.

4. In combination with the mandrel, the bending-roll, and the deflecting devices, the cam N, pivoted to the frame and adapted to oscillate toward and from the mandrel, and having the cam-face n^{10} located and sloping, as described, and the end n^{11} facing the plane of the axes of the mandrel and bending-roll, whereby the end of the coiled spring in the course of its second revolution is forced to collide with it and rock the cam away from the mandrel, substantially as set forth.

5. The combination, substantially as and for the purpose set forth, of the two frame-brackets A′ A′, formed, respectively, symmetrical, the shafts journaled therein and reversible end for end and carrying their respective feeding and coiling rolls and intermeshing gears, and a pitch-controlling device securable on the outer face of either one of said frames, whereby the machine is adapted to coil either right or left spirals.

6. In a machine for coiling spirals, the primal bending-roll and the mandrel having peripheral flanges with flat faces transverse to their axes and laterally opposed and opposite to each other, for the purpose of gripping and guiding the flat faces of the rod coiled into planes transverse to the axis of the coil, substantially as set forth.

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