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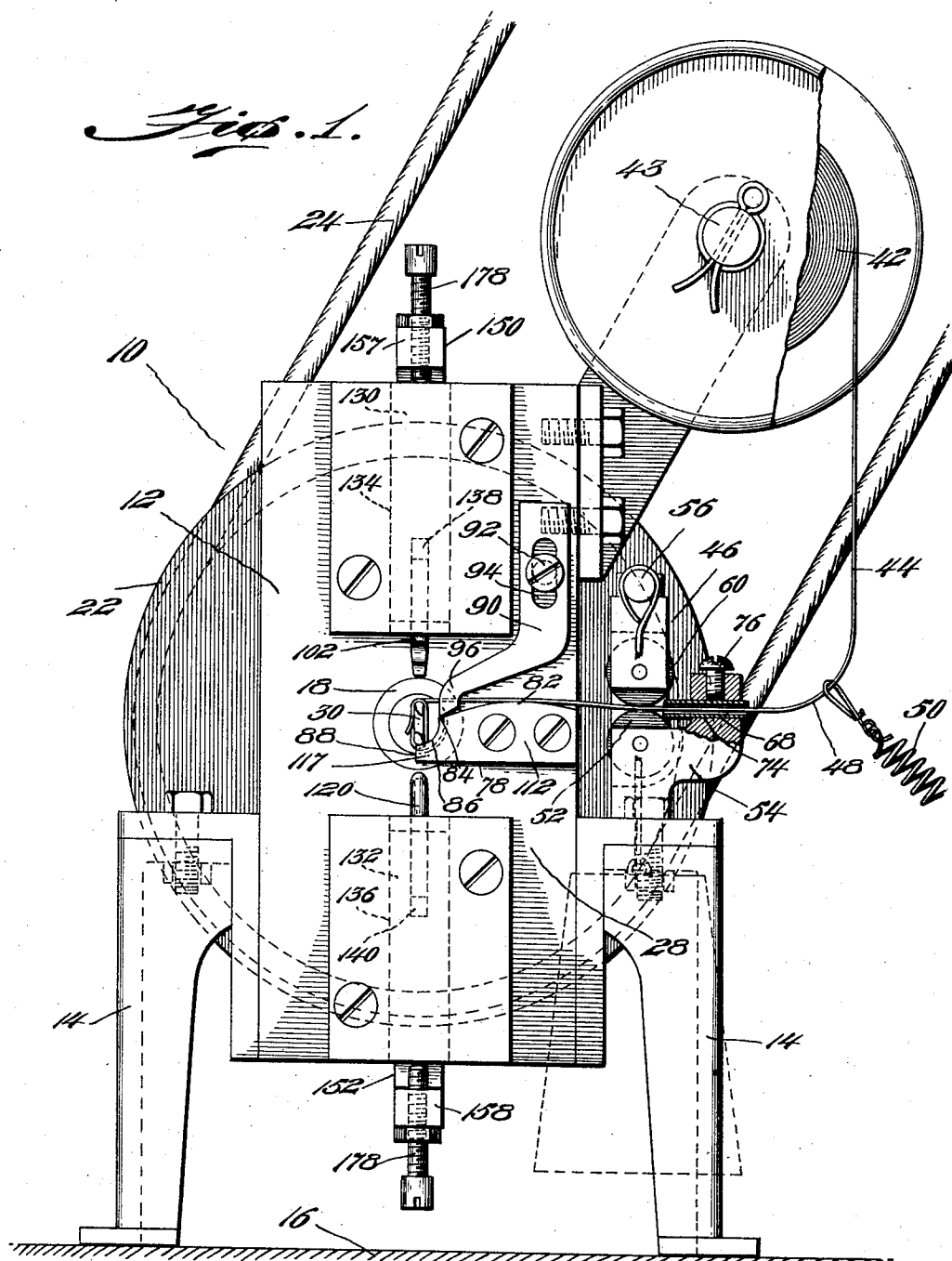
A. H. GARST

1,896,670

METHOD OF AND APPARATUS FOR FORMING WIRE COILS

Filed May 31, 1930

4 Sheets-Sheet 1



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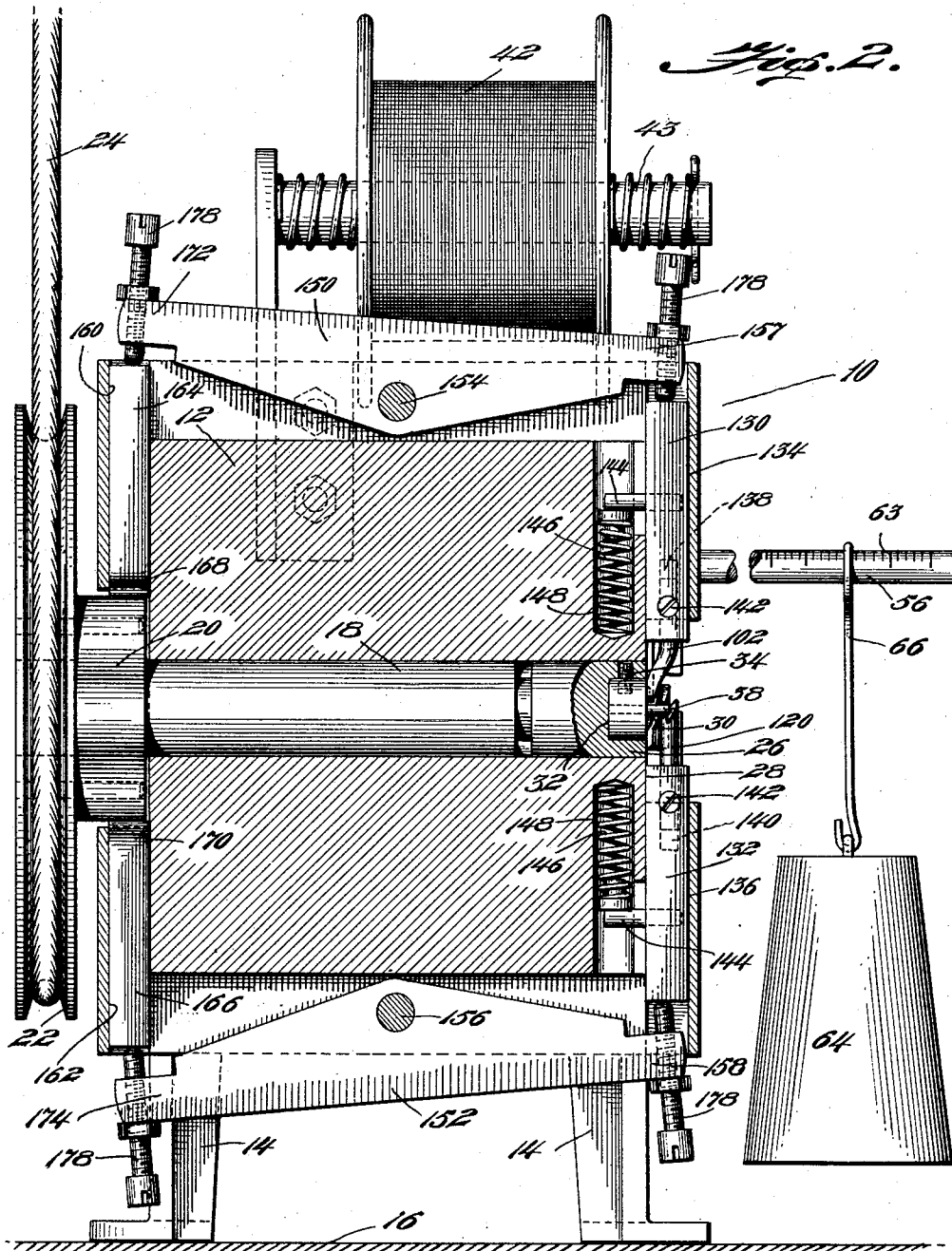
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4 Sheets-Sheet 2



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4 Sheets-Sheet 4

Fig. 5.

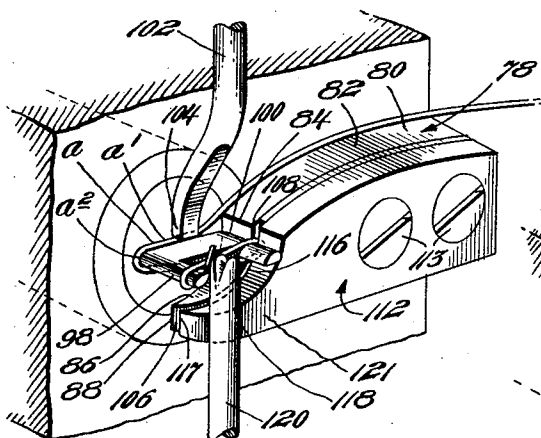


Fig. 6.

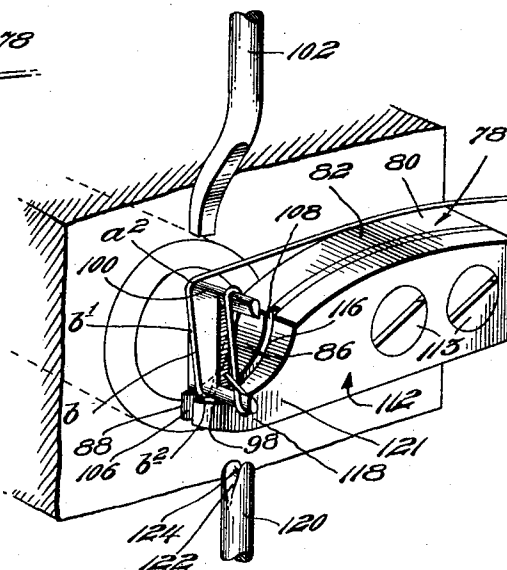


Fig. 7.

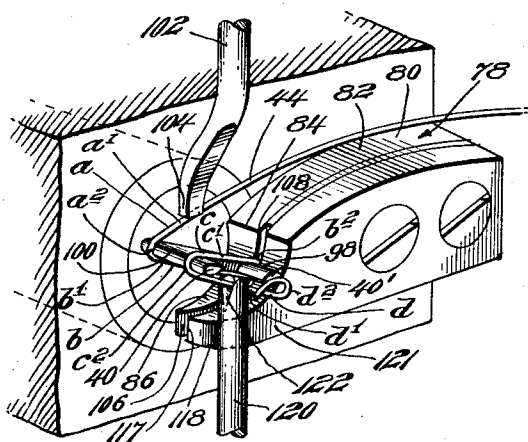


Fig. 8.

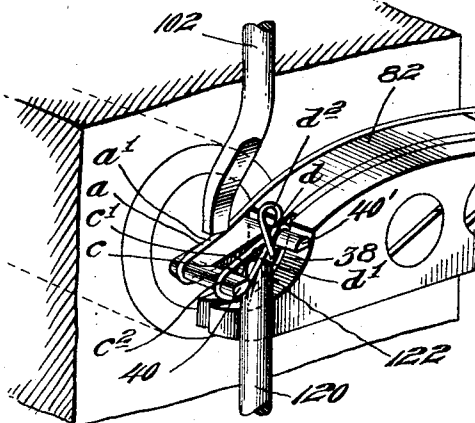
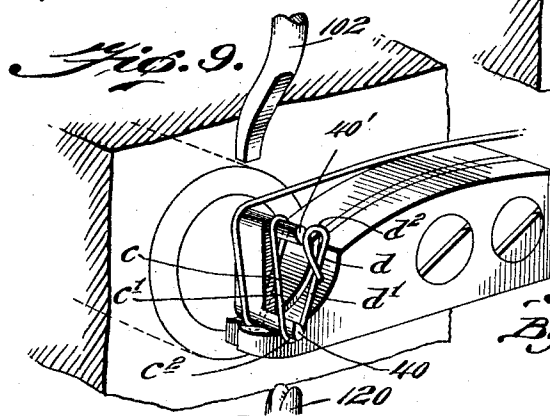


Fig. 9.



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UNITED STATES PATENT OFFICE

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METHOD AND APPARATUS FOR FORMING WIRE COILS

Application filed May 31, 1930. Serial No. 457,877.

My invention relates to an improved method of and apparatus for forming wire coil. While my invention may be employed for shaping any type of coiled wire, it is particularly adapted for use in shaping spring wire in which the coils thereof are spaced further apart than the normal winding pitch. By winding pitch I mean the pitch imparted to the wire by merely winding it in a coil on a mandrel. While I believe that my specific apparatus for imparting more than the desired pitch to any shape coil, is broadly new, my invention is particularly adapted for use in forming oblong shaped wire of the contraction or expansion spring type.

In forming generally oblong shaped wire, it is particularly desirable that each end of the sides thereof be imparted the desired set so that the spring wire coils will return to a substantially set position in use. Wire of this description has been made in two different manners heretofore. The method most commonly in use includes first making a circular or cylindrical coil and then flattening it. In flattening the cylindrical coil it is substantially impossible to give the desired set to the respective coil ends and the wire produced is apt to be twisted, so as not to have the sides thereof parallel and in general to impart a generally spiral twist in addition to the usual helical twist in the wire. One large use of wire of this description is in expansion bracelets, either one of the expansible box type or a bracelet which has one or more expansible members in it, such as for use in wrist watch bracelet straps, either for ready removal of the wrist watch strap from the hand, or to allow free play of the bracelet on the wrist during all movements of the wrist while firmly retaining the strap thereto. When spirally twisted wire of this type just referred to has been inserted within the boxes or expansible members of the bracelet its spiral configuration has tended to make it twist therein and thus, in use, to grate against its enclosing members.

Spring wire coils of generally oblong shape have also been made by winding them on a cylindrical mandrel without imparting any

more than the winding pitch thereto and after the coil is formed attempting to stretch it to the desired length. When this has been done it has been very hard to stretch it so that it will assume just the desired set position in use. Even if each half coil of wire is spaced more than the desired pitch and the wire formed in this manner, such wire generally also has had the same difficulty as that mentioned from wire made from a flattened cylindrical coil, namely—that the sides of the flat portions thereof are not parallel and that a spiral twist in addition to the helical twist has been imparted thereto so that also in use it will grate against the enclosing members.

An object of my invention therefore, is to provide oblong helically wound wire coil in which the sides thereof will remain substantially parallel in use.

A further difficulty in wire made in either one of the former manners has been the tendency referred to hitherto, of assuming a spiral configuration or twisting after it has been made. I believe I am the first to provide means to bend each side of the wire toward the other after it has been formed to give each end of the wire the desired set so that in use each side thereof will remain substantially parallel to adjacent sides; thus when the wire has flat parallel sides to form a substantially flat wire throughout its length.

A further difficulty in making oblong wire of this description, has been the tendency of the sides to be bowed. In addition to the means I provide therefore to press each end of the wire beyond its set position so that in use it will assume its set position, I also believe I am the first to provide means to bend each side of the wire toward the opposite side so that in use it will assume the desired position parallel to that of adjacent sides; thus, when flat wire is being formed I bend each flat side coil to more than a flat position so that in use it will assume a substantially flat position.

In addition to these broad, novel steps in the method of forming oblong wire of this description, further features of my invention relate to the specific apparatus I employ for this purpose. In order to impart more than

the winding pitch to the wire as it is being wound on the mandrel, I provide a pitch cam to obliquely bend one end of the wire forward while the other is firmly held and by varying the shape or size of said pitch cam, the amount of this obliquely forward bending can readily be varied. I have found that if I employ a relatively short mandrel having a free end and provide means to immediately strip the wire coil from the free end as it is being formed, that there will be no tendency of the wire coil to bind on the mandrel and that a much more desirable apparatus for continuously making wire is provided. The stripper cam, however, becomes particularly useful when I employ the means about to be described for bending the ends of an oblong coil more than their desired set degree of curvature by bending one side toward the opposite side. For this purpose I provide a mandrel having an open center portion on its outer end so as to form winding pins projecting forwardly from each side thereof and I provide a coil end curving arm preferably having a bifurcated end, adapted to project through the open portion of the plunger end as the outer end of said coil is being stripped from said plunger end to bend the obliquely extending half coil through the open portion of said mandrel to give the desired set degree of curvature to each respective half coil end at a pre-determined period of mandrel revolution. In order to do this it is necessary to strip an end of each coil from the mandrel in order that a side thereof may be pushed through the center portion of the mandrel toward the opposite side.

To shape each side of the coil and to prevent it from being bowed, I provide means such as a shaping arm to abut the side of the wire at a pre-determined period of mandrel revolution to bend it to more than its desired set shape toward the opposite side so that in use it will assume the desired set shape.

Different sizes and types of springs have different resilient tendencies and I also provide in my apparatus means to set the machine to operate on different sizes or types of wire. I feed the wire to the mandrel under tension and I provide means whereby the tension may be varied, preferably in a graduated manner so as to adjust the amount of oblique bending of each coil end for wires of different resiliences.

These and such other objects of my invention as may hereinafter appear, will be best understood from a description of an embodiment thereof, such as is shown in the accompanying drawings.

In the drawings, Fig. 1 is a front elevation of an apparatus constructed according to the principles of my invention.

Fig. 2 is a longitudinal sectional view showing

parts thereof in elevation of my improved apparatus shown in Fig. 1

Fig. 3 is a skeleton perspective view showing certain operative parts of my invention.

Fig. 4 is a side elevation of the tension means I preferably employ.

Fig. 4a is an edge view of a piece of oblong wire constructed according to the principles of my invention.

Figs. 5 to 9 are diagrammatic perspective views illustrating various steps in the actual operation of forming the wire.

In the drawings, wherein like characters of reference generally indicate like parts throughout 10 generally indicates an embodiment of apparatus suitable for carrying out the principles of my invention and particularly adapted for forming a continuous oblong coil of wire.

As stated, while my invention may be employed for making any type of wire, it is particularly adapted for making spring wire which is desired in use to return to a definite set position which spring wire is also preferably tempered. Said apparatus includes a frame 12 having legs 14 depending therefrom adapted to rest on a suitable support such as the workbench 16. I provide the rotatable shaft 18 which, as shown in my preferred embodiment, extends longitudinally substantially centrally of the frame 12. The shaft 18 is provided in the embodiment shown with the elliptical cam 20 in rear of the frame 12 and the driving pulley 22 which may be driven in any suitable manner, such as by the belt 24. The front end 26 of said rotatable shaft 18 terminates substantially flush with the front surface 28 of said frame 12. The mandrel 30 of the desired shape is secured, preferably detachably to the front end of said shaft. In the embodiment shown the front end 26 of said shaft is provided with the socket 32. Said shaft is also provided with the detachable set screw 34 therein for detachably securing different shaped mandrels 30 to the front end of said shaft. In the embodiment shown, I provide a generally oblong shaped mandrel particularly adapted for winding generally oblong shaped coils of wire. For a purpose to be described the mandrel 30, preferably only projects a relatively short distance from the front end 26 of said shaft 18, in the embodiment shown being sufficient to wind approximately two coils of wire on said mandrel. For a purpose to be described, the outer end 38 of said mandrel preferably has the center portion 36 thereof open to form the winding pins 40 and 40¹ projecting forwardly from each end of the front end of the mandrel 30.

I will describe the various steps which take place in the manufacture of the wire and the corresponding movements in the apparatus therefor in the order of their occurrence, al-

though it is apparent that the exact order of these steps may be varied in use as desired.

The wire is fed from a suitable source of supply in the embodiment shown, said source of supply consisting of the wire coil 42 rotatably mounted on an adjacent shaft 43 parallel to the shaft 18. The continuous wire 44 from said coil 42 is then passed through suitable tension means 46. While any suitable type of tension means may be employed, I preferably provide the specific means about to be described in which the tension may be adjustably varied in a pre-determined manner. The wire 44 from the coil 42 in the embodiment shown is first led substantially vertically downwardly and then bent at substantially right angles as at 48 by means of the spring loop 50 into the tension means 46. Said means includes the lower roller 52 revolvably mounted in an extension 54 of the frame. The arm 56 is pivotally mounted as at 58 so as to project forwardly from said pivot point thereof. Said arm 56 has the upper roller 60 revolvably mounted therein so as to depend therefrom over the lower roller 52. The spring 62 is provided to normally urge the arm 56 away from its support 54. The arm 56 extends forwardly a considerable distance and has its outer end graduated as at 63. The weight 64 is adapted to be adjustably hung through the medium of the hook 66 on said graduated arm 56 to vary the amount of tension exerted on the upper roller 60 to vary the tension at which the wire is fed to the mandrel 30. I also provide the adjustable guide tube 68 adjustably mounted through a channel 74 extending inwardly of said support 54 and retained in set position through the medium of the set screw 76 and having an inner end adapted to lead the wire into the nip between the two tension rollers 52 and 60.

In order to guide the wire toward the mandrel in the desired manner I provide the pitch cam 78 which also performs an additional function of imparting the desired pitch to the wire in a manner to be described. The pitch cam 78 is secured to the front end 28 of said frame 12 between the mandrel 30 and the tension rollers. Said pitch cam 78 has an outer irregular top surface 80 provided with a high point 82, in the embodiment shown being curved. Said outer top surface 80 of the pitch cam terminates in an inner end 84 substantially adjacent the circular path of the mandrel edge. Said inner end 84 is, for a purpose to be described, lower than the high point 82 of said outer top surface 80 and said inner end 84 is also, for a purpose to be described, at a point substantially above the opposite end of the oblong mandrel when said mandrel is rotated to a substantially horizontal position. Said pitch cam 78 is also provided with an inner arcuate top portion 86 of substantially the curvature

of the circular path of the edge of said mandrel, terminating at a point substantially below the vertical position of the mandrel at the inner end 88.

In order to firmly retain the wire against the side of the frame 12 as it is being wound on the mandrel, I provide the retaining arm 90 adjustably mounted on the front end 26 of said frame above said pitch cam 78. Said retaining arm 90 is adjustably mounted on said frame through the medium of the bolt 92 adjustable within the slot 94 in said arm 90. Said retaining arm 90 has the lower end 96 terminating substantially near the inner end 84 of the top outer surface 80 of the pitch cam and near the circular path of the mandrel edge; said lower end 96 is spaced from the front face 26 of the frame 12 more than the diameter of the wire to prevent the wire from sliding out therefrom. To retain the continuously fed wire 44 adjacent the frame and inner end of the mandrel said retaining arm 90 is made adjustable in case different size mandrels or wires are employed and adjustments of the arm 96 will have some effect in determining the oblique pitch of the wound wire.

For ease in understanding the operation of the specific embodiment of my invention, I will divide the description of the winding of the wire into that of its each respective four half coils. In Figs. 5 to 9 I have attempted diagrammatically to show these steps.

Fig. 5 shows the mandrel in substantially horizontal position with approximately one full coil wound thereon. In the description I will refer to the half coils *a*, *b*, *c* and *d* as including both the sides *a*¹, *b*¹ etc., thereof and the ends *a*², *b*² etc. thereof.

Coil *a* is formed by rotating the mandrel from one substantially horizontal position through a half revolution to a horizontal position substantially that of Fig. 5. When the thus last formed half coil *a* on the mandrel 30 assumes the substantially horizontal position shown in Fig. 5 I provide suitable means adapted to abut the side *a*¹ of said half coil to compress it to a position lower than its desired set position so that in use it will assume or spring back to its set position. It is apparent that as the mandrel 30 is rotated from the vertical indicated position in Fig. 6 namely a semi-revolution prior to that actually shown, to the substantially horizontal position shown in Fig. 5, that the continuous source of wire supply, including the side *a*¹ of the half coil *a*, will be supported at two points indicated in Fig. 7 namely a semi-revolution prior to that actually shown; namely, at the top point 82 of the outer top surface 80 of the cam 78 and at the opposite mandrel edge 98. The means I employ to bend the side *a*¹ of the last formed half coil *a* to more than its set position, includes the shaping arm 102 operable in a manner to be

explained as the mandrel 30 assumes a substantially horizontal position having a substantially flat lower end 104 bent to lie adjacent the front frame face 26 above the inner end of the mandrel and to be moved from the position indicated in Fig. 7 abutting the wire 44 as the mandrel moves from the position indicated in Fig. 7 to the position shown in Fig. 5 to be depressed to bend the half coil side a^1 downward, on the outer top surface of the cam 78. The downward movement of the side a^1 and wire 44 is limited by the inner end 84 of the outer top surface 80 of the cam 78 which, as seen in Fig. 5, is substantially above the adjacent edge 100 of the mandrel when the mandrel assumes the horizontal position. It is thus seen that the side a^1 of the wire is bent to a substantially more than flat position so that in use it will assume when set, a substantially flat position. It is also apparent that the side a^1 of the wire can be made either concave or convex by adjusting the depression of the lower end 104 of the shaping arm 102 during this operation, thus forming in the finished wire coil either parallel oblate spheroids having concave sides, the substantially flat wire coil having substantially flat parallel sides as shown or an oblong shape having parallel convex sides and in the claims I employ the word oblong to include any of these shapes whether the side a^1 is flat or not, so long as the sides of the wire are substantially parallel to adjacent sides in the coil. It is apparent that the end a^2 of the last formed half coil a will be initially suitably shaped by winding it around the mandrel edge 98.

I will now describe the formation of the next to the last formed half coil b . After the half coil a is formed, as the mandrel 30 is revolved another semi-revolution, it is obvious that the first formed half coil a will become the half coil b and that a new half coil a will be formed in a manner herein described. As stated, I provide the pitch cam 78 adapted to bend one end of each wire half coil obliquely outwardly while the other end is being firmly held to impart more than the winding pitch namely the desired pitch to the completed wire. The mandrel 30 is rotated a quarter revolution from the position shown in Fig. 5 to the position shown in Fig. 6. It is apparent that as the mandrel approaches a vertical position, the edge 98 will draw near the inner end 88 of the pitch cam 78. In order to impart the desired pitch to the wire, the outer surface 106 of the pitch cam is curved from the inner end 88 thereof substantially adjacent the shaft end and mandrel edge 98 when it assumes a vertical position to the front end 108 of the outer end 84 of the arcuately curved inner top surface 86 of the pitch cam 78 in an arc to provide the desired pitch to the wire during its outward travel on the mandrel in the formation of the

next to the last formed half coil b thereon. As shown in Fig. 5, the outer edge 84 of the inner arcuate top portion 86 of the pitch cam 78, terminates at a point approximately 20 degrees above the horizontal position of the mandrel shown in Fig. 5. As the mandrel rotates the end b^2 of the half coil b of the wire abuts the front curved surface 106 of said cam and is forced outwardly through an arc of approximately 110 degrees until the end b^2 passes from said outer surface 106. While the end b^2 of said half coil b is being urged outwardly by the front surface 106 of the cam 78, the inner end a^2 of said half coil b is firmly retained near the inner end of said mandrel by the tension between the tension rollers and edge 100 of said mandrel and also by the lower end 96 of said retaining arm and thus the end b^2 of said half coil b is forced outwardly while the opposite end a^2 is firmly held in position adjacent the inner end of the mandrel, thus bending the wire obliquely outwardly to impart the desired pitch thereto. As the next successive half coils a and b are being formed, the first formed half coil becomes the half coil c , etc. As the side b^1 thereof has already been given an oblique set, it is obvious it will merely travel outwardly as c^1 on the mandrel 30 as shown in Fig. 7. As the mandrel is given a further semi-revolution, it is obvious that successive half coils, a , b and c will be formed and that the first formed half coil will become the half coil d and will assume a position in which it may be readily stripped from the mandrel and bent toward the next formed half coil c in a manner to give the desired set to the wire about to be explained.

Particularly in making very small wire, the next to the last formed half coil b may be simultaneously stripped from the wire as the pitch is being imparted thereto by the single pitch cam 78. However, particularly in making heavy wire to impart very clearly the desired degree of pitch, I have found it desirable to wind the extra half coils c and d upon the mandrel before stripping the first formed half coil d therefrom. For this purpose I provide the stripper cam 112 preferably of the general configuration of the pitch cam 78 and also secured to said frame with said pitch cam 78 through the medium of the bolts 113. The upper and lower surfaces of said stripper cam 112 are preferably substantially parallel and coincident with those of the pitch cam. The rear surface 116 of said stripper cam is spaced from the front surface of said pitch cam sufficiently to permit the oblique bending of the wire. Said rear surface 116 also acts to form with the front surface of the pitch cam a guide-way to prevent excessive outward movement of the end b^2 . The front surface 118 of said stripper cam 112 near the inner end thereof, is curved from the inner end 117 thereof substantially adjacent to the inner end 88 of said pitch cam but spaced there-

from more than the diameter of the wire with a greater degree of curvature than that of the pitch cam, ending at the portion 121 of the cam, not as far out as the outer end 84 of the inner top surface 86 of the pitch cam, in order to strip the end d^2 of the wire from the pin 40¹ at a point substantially before the mandrel 30 again attains a horizontal position. It is thus apparent that after the substantially 60° revolution taking place as shown between Fig. 6 and Fig. 7, that the end d^2 is stripped from the pin 40¹ and due to the inherent resiliency of the wire, will spring downward.

As stated, I have provided means to bend the stripped end d^2 and side d upwards as shown in Fig. 8 past the opposite parallel sides c^1 and a^1 of the half coils c and a to give to the end c^2 thereof a curvature greater than its desired curvature in use so that in use it will assume this desired curvature and assist in making the sides a^1 , b^1 , c^1 and d^1 of the wire substantially parallel. For this purpose I provide the coil end curving arm 120 having a bifurcated upper end 122 adapted to project upwardly as the mandrel again approaches a horizontal position to strike the side d^1 of the half coil d and bend it upwardly through the open center portion 36 of said mandrel, to bend the end c^2 more than the desired degree of curvature so it will assume its set position in use. For this purpose, the bifurcated upper end 122 has the slot 124 therein substantially parallel to the frame front wall and the outer end of the mandrel. Thus, when the mandrel is in the position shown in Fig. 7, the coil end curving arm 120 will be raised so as to strike the resiliently lowered side d^1 of the half coil d and as the mandrel moves from the position shown in Fig. 7 to the position shown in Fig. 8, the coil end curving arm 120 will be forced upwardly to bend the side d^1 of the half coil d upwardly through the open center portion 36 of said mandrel, past the pin 40¹ to give more than the desired degree of curvature to the coil end c^2 retained on the pin 40 of the mandrel. It is then obvious that as said plunger arm is again lowered on further rotation of the mandrel, that the side d^1 will come back to the approximately flat shape desired in use and illustrated in Fig. 9.

While any means may be provided for advancing the shaping arm 102 and coil end curving arm 120 at the desired periods in mandrel revolution, in the embodiment shown; namely—when the mandrel 30 is around its horizontal position twice each cam revolution in the formation of each respective half coil a , b , c , and d , in my preferred embodiment I preferably construct said means as follows:—I provide the upper and lower front plungers 130 and 132 respectively vertically slidable in guide-ways 134 and 136 respectively in the front end of said

frame 12. Said plungers 130 and 132 are provided at their inner ends respectively with sockets 138 and 140 for detachably securing therein the desired size shaping arm 102 and coil end curving arm 120. Said arms 102 and 120 are adjustable in said slots 138 and 140 respectively by medium of the set screws 142. I also provide means to normally urge said plungers away from said mandrel 30. In my preferred embodiment said means comprises the pins 144 projecting inwardly from said plungers adapted to be urged outwardly by the springs 146 resting in suitable sockets 148 in said frame. I mount the upper lever arm 150 and the lower lever arm 152, both levers of the first class, respectively on the pivot bars 154 and 156 mounted centrally transversely of the upper and lower portions of said frame 12. Said lever arms 150 and 152 are levers of the first class and each has a respective front end 157 and 158 adapted to adjustably abut the outer ends of the respective plungers 130 and 132 respectively. I also in suitable guide ways 160 and 162 vertically slidably mount the upper and lower respective rear plungers 164 and 166 on the rear end of said frame 12 having the inner ends 168 and 170 thereof adapted to abut diametrically opposite points on said elliptical cam 20. Said upper and lower levers 150 and 152 are provided with rear ends 172 and 174 respectively adapted to abut the outer ends of the respective upper and lower rear plungers 164 and 166. I provide the bolts 178 in the front and rear ends respectively of said levers 150 and 152 adjustable within to abut the outer ends of said plungers and it is obvious that the amount of movement of said plungers and respective arms may be varied by adjusting the length of the inwardly projecting ends of said bolts 178. It is thus apparent that with the elliptical construction of the cam 20, said plungers 102 and 120 may be advanced to an advanced position adjacent the mandrel 30 at two periods of the cam shaft and mandrel cycles of revolution namely as shown when the mandrel approaches its horizontal position in the manner described; thus causing the upper front plunger shaping arm 102 to strike the upper surface of said last formed half coil side a^1 to bend it downward between its points of support on the pitch cam and opposite mandrel edge to bend it to the desired configuration past its desired set configuration and said lower front plunger curving arm 120 may strike the just stripped half coil side d^1 to bend its inner end c^2 upward through the open central mandrel portion 38 between said pins 40 and 40¹ to give the coil end c^2 the desired set degree of configuration twice each revolution as said mandrel is around its horizontal position.

I have found that by varying the adjustment of the weight 64 on the arm 56 that

the degree of tension may be varied to give the desired oblique curvature to the sides a , etc., of the coil and the desired degree of curvature of the ends a^2 etc., of the coils for wires of different size and different degrees of resiliency.

It is apparent that I have provided not only a novel apparatus for forming substantially oblong wire coils but that I have provided a novel method of making wire coils particularly those of oblong shape so as to insure that they will assume the flat position shown in Fig. 4^a with the half coils a , b , c , etc., thereof substantially parallel in use, whether the sides a^1 , b^1 , c^1 , etc., are substantially flat, concave or convex and that the shape of said sides may be varied in a manner hitherto explained by adjustment of the depression of the shaping arm 102. As stated hitherto the steps I believe novel include the steps of imparting more than the winding pitch to the wire by bending it obliquely outwardly on the rotating mandrel as it is being formed, the steps particularly useful in forming oblong shaped wire of bending the sides thereof towards adjacent and even past adjacent opposite sides to bend the ends a^2 , b^2 , etc., more than the desired set degree of curvature to make said sides a^1 , b^1 , etc., substantially parallel and of compressing each half coil side a^1 , b^1 , c^1 , etc., towards the opposite side I have also aided in shaping each side of the coil to the desired shape, preferably to a point past the position it is desired for it to assume in use so that in use it may assume the desired set position, and that by the novel step I employ of using stripping means to strip the coil from a short mandrel, I have also been able to further facilitate the manufacture of wire coil of this description.

I also believe that the pitch cam I employ in combination with the rotating mandrel is broadly new, the stripper cam is broadly new and that the provision of a mandrel having a hollow outer end to permit the bending of a wire side through it, is also broadly new.

It is understood that my invention is not limited to the specific embodiment shown or methods described and that various deviations may be made therefrom without departing from the spirit and scope of the appended claims.

What I claim is:

1. The method of making substantially oblong wire coil having spaced substantially parallel coils which comprises forming wire into a series of oblong coils by continuously forming it under tension, imparting to each coil as it is formed the desired pitch by bending it obliquely outwardly the desired amount, compressing each half coil side beyond its desired set position to cause it to resiliently spring back to its desired flat po-

sition to shape each side of the coil to the desired shape and pressing each oblique half coil transversely to the axis of the coil beyond its desired finished position to give the desired set degree of curvature to each respective half coil end.

2. The method of making substantially oblong wire coil having spaced substantially parallel oblong coils which comprises forming wire into a series of oblong coils by continuously winding it under tension, imparting to each coil as it is formed the desired pitch by bending it obliquely outwardly the desired amount and pressing each oblique half coil transversely to the axis of the coil beyond its desired finished position to give the desired set degree of curvature to each respective half coil end.

3. The method of making substantially oblong wire coil having spaced substantially parallel coils which comprises forming wire into a series of oblong coils by continuously winding it under tension, imparting to each coil as it is formed the desired pitch by bending it obliquely outwardly the desired amount and compressing each half coil side beyond its desired set position to cause it to resiliently spring back to its desired flat position to shape each side of the coil to the desired shape.

4. The method of making substantially oblong wire coil having spaced substantially parallel coils which comprises forming wire into a series of oblong coils by continuously winding it under tension, compressing each half coil side beyond its desired set position to cause it to spring back to its desired flat position to shape each side of the coil to the desired shape and pressing each half coil transversely to the axis of the coil beyond its desired finished position to give the desired set degree of curvature to each respective half coil end.

5. The method of making substantially oblong wire coil having spaced substantially parallel coils which comprises forming wire into a series of oblong coils by continuously winding it under tension and compressing each half coil side beyond its desired set position to cause it to resiliently spring back to its desired flat position to shape each side of the coil to the desired shape.

6. The method of making substantially oblong wire coil having spaced substantially parallel coils which comprises forming wire into a series of coils by continuously winding it under tension and pressing each oblique half coil transversely to the axis of the coil beyond its desired finished position to give the desired set degree of curvature to each respective half coil end.

7. In an apparatus for forming substantially oblong wire coil, a revoluble oblong mandrel having the center portion of one end thereof open to form winding pins project-

ing forwardly therefrom, means to continuously feed wire under tension to said mandrel, means to bend said wire as formed on said mandrel towards the free end of said mandrel to impart more than the winding pitch thereto, means to compress each half coil side as formed beyond its desired set position to cause it to spring to the desired shape, and means to press each oblique half coil side as one end thereof passes beyond the mandrel end through the open center portion of said mandrel to give the desired set degree of curvature to each respective half coil end.

8. In an apparatus for forming substantially oblong wire coil, a revoluble oblong mandrel having the center portion of one end thereof open to form winding pins projecting forwardly therefrom, means to continuously feed wire under tension to said mandrel, means to bend said wire as formed on said mandrel towards the free end of said mandrel to impart more than the winding pitch thereto, and means to press each oblique half coil side as one end thereof passes beyond the mandrel end through the open center portion of said mandrel to give the desired set degree of curvature to each respective half coil end.

9. In an apparatus for forming substantially oblong wire coil, a revoluble oblong mandrel, means to continuously feed wire under tension to said mandrel, means to bend said wire as formed on said mandrel towards the free end of said mandrel to impart more than the winding pitch thereto and means to compress each half coil side as formed beyond its desired set position to cause it to spring back to the desired set shape.

10. In an apparatus for forming substantially oblong wire, a revoluble oblong mandrel having the center portion of one end thereof open to form winding pins projecting forwardly therefrom, means to continuously feed wire coil under tension to said mandrel, means to compress each half coil side as formed beyond its desired set position to cause it to spring back to the desired set shape, and means to press each oblique half coil side as one end thereof passes beyond the mandrel end through the open center portion of said mandrel to give the desired set degree of curvature to each respective half coil end.

11. In an apparatus for forming substantially oblong wire coil, a revoluble oblong mandrel, means to continuously feed wire under tension to said mandrel, and means to compress each half coil side as formed beyond its desired set position to cause it to spring back to the desired set shape.

12. In an apparatus for forming substantially oblong wire coil, a revoluble oblong mandrel having the center portion of one end thereof open to form winding pins pro-

jecting forwardly therefrom, means to continuously feed wire under tension to said mandrel, and means to press each oblique half coil side as one end thereof passes beyond the mandrel and through the open center portion of said mandrel to give the desired set degree of curvature to each respective half coil end.

13. In an apparatus for forming substantially oblong wire coil, a frame, a substantially oblong mandrel rotatably mounted on said frame, having the center portion of one end thereof open to form winding pins projecting from each end thereof, means to continuously feed wire under tension to said mandrel, a pitch cam shaped to abut each wire half coil as it is being wound on said mandrel and to force it outwardly toward the free end of said mandrel to impart more than the winding pitch thereto, means on said frame to hold the opposite end of said half coil while the outer end thereof is being bent outwardly by said pitch cam to impart the desired pitch thereto, a stripper cam attached to said frame adjacent the free end of said mandrel to strip one oblique end of said obliquely bent half coil from said mandrel and at a pre-determined period of mandrel revolution, a shaping arm, time controlled means to advance said shaping arm to a position to compress each coil flat side to the desired configuration at a pre-determined period in the mandrel revolution, a coil end curving arm having a bifurcated end and time controlled means to advance said coil end curving arm to a position to bend said oblique stripped first formed half coil through the center portion of said mandrel to give the desired curvature to each coil end at a pre-determined period of mandrel revolution.

14. In an apparatus for forming substantially oblong wire coil, a frame, a substantially oblong mandrel rotatably mounted on said frame, having the center portion of one end thereof open to form winding pins projecting from each end thereof, means to continuously feed wire under tension to said mandrel, a pitch cam shaped to abut each wire half coil as it is being wound on said mandrel and to force it outwardly toward the free end of said mandrel to impart more than the winding pitch thereto, means on said frame to hold the opposite end of said half coil while the outer end thereof is being bent outwardly by said pitch cam to impart the desired pitch thereto, a coil end curving arm having a bifurcated end and time controlled means to advance said coil end curving arm to a position to bend said oblique stripped first formed half coil through the center portion of said mandrel to give the desired curvature to each coil end at a pre-determined period of mandrel revolution.

15. In an apparatus for forming substan-

tially oblong wire coil, a frame, a substantially oblong mandrel rotatably mounted on said frame, means to continuously feed wire under tension to said mandrel, a pitch cam shaped to abut each wire half coil as it is being wound on said mandrel and to force it outwardly toward the free end of said mandrel to impart more than the winding pitch thereto, means on said frame to hold the opposite end of said half coil while the outer end thereof is being bent outwardly by said pitch cam to impart the desired pitch thereto, a shaping arm, and time controlled means to advance said shaping arm to a position to compress each coil flat side to the desired configuration at a pre-determined period in the mandrel revolution.

16. In an apparatus for forming substantially oblong wire coil, a frame, a substantially oblong mandrel rotatably mounted on said frame, having the center portion of one end thereof open to form winding pins projecting from each end thereof, means to continuously feed wire under tension to said mandrel, a shaping arm, time controlled means to advance said shaping arm to a position to compress each coil flat side beyond its desired set position at a pre-determined period in the mandrel revolution to cause it to spring to the desired configuration, a coil end curving arm having a bifurcated end, and time controlled means to advance said coil end curving arm to a position to bend first formed half coil through the center portion of said mandrel to give the desired curvature to each coil end at a pre-determined period of mandrel revolution.

17. In an apparatus for forming substantially oblong wire coil, a frame, a substantially oblong mandrel rotatably mounted on said frame, means to continuously feed wire under tension to said mandrel, a shaping arm, and time controlled means to advance said shaping arm to a position to compress each flat coil side beyond its desired set position at a pre-determined period in the mandrel revolution to cause it to spring back to the desired flat configuration.

18. In an apparatus for forming substantially oblong wire coil, a frame, a substantially oblong mandrel rotatably mounted on said frame, having the center portion of one end thereof open to form winding pins projecting from each end thereof, means to continuously feed wire under tension to said mandrel, a coil end curving arm having a bifurcated end, and time controlled means to advance said coil end curving arm to a position to bend first formed half coil through the center portion of said mandrel to give the desired curvature to each coil end at a pre-determined period of mandrel revolution.

19. In an apparatus for forming substantially oblong wire coil, a frame, a substan-

tially oblong mandrel rotatably mounted on said frame, having the center portion of one end thereof open to form winding pins projecting from each end thereof, means to continuously feed wire under tension to said mandrel, a pitch cam shaped to abut each wire half coil as it is being wound on said mandrel to impart more than the winding pitch thereto, means on said frame to hold the opposite end of said half coil while the outer end thereof is being bent outwardly by said pitch cam to impart the desired pitch thereto, a stripper cam attached to said frame adjacent the free end of said mandrel to strip one oblique end of said obliquely bent half coil from said mandrel end at a pre-determined period of mandrel revolution, a coil end curving arm having a bifurcated end, and time controlled means to advance said coil end curving arm to a position to bend said oblique stripped first formed half coil through the center portion of said mandrel to give the desired curvature to each coil end at a pre-determined period of mandrel revolution.

20. In an apparatus for forming substantially oblong wire coil, a frame, a substantially oblong mandrel rotatably mounted on said frame, means to continuously feed wire under tension to said mandrel, a pitch cam shaped to abut each wire half coil as it is being wound on said mandrel and to force it outwardly toward the free end of said mandrel to impart more than the winding pitch thereto, means on said frame to hold the opposite end of said half coil while the outer end thereof is being bent outwardly by said pitch cam to impart the desired pitch thereto, a stripper cam attached to said frame adjacent the free end of said mandrel to strip one oblique end of said obliquely bent half coil from said mandrel end at a pre-determined period of mandrel revolution, a shaping arm, and time controlled means to advance said shaping arm to a position to compress each coil flat side to the desired configuration at a pre-determined period in the mandrel revolution.

21. In an apparatus for forming substantially oblong wire coil, a frame, a substantially oblong mandrel rotatably mounted on said frame, having the center portion of one end thereof open to form winding pins projecting from each end thereof, means to continuously feed wire under tension to said mandrel, a stripper cam attached to said frame adjacent the free end of said mandrel to strip one end of each half coil from said mandrel end at a pre-determined period of mandrel revolution, a shaping arm, time controlled means to advance said shaping arm to a position to compress each coil flat side to the desired configuration at a pre-determined period in the mandrel revolution, a coil end curving arm having a bifurcated end, and

time controlled means to advance said coil end curving arm to a position to bend said stripped first formed half coil through the center portion of said mandrel to give the
5 desired curvature to each coil end at a pre-determined period of mandrel revolution.

22. In an apparatus for forming substantially oblong wire coil, a frame, a substantially oblong mandrel rotatably mounted on
10 said frame, having the center portion of one end thereof open to form winding pins projecting from each end thereof, means to continuously feed wire under tension to said mandrel, a stripper cam attached to said
15 frame adjacent the free end of said mandrel to strip one end of each half coil from said mandrel end at a pre-determined period of mandrel revolution, a coil end curving arm having a bifurcated end, and time controlled
20 means to advance said coil end curving arm to a position to bend said stripped first formed half coil through the center portion of said mandrel to give the desired curvature to each coil end at a pre-determined period
25 of mandrel revolution.

23. In an apparatus for forming wire coil, a revoluble substantially oblong mandrel having the center portion of one end thereof solid and the center portion of the other end
30 thereof open to form winding pins projecting forwardly therefrom.

In testimony whereof I affix my signature.
ARTHUR H. GARST.

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