June 12, 1956 H. L. KITSELMAN 2,749,962

HELIX FORMER

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Fig. 1.

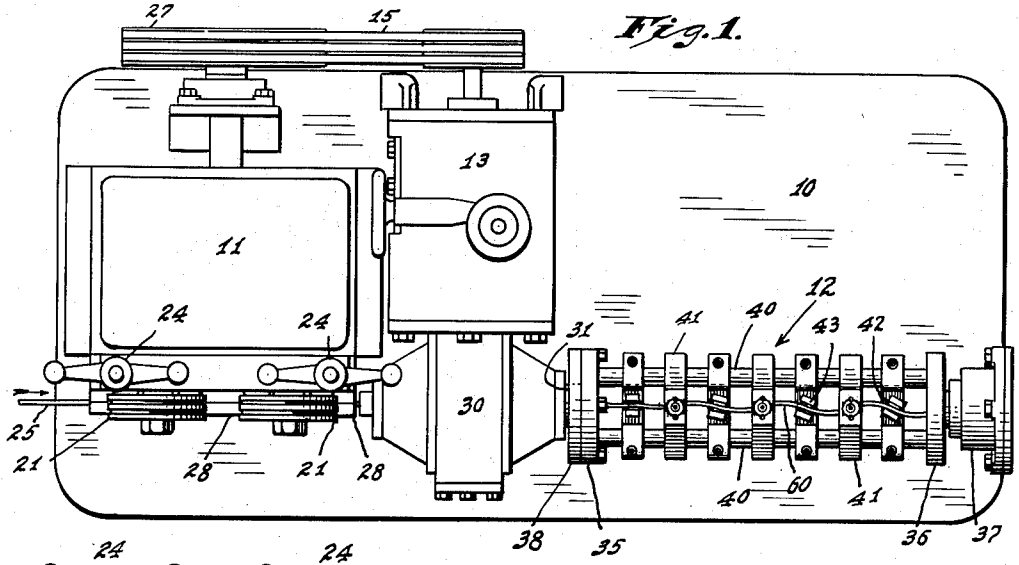



Fig. 2.

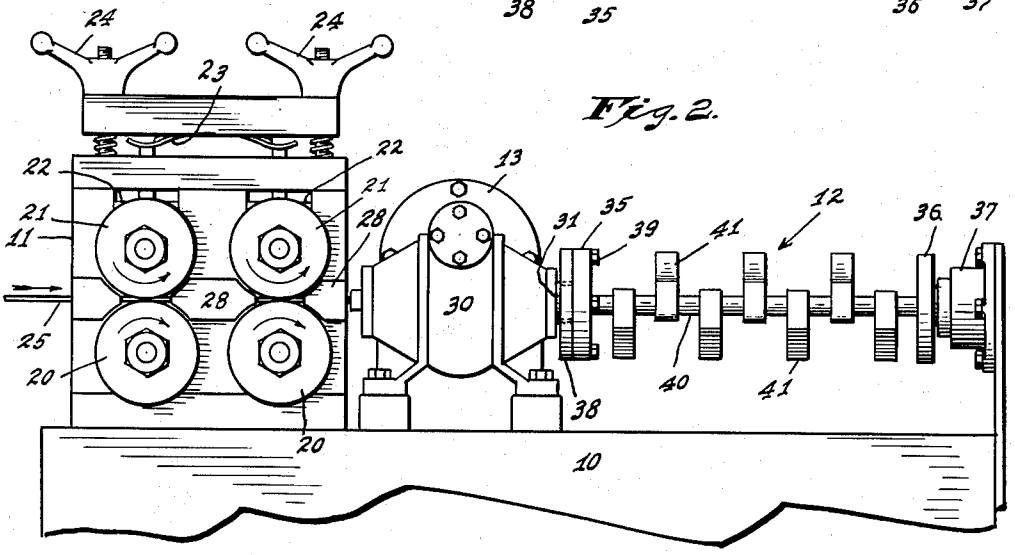
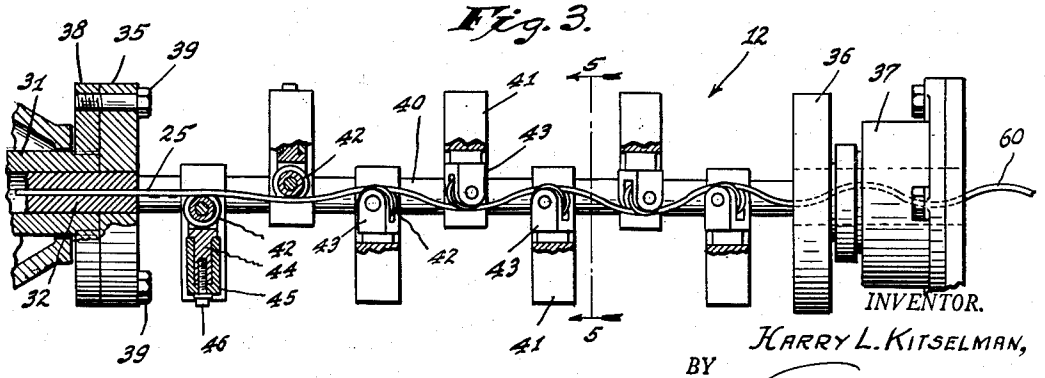



Fig. 3.




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Fig. 4.

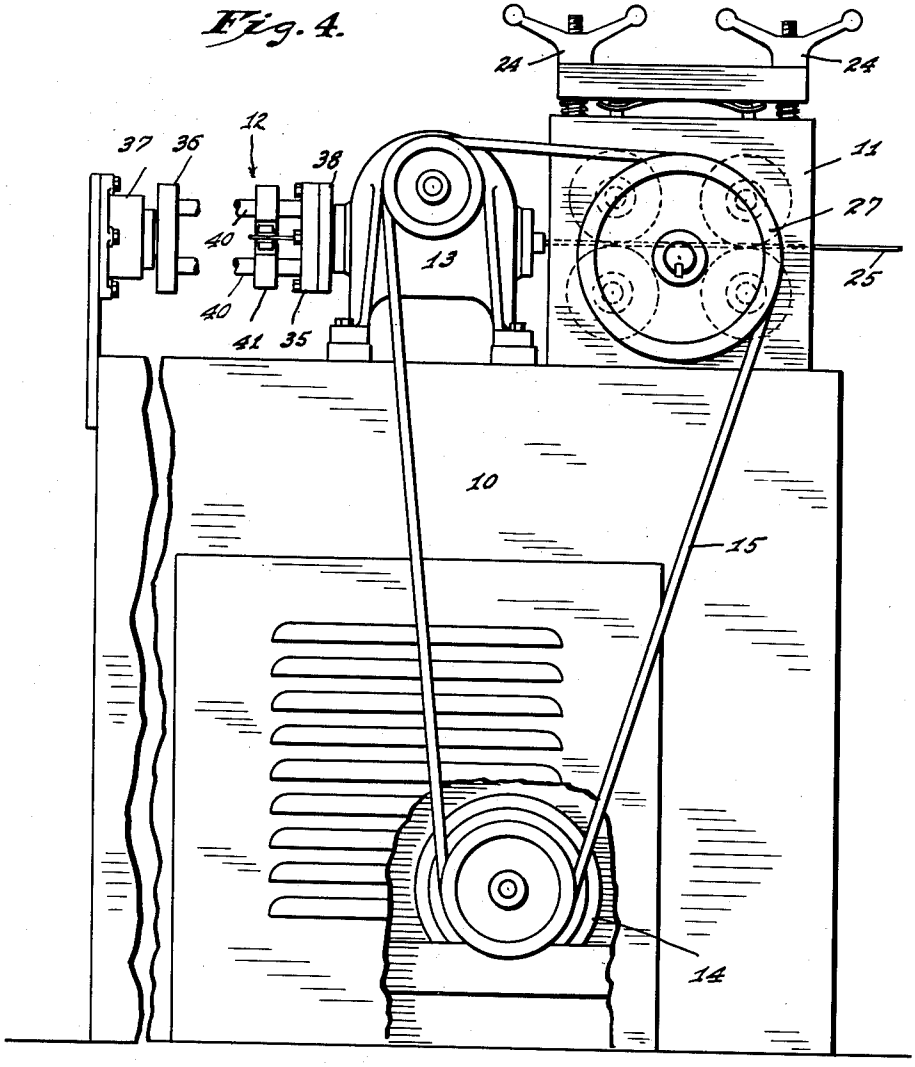



Fig. 5.

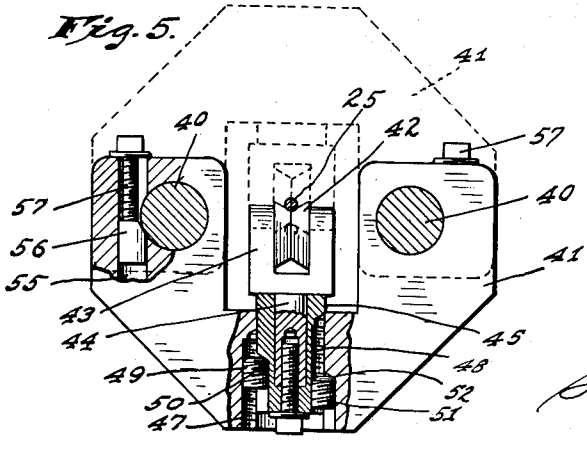
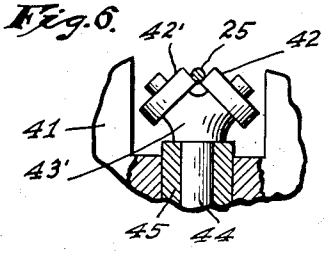



Fig. 6.




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2,749,962

# HELIX FORMER

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Application November 21, 1951, Serial No. 257,467

15 Claims. (Cl. 153—64)

This invention relates to a machine for forming wire continuously into a helix. The invention is especially suited for the formation of a helix of relatively long pitch, by which I mean a helix whose pitch is considerably greater, and usually several times greater, than its diameter. The machine operates to bend at a constant curvature a wire which is fed into it and to rotate the plane of bending about the axis of the wire.

It is an object of the invention to produce a machine of the type described which can be simply and economically constructed and which is readily adjustable to vary the pitch, the diameter, and the hand of the helix produced.

In carrying out the invention in its preferred form I employ a rotating bending unit having a series of three or more wire-engaging elements, desirably rollers, adjacent ones of which are offset transversely of the axis of unit rotation to produce a bend in the wire. Wire-feeding means forces the wire into and through the bending unit, which rotates at a speed co-ordinated with the speed of wire-feed to produce the desired helix. The wire-engaging elements of the bending unit are mounted for independent adjustment transversely of the axis of unit rotation so as to vary the degree of bending they effect. In addition, the wire-engaging elements are mounted for adjustment axially of the unit to vary the pitch of the helix produced. Conveniently, the wire-feeding means is arranged to feed wire at a constant rate and a variable-speed means is employed to rotate the bending unit. If the driving means for the bending unit is made reversible, helixes of either hand can be produced.

The accompanying drawing illustrates the invention: Fig. 1 is a plan view of the helix-forming machine; Fig. 2 is a fragmental front elevation of the machine shown in Fig. 1; Fig. 3 is a fragmental view similar to Fig. 2 but on an enlarged scale illustrating details of the bending unit; Fig. 4 is a rear elevation of the machine; Fig. 5 is a transverse section on the line 5—5 of Fig. 3; and Fig. 6 is a fragmental view similar to Fig. 5, but showing a modified construction.

The machine shown in the drawing comprises a base **10** from which there are supported a wire-feeding unit **11**, a wire-bending unit **12**, a variable-speed transmission unit **13** and a driving means such as an electric motor **14** (Fig. 4) for driving the wire-feeding unit **11** and transmission **13**. As shown, the motor **14** is mounted near the bottom of the base and is connected through a belt drive **15** to the feed unit **11** and transmission device **13**.

The wire-feed unit shown is conventional in type and includes two pairs of wire-gripping rolls. Each such pair of rolls comprises a lower roll **20** mounted on a fixed axis and an upper roll **21** rotatably supported from a vertically movable slide **22**. A leaf spring **23** urges the slides **22** downwardly with a force which can be varied by the adjusting nuts **24**. The feed rolls are provided with coplanar grooves which receive the stock wire **25**,



and the lower rolls are driven through gearing (not shown) from a pulley **27** over which the belt **15** passes. Between and beyond the feed rolls **20**, **21**, the stock wire **25** is supported by suitable guides **28**.

Supported from the base **10** beyond the wire-feeding unit **11** in the direction of wire feed is a housing **30** within which there is mounted a hollow shaft **31** rotatable about an axis aligned with the stock wire **25** and operatively connected as through worm gearing (not shown) with the driven element of the transmission device **13**. Desirably, the shaft **31** is provided with a bushing or liner **32** which rather closely receives and supports the stock wire **25** after it leaves the feeding unit **11**.

The transmission device **13**, which is driven from the belt **15** as above noted, is desirably of the type which provides an infinitely or steplessly variable ratio between its driving and driven elements. Reversibility of the shaft **31** necessary to the alternative production of right-hand or left-hand helixes, may be provided by the transmission device **13**; but if the transmission device itself is not capable of driving the shaft **31** alternatively in either direction, a supplementary reversing gear may be employed for the purpose.

The wire-bending unit **12** comprises a pair of spaced, co-axial heads **35** and **36**, the former connected to the shaft **31** and the latter rotatably supported from the base **10** through an appropriate bearing **37**. Conveniently, the shaft **31** is provided with a flange **38** to which the head **35** is removably secured as by means of screws **39**.

Extending between and secured to the heads **35** and **36** on opposite sides of their common axis of rotation are two parallel rods **40** which slidably support cross-members **41** providing space mountings for wire-engaging elements desirably in the form of grooved rollers **42**. Each of such rollers is supported for rotation about its own axis in a yoke **43** which is in turn supported from the cross member **41** for rotation about an axis coplanar with and perpendicular to the axis of rotation of the wire-bending unit. In addition to being rotatable about the axis last mentioned, each yoke **43** is mounted for adjustment transversely of the axis of unit rotation.

In the preferred arrangement for supporting the yokes from the cross-members **41**, each yoke has a shank **44** rotatably received in a sleeve **45** which is slidable radially of the bending unit in the associated cross-member **41**. A clamp screw **46** extends through the end of the sleeve **45** and into the shank **44** so that the yoke **43** may be clamped in any desired position of adjustment about the shank-axis. On diametrically opposite sides of the sleeve **45** are two holes which are parallel to the axis of the sleeve and each of which is located half in the sleeve and half in the cross-member **41**. In one of such holes, the half located in the cross member **41** is provided with screw threads, as indicated at **47**, while in the other hole the half located in the sleeve **45** is screw-threaded as shown at **48**. The former hole receives a set screw **49** which cooperates with the screw threads **47** and seats against a shoulder **50** at the inner end of the hole-half in the sleeve **45**; while the other hole receives a set screw **51** cooperating with the screw threads **48** and similarly seating against a shoulder **52**. It will be obvious that the screws **49** and **51** can be rotated to move the sleeve **45** toward or away from the axis of rotation of the wire-bending unit and that engagement of the screws with the shoulders **50** and **52** will lock the sleeve **45** in any desired position of adjustment.

In manufacture of the sleeve-adjusting means just described, which is not new with me, the sleeve **45** is secured in the cross member **41**, and two holes are drilled on diametrically opposite sides of the sleeve axis with their

axes approximately coinciding with the outer surface of the sleeve. One of these holes is conveniently deeper than the other and has a diameter equal to the tap-drill diameter of the threads on the screws 49 and 51; while the other, or shallower, hole has a diameter equal to or slightly greater than the outer diameter of the screws 49 and 51. With the sleeve still held in the position it occupied when the holes were drilled, the deeper hole is tapped to provide the threads 47 and 48. After the tapping operation, the sleeve 45 is turned through 180° about its axis into the position shown, and the screws 49 and 51 are inserted.

For the purpose of locating the cross-members 41 in the desired positions of axial adjustment along the rods 41, any convenient form of clamping means may be employed. In the arrangement illustrated each of the cross-members 41 is provided with a pair of holes 55 located in a plane normal to the rods 40 and offset from but intersecting the holes which slidably receive the rods 40. In each of the holes 55, there is a slidable plug 56 having one end struck off to conform approximately to the curvature of the surface of the rod 40. A clamp screw 57 serves to draw the plug 56 longitudinally of the hole 55 and to force it into firm gripping engagement with the associated rod 40.

In setting up the machine illustrated to produce a helix of any given proportions, the cross-members 41 are distributed along the rods 40 at intervals equal to one-half the pitch of the helix which is to be formed, adjacent cross members facing in opposite directions transversely of the axis of rotation of the bending unit. The sleeves 45 are then adjusted axially of themselves and radially of the unit to produce the desired degree of bending of the wire. To facilitate threading of the wire through the bending unit, advancing of the sleeves 45 to their final position may be deferred until after the wire has been passed completely through the bending unit. With the clamp screws 47 loosened to permit free rotation of the yokes 43 in the sleeves 45, the bending unit is ready for its initial operation. Before beginning such initial operation, the transmission device 13 is adjusted to co-ordinate properly the rotational speed of the bending unit both with the rate of wire-feed and with the pitch of the helix which is to be produced. The machine is then placed in operation, the rollers 20—21 feeding the stock wire axially through the shaft 31 and the bending unit 12 rotating to rotate relatively to the stock-wire the plane in which the wire is bent by the opposing pressures which the rollers 42 exert upon it. The grip of the feed rolls 20—21 on the wire prevents the stock wire from rotating; and, as a result, the wire emerges from the bending unit 12 in the form of a helix 60. Since the clamp screws 47 are loosened, and the yokes 43 free to swing about the axes of the sleeves 45, the rollers 42 will assume inclined positions conforming to the pitch angle of the helix being produced. After a short period of initial operation, the machine may be stopped and the helix checked to determine whether or not any adjustment of the rolls 42 either transversely or axially of the bending unit is necessary to produce a helix of the required conformation. If any such adjustments are indicated, they are made and the machine is again placed in operation. After it has been determined that the rolls 42 are properly adjusted both radially and axially the clamp screws 47 may be tightened.

If the rotational speed of the shaft 31 is exactly co-ordinated with the helix-pitch and rate of stock-wire feed, the finished helix 60 will emerge from the machine without rotating about its axis. However, if the rotational speed of the shaft 31 is not exactly co-ordinated with the pitch and rate of stock-wire feed, the completed helix will rotate in one direction or the other depending upon whether the rotational speed of the shaft 31 is greater or less than it should be.

It may or may not be advisable to employ all the rolls 42 in effecting the necessary transverse bending of the wire. If the helix-diameter is great relatively to the diameter of the stock wire it may be desirable to distribute the bending by increasing progressively from one end of the head to the other the extent to which the rollers 42 project beyond the axis of bending-unit rotation. On the other hand, if the helix diameter is relatively small, the necessary bending may be effected by only three or four successive rollers 42. In the latter event, it is desirable to employ as the bending rollers those located near the forward or left-hand end (Figs. 1 and 3) of the bending unit, the remaining rollers near the opposite end of the bending unit being adjusted merely to hold the wire in position without exerting any effective bending effort.

In adjusting the respective positions of the rollers 42, it is necessary to take into account the "spring-back" of the wire after it is relieved of the forces exerted on it by the rollers. Generally speaking, the spring-back which the finished helix undergoes when relieved of roller-pressure decreases helix-diameter to a slight extent and also slightly increases the pitch of the helix.

In the particular arrangement illustrated in the drawings, the cross-members are distributed along substantially the entire length of the rod 40. If the helix had a shorter pitch than that illustrated, the cross-members would be closer together and would occupy less than the full length of the rods 40. In such a situation, it is desirable to group the cross-members near the discharge end of the bending unit, maintaining the proper interval between them, and to provide for the shaft 31 a liner 32 which will project rearwardly from the shaft and support the stock wire to a point adjacent the first of the wire-bending rollers 42.

Obviously, the hand of the helix produced will depend upon the direction in which the bending unit rotates. By providing a reversible drive for the shaft 31 and by utilizing the rotatability of the yokes 43 about the axes of their shanks 44, helixes of either hand can be produced.

In the modified form of wire-engaging element shown in Fig. 6, each grooved roller 42 is replaced by a pair of rollers 42′ mounted on a support 43′ with their axes perpendicular to each other and their peripheral portions closely adjacent to define a wire-receiving space functionally equivalent to the groove in the roller 42. The rollers 42′ may be the outer races of ball-bearings.

It will be understood that the structure illustrated and described above is a preferred form and that changes in the construction and arrangement may be made without departing from the scope and spirit of the invention claimed.

I claim as my invention:

1. In a machine for forming wire or the like into a helix, a wire-bending unit, means supporting said unit for rotation about an axis, means for feeding wire longitudinally of itself to said unit along a line coincident with such axis, said unit including a series of wire-engaging members spaced from each other axially of the unit, adjacent ones of said members being offset oppositely from each other transversely of the axis of unit rotation to cause progressive bending of the wire fed through the unit, said wire-engaging members being provided with wire-receiving grooves and being mounted in said supporting means for angular adjustment about axes radial with respect to the bending-unit axis and means for rotating said unit about its axis in timed relation to the rate at which the feeding means feeds the wire.

2. The invention set forth in claim 1 with the addition of means supporting said wire-engaging members for adjustment transversely of the axis of bending-unit rotation.

3. The invention set forth in claim 2 with the addition that said wire-engaging members are rollers.

4. The invention set forth in claim 1 with the addition of means supporting said wire-engaging members for

adjustment parallel to the axis of bending-unit rotation.

5. The invention set forth in claim 4 with the addition that said wire-engaging members are rollers.

6. The invention set forth in claim 1 with the addition of means supporting said wire-engaging members for adjustment both transversely of and parallel to the axis of bending-unit rotation.

7. The invention set forth in claim 6 with the addition that said wire-engaging members are rollers.

8. In a machine for forming wire or the like into a helix, a wire-bending unit, means supporting said unit for rotation about an axis, means for feeding wire longitudinally of itself to said unit along a line coincident with such axis, said unit including a series of wire-engaging members spaced from each other axially of the unit, adjacent ones of said members being offset oppositely from each other transversely of the axis of unit rotation to cause progressive bending of the wire fed through the unit, and means for driving said wire feeding means and said wire-bending unit, said driving means including adjustable mechanism to vary the relation between the rate of wire feeding produced by said wire-feeding means and the rate of rotation imparted to said wire-bending unit.

9. The invention set forth in claim 8 with the addition of means supporting said wire-engaging members for adjustment transversely of the axis of bending-unit rotation.

10. The invention set forth in claim 8 with the addition of means supporting said wire-engaging members for adjustment parallel to the axis of bending-unit rotation.

11. The invention set forth in claim 8 with the addition of means supporting said wire-engaging members for adjustment both transversely of and parallel to the axis of bending-unit rotation.

12. In a machine for forming wire or the like into a helix, a rotatable shaft, a wire-bending unit located at one end of said shaft and operatively connected thereto for rotation therewith, said shaft having an axial opening through which wire may be fed to the bending unit, wire-feeding means located at the other end of the shaft for feeding wire through said opening to and through the bending unit, said bending unit including a series of wire-engaging members spaced from each other axially of the bending unit, adjacent ones of said members being offset oppositely from each other transversely of the axis of unit rotation to cause progressive bending of wire fed through the unit, means operatively connected to said shaft for rotating it and the unit in timed relation to the rate at which the feeding means feeds wire, and a liner removably mounted in said shaft and having an axial opening which closely receives the wire and locates it substantially coincident with the axis of the shaft.

13. In a machine for forming wire or the like into a helix, a wire-bending unit, means supporting said unit for rotation about an axis, means for feeding wire longitudinally of itself to said unit along a line coincident with such axis, said unit including a series of wire-engaging members spaced from each other axially of the unit, adjacent ones of said members being offset oppositely from each other transversely of the axis of unit rotation to cause progressive bending of the wire fed through the unit, and means for rotating said unit about its axis in timed relation to the rate at which the feeding means feeds the wire, said bending unit including two rods parallel to and on opposite sides of the axis of unit rotation, cross-members extending between and slidable along said rods, a yoke associated with each cross-member and pivotally supported therefrom for rotative movement about an axis perpendicular to the axis of unit-rotation, each of said wire-engaging members comprising a roller rotatably supported from one of said yokes, and means for releasably securing each of said cross-members in a fixed position of adjustment along said rods.



14. In a machine for forming wire or the like into a helix, a wire-bending unit, means supporting said unit for rotation about an axis, means for feeding wire longitudinally of itself to said unit along a line coincident with such axis, said unit including a series of wire-engaging members spaced from each other axially of the unit, adjacent ones of said members being offset oppositely from each other transversely of the axis of unit rotation to cause progressive bending of the wire fed through the unit, and means for rotating said unit about its axis in timed relation to the rate at which the feeding means feeds the wire, said bending unit including a support for each of said wire-engaging members, each of said supports having an opening extending perpendicularly to the axis of bending-unit rotation, a sleeve slidably mounted in said opening for movement toward and away from such axis, means for holding said sleeve in adjusted position along its path of sliding movement, and a yoke having a shank received in said sleeve for pivotal movement about an axis perpendicular to the axis of bending-unit rotation, each of said wire-engaging members comprising a roller rotatably mounted in one of said yokes.

15. In a machine for forming wire or the like into a helix, a rotatable shaft, a wire-bending unit located at one end of said shaft and operatively connected thereto for rotation therewith, said shaft having an axial opening through which wire may be fed to the bending unit, wire-feeding means located at the other end of the shaft for feeding wire through said opening to and through the bending unit, said bending unit including a series of wire-engaging members spaced from each other axially of the bending unit, adjacent ones of said members being offset oppositely from each other transversely of the axis of unit rotation to cause progressive bending of wire fed through the unit, and means operatively connected to said shaft for rotating it and the unit in timed relation to the rate at which the feeding means feeds wire, said last named means being power-operated and adjustable to vary the speed of bending-unit rotation.


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