March 20, 1962 M. G. CLAY 3,025,889

WIRE FORMING MACHINES

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Fig. 1

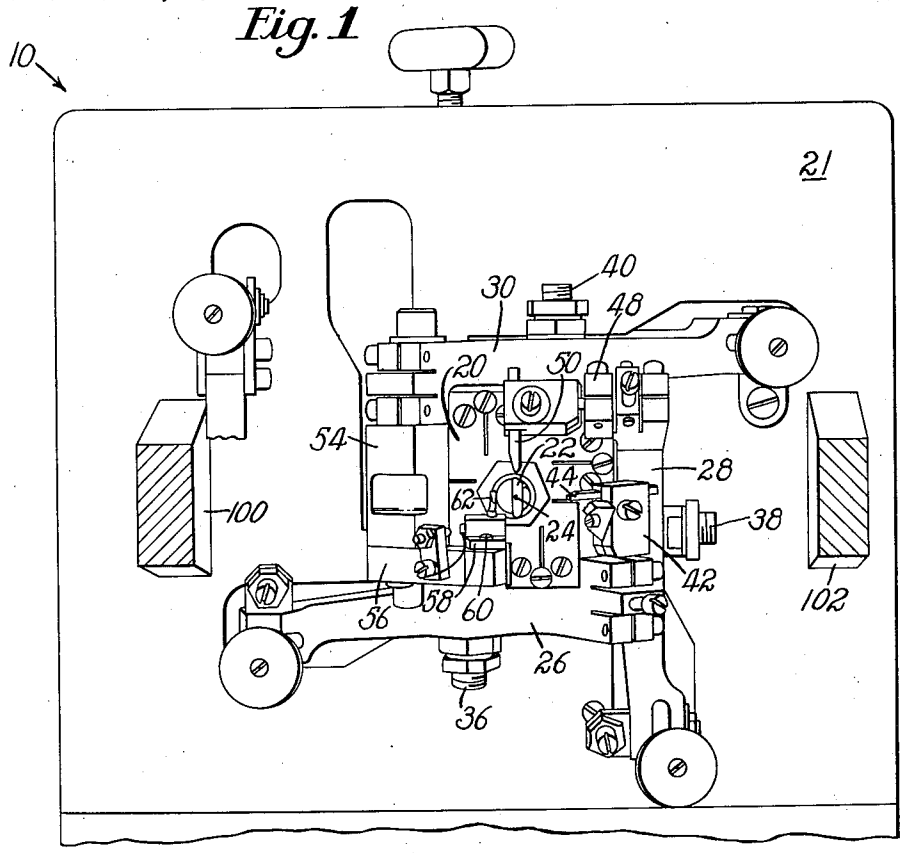
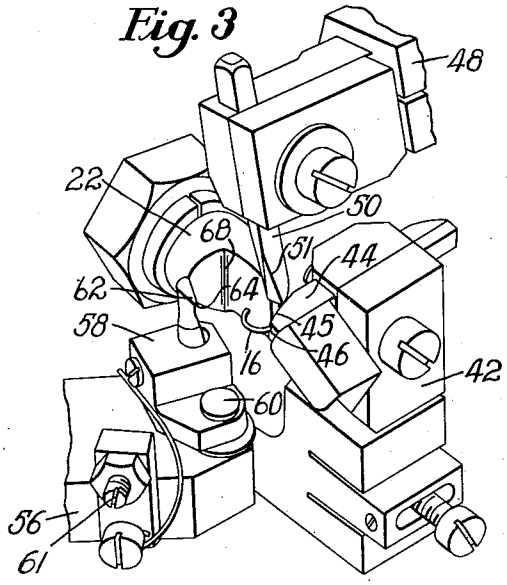


Fig. 3



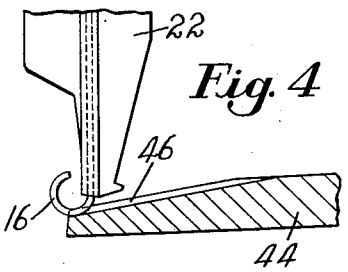


Fig. 4

Inventor

Murray G. Clay

By his Attorney

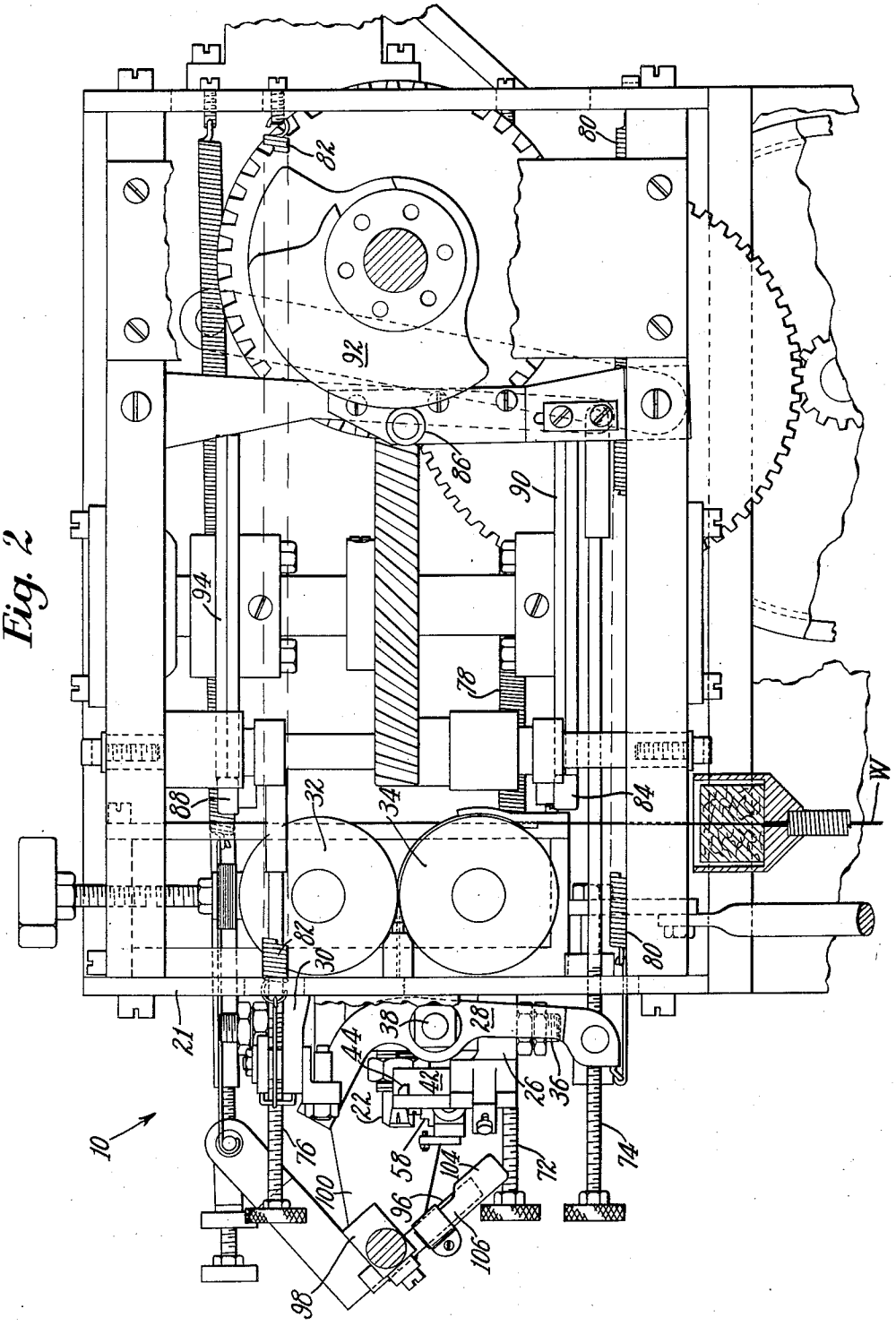
Robert E. Ross

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Fig. 2



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Fig. 5

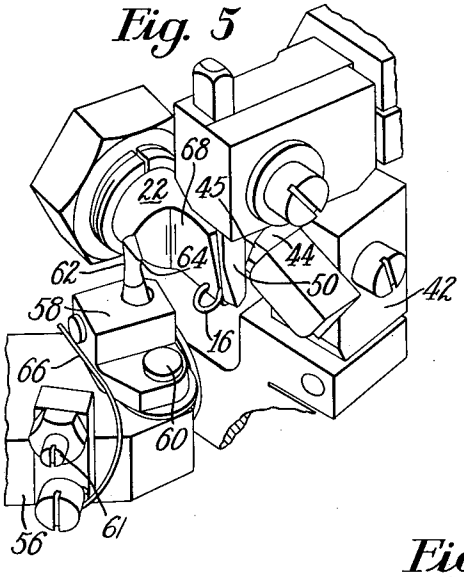


Fig. 6

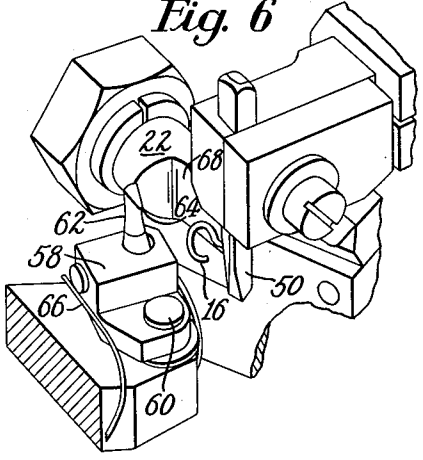
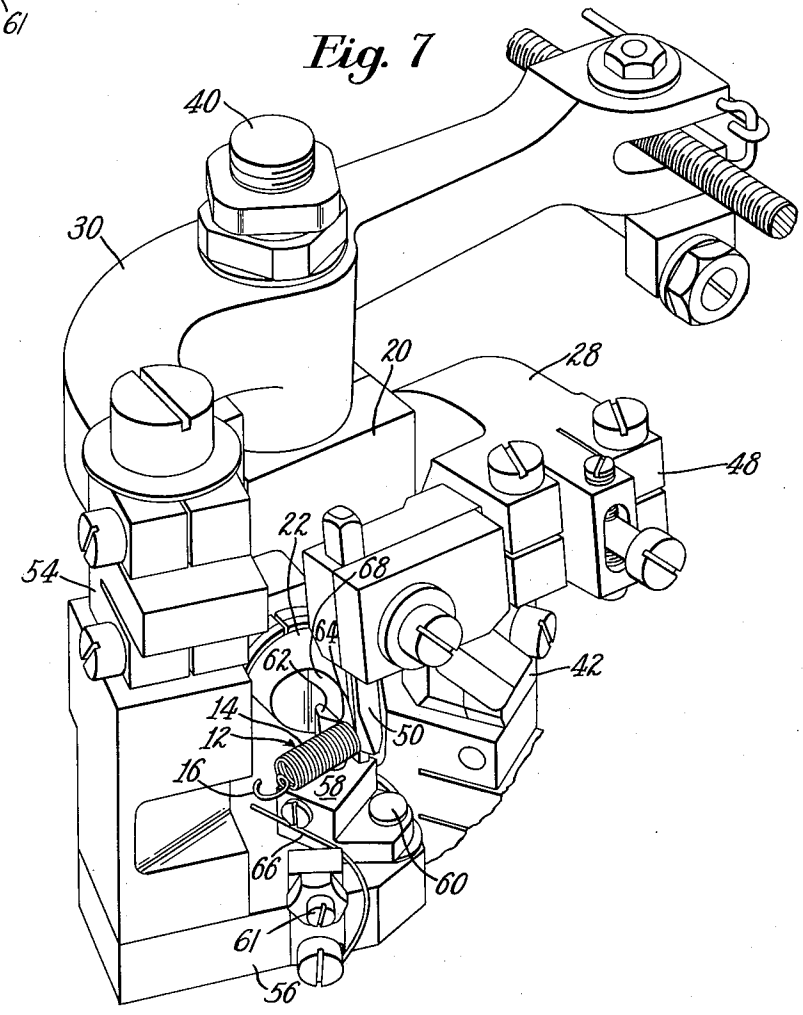


Fig. 7



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Fig. 8

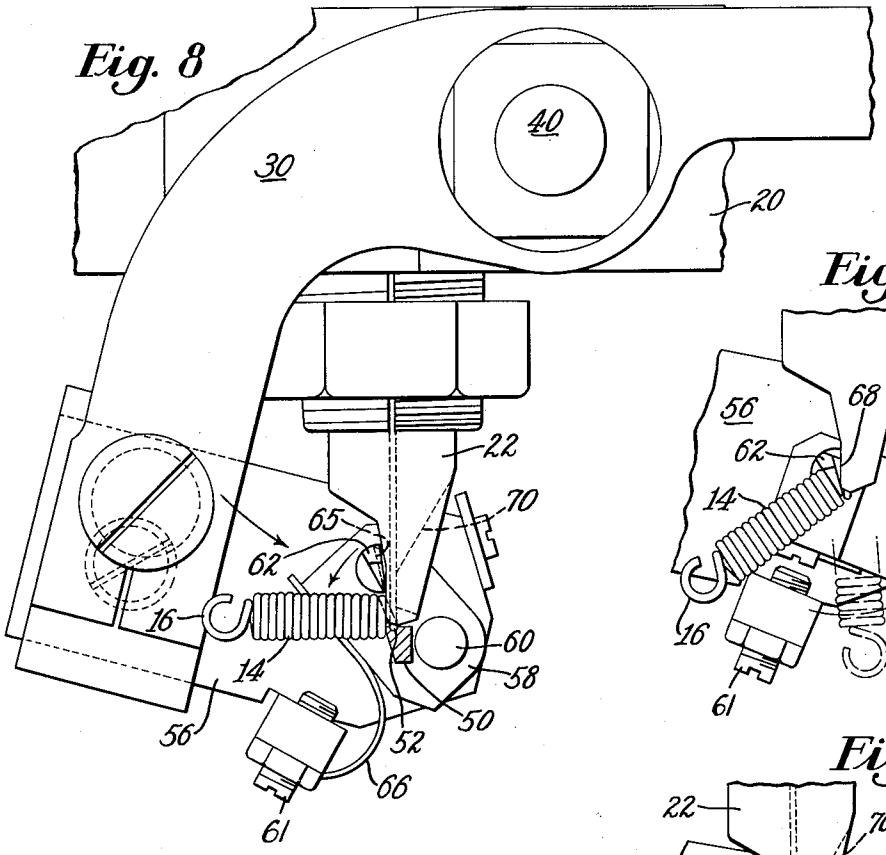


Fig. 9

Fig. 10

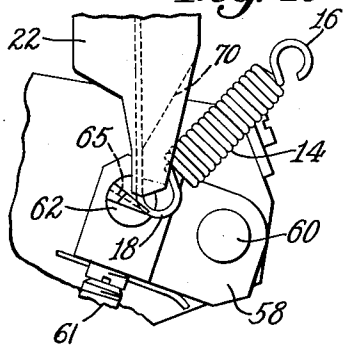


Fig. 11

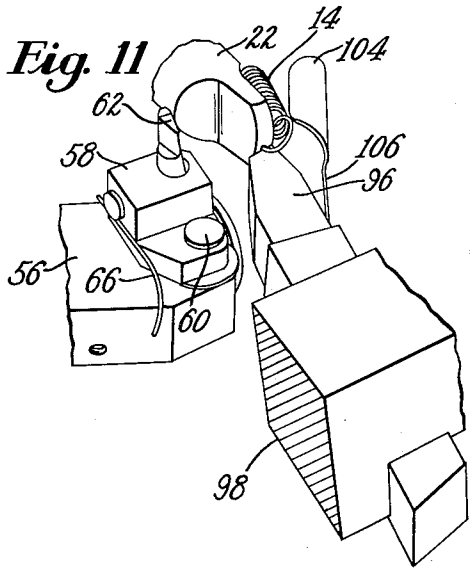
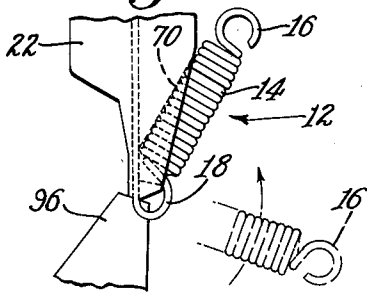


Fig. 12



United States Patent Office 3,025,889 Patented Mar. 20, 1962

3,025,889

WIRE FORMING MACHINES

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5 Claims. (Cl. 140—71)

This invention relates generally to wire forming machines, and has particular reference to a machine of the type in which a wire is fed from a guide member to impinge against a suitable tool to cause deflection and coiling of the wire as it is fed.

The invention is herein illustrated as embodied in a machine of the type disclosed in my co-pending application Serial 705,522 filed December 27, 1957, in which is disclosed a wire forming apparatus having a plurality of individual deflecting tools movable into and out of an operative position in front of an orifice provided in guide through which the wire is fed, to cause deflection and coiling of the wire in different directions and in different planes in a predetermined sequence.

The object of this invention is to provide a machine of the type described in which means is provided to facilitate the formation of a piece of wire into a coil followed by a loop whose plane is disposed perpendicular to the plane of the coil.

A further object of the invention is to provide a machine of the type described which is particularly adapted to make springs of the tension type, having a body composed of a plurality of coils and a loop at each end whose plane is perpendicular to the plane of the body coils.

A further object of the invention is to provide a machine of this type in which a forwardly extending wire guide member is formed to provide a coiling surface on one side thereof, and tool means is provided to swing the coil being formed to the opposite side of the guide member to form the final loop.

A similar and related object of the invention, in a machine of this character, is to provide such a wire guide member wherein the side thereof remote from the coiling surface is provided with a coil-receiving recess into which the coiled spring body moves during formation of the final loop, such recess constituting a clearance void for the spring body so that there will be no interference with the normal operation of the tool means which effects the formation of such final loop.

Yet another object of the invention, in a machine of the character briefly outlined above, is to provide a novel combination of a wire guide and cooperating tool wherein primary movements of the tool toward and away from the wire guide are effected under the control of mechanism which is entirely independent of the wire guide and wherein secondary movements of the tool across the face of the wire guide orifice for actual wire-shaping operations are effected by mutual contact and consequent cooperation between the tool and wire guide.

Other objects of the invention will be obvious to one skilled in the art from the following description of a specific embodiment thereof.

In the drawings:

FIG. 1 is a front plan view of a wire forming machine embodying the features of the invention;

FIG. 2 is a view of the machine of FIG. 1 as seen from the right side;

FIG. 3 is a perspective view of the wire guide and associated tools in which a tool has moved into position for forming the first loop of a tension spring;

FIG. 4 is a plan view, partly in section, of the wire guide and loop forming tool in the position of FIG. 3, with other parts of the mechanism omitted for clarity;

FIG. 5 is a perspective view of the wire guide and associated tools showing the coil body forming tool moving into position as the first loop forming tool is being retracted.

FIG. 6 is a view similar to FIG. 5 showing the coil body forming tool in the operative position;

FIG. 7 is a perspective view of the mechanism showing the second loop forming tool moving into position as the coil body forming tool starts to retract;

FIG. 8 is a top plan view of the wire guide and final loop forming tool in the position of FIG. 7, with certain parts of the machine omitted for clarity;

FIG. 9 is a plan view of the wire guide and final loop forming tool in a position subsequent to that of FIGS. 7 and 8 showing the action of the tool in swinging the spring body forwardly;

FIG. 10 is a view similar to FIG. 9 in which the final loop forming tool has moved into position in front of the wire guide to deflect the issuing wire to form the final loop;

FIG. 11 is a perspective view of the mechanism in a position subsequent to that of FIG. 10, in which the second loop forming tool has been retracted, and the cut-off tool is moving into position to sever the wire at the wire guide; and

FIG. 12 is a plan view of the wire guide spring and cut-off tool in the position of FIG. 11, with certain parts of the apparatus omitted for clarity.

Referring to the drawings, there is illustrated a wire forming machine **10** which is adapted to form a length of wire W into a predetermined configuration, such as that of a tension spring **12** having a central body portion **14** comprised of a plurality of coils and end loops **16** and **18** whose plane is generally perpendicular to that of the body coils.

The machine **10** comprises generally a head **20** secured to a face plate **21**, having a forwardly protruding wire guide **22** with a longitudinal guide channel **24** extending therethrough, rocker arms **26**, **28**, and **30** mounted on the head to carry forming tools into and out of a forming position in front of the wire guide, and miscellaneous mechanisms disposed behind the head for feeding the wire through the guide and for operating the rocker arms in a predetermined sequence.

The wire feeding mechanism in the illustrated embodiment comprises a pair of feed rolls **32** and **34** disposed behind the wire guide and which may be driven by any convenient means, such as that disclosed in my co-pending application referred to above, so that a predetermined length of wire is fed out of the wire guide during each machine cycle.

The rocker arm assemblies **26**, **28**, and **30** are mounted on spindles **36**, **38**, and **40** which extend outwardly from the head in a plane generally perpendicular to the wire feed axis, with adjacent spindles being perpendicular to each other. Each rocker arm is adapted to oscillate on its spindle in response to action of the operating mechanisms disposed to the rear of the head, as will be described hereinafter.

As illustrated in FIGS. 1 and 3, the rocker arm **26**, mounted on downwardly extending spindle **36**, is provided on one end with a tool holder assembly **42** which extends upwardly in spaced relation to the wire guide and carries forming tool **44** which extends radially inwardly toward the wire guide. The tool **44** is provided with a beveled end having a wire forming groove **46** positioned to be aligned with the wire feed axis when the tool **44** is moved into an operative position, to deflect wire emerging from the guide laterally.

Similarly the rocker arm **28**, mounted on horizontally extending spindle **38** is provided on one end with a tool holder assembly **48** which extends laterally above the

wire guide and carries forming tool 50. The tool 50 is also provided with a beveled end having a wire forming groove 52 positioned to be aligned with the wire feed axis when the tool 50 is moved to the operative position, to deflect the wire emerging from the guide downwardly.

The rocker arm 30, mounted on upwardly extending spindle 40, is provided at one end with a tool holder assembly 54 which extends downwardly and carries a tool support block 56 on the lower end, which is so positioned that its plane of movement, on oscillation of the rocker arm 30, is below the axis of the wire guide 22.

A pivot block 58 is mounted on the tool support block 56, so as to be pivotable about a pin 60 disposed through the forward ends of the support block 56 and the pivot block 58, rotation of the block in a counterclockwise direction being limited by an adjustable stop 61, as shown in FIGS. 3, 5, 7, 8, 9 and 10.

The block 58 carries an upstanding wire forming tool 62 which is disposed rearwardly on the block from the pivot pin 60, and is generally wedge-shaped with the apex 64 of the wedge extending forwardly, and a horizontal wire forming groove 65 disposed in the side adjacent the guide. A spring 66 is attached to the support block 56 and bears against the rear portion of the pivot block 58 so that the pivot block is normally urged in a clockwise direction, as seen from the top, so that the tool 62, during a portion of the machine cycle, resiliently bears against the adjacent side of the wire guide 22.

To enable the mechanism to form a tension spring, with a loop on each end, as will be hereinafter described, the forward end portion 68 of said adjacent side of the wire guide is substantially flat, vertical, and parallel to the wire guide channel 24, and the opposite side of the guide is provided with a recess 70.

As described in my co-pending application referred to above, the operation of the rocker arms 26, 28, and 30 to carry the wire forming tools into and out of the operative position, is controlled by pull rods 72, 74, and 76 respectively, and springs 78, 80, and 82 respectively, the pull rods being operated oy cam followers 84, 86, and 88 respectively, riding on cams 90, 92, and 94 respectively. The cams each comprise two portions which are angularly adjustable in relation to each other and to the shaft by which they are driven, so that the motion of the cam follower and consequently the motion of the rocker arm and its associated tool may be controlled. This portion of the mechanism is fully described in my co-pending application referred to above, and no further description is needed here. However it may be noted that the springs 78, 80, and 82 bias the rods rearwardly, tending to pivot the rocker arms so as to move the tools into the operative position. Hence the action of the cam followers on the cams is to permit the springs to move the tools into position when the cam followers reach a depression on the cam surface, and to retract the tools as the cam followers rise out of the depression. By this means damage to the machine is prevented during adjustment of the various mechanisms.

A wire cut-off tool 96, normally disposed below the guide 22, is mounted on a support bar 98, carried by brackets 100 and 102 secured to the face plate 21, and is adapted to be swung upwardly by any suitable mechanism at the completion of a wire forming operation, to shear off the wire at the end of the guide channel 24.

To provide means for controlling the motion of the completed spring after it has been cut off by the tool 96, a deflector 104 is mounted on the tool 96 by a resilient arm 106 which is adapted to prevent upward movement of the spring after it is cut-off, in a manner to appear hereinafter.

The operation of the machine may best be described by assuming that the cams have been adjusted for the manufacture of a tension spring of the type previously described. As the wire feeding commences, the rocker arm 26 pivots about its spindle to permit tool 44 to move into position in front of the wire guide, so that as the wire feed continues the wire is deflected laterally to form loop 16. (See FIGS. 3 and 4.) On the completion of the forming of loop 16, tool 44 is retracted. Just prior to the completion of the loop 16, rocker arm 28 has commenced to pivot to start tool 50 moving downwardly, so that as soon as tool 44 has retracted, tool 50 almost immediately moves into position in front of the wire guide, so that the portion of the wire projecting from the guide is bent downwardly, and further wire issuing from the guide is deflected downwardly and coiled against the side 68 of the guide to form the body portion 14. (See FIGS. 5 and 6.) After the prescribed number of coils has been formed, the rocker arm 30 is pivoted about its spindle to move the tool support block 56 through an arc which passes across and under the axis of the wire guide, while the tool 50 is being retracted. This movement of the support block causes the tool 62 on the pivot block to slide forwardly along the side 68 of the guide, so that the apex 64 of the tool passes between the side 68 of the guide and the most recently formed coil disposed thereagainst. (See FIGS. 7 to 9.)

The initial movement of the tool 62 into position between the coil and the guide causes the body 14 of the spring to swing outwardly, and on further transverse movement of the support block 56, the tool 62 is cammed around the end of the guide to stop in a position directly in front of the guide channel with the pivot block resting against stop 61, with the side of the tool adjacent the guide being disposed at an angle to the wire feed path, and the groove 65 aligned therewith. (See FIG. 10.)

This final portion of the movement of the tool 62 bends the portion of the wire immediately in front of the guide laterally, causing the spring body to swing further around the end of the guide toward the opposite side thereof. Wire subsequently fed from the guide is deflected laterally to form the end loop 18 as the body swings into the recess 70. During the above movement the pivot block is forced against the adjustable stop 61 by the wire being deflected, thus providing a fixed position for the tool 62 during this phase of the operation.

Immediately thereafter the tool 62 is retracted, and the cut-off tool 96 swings upwardly, shearing the wire at the end of the guide. (See FIGS. 11 and 12.) During the upward movement of the tool 96, the edge of the deflector 104 snaps past the spring body into a position above the body so that when the tool 96 shears the wire, the spring is prevented from being forced upwardly, and is deflected downwardly away from the operating mechanism into a suitable container. (Not shown.) Thereafter the cut-off tool 96 returns to its original position and the machine is ready for another cycle.

Although in the illustrated embodiment it is intended that the wire be fed continuously during one machine cycle, it is evident that if necessary, the wire feed mechanism may be so arranged that the rate of wire feed may be varied, so that the wire may be slowed or stopped during those portions of the machine cycle when one tool is being retracted and another advanced.

The particular spring illustrated is, of course, only exemplary, since by adjustments in the timing and position of the tools, springs of many other sizes and shapes may be made. However the principal use of the particular form of the machine illustrated is to make a wire form in which a full coil is followed directly by a loop whose plane is perpendicular to that of the coil.

Since certain obvious changes may be made in the iliustrated device without departing from the scope of the invention, it is intended that all matter contained herein be interpreted in an illustrative and not a limiting sense.

I claim:

1. An apparatus for progressively shaping longitudinal-

ly moving wire, said apparatus including a fixed wire guide having a rear end and a forward end, said guide having a bore terminating at its forward end in a rigid feed orifice, feed means for successively forcibly projecting lengths of wire longitudinally through said bore and orifice, means for shaping a portion of the moving wire including a tool support block mounted adjacent said guide and movable from a retracted position rearwardly of the forward end of the guide to an advanced position adjacent said forward end of the guide, a wire deflecting tool movably mounted on said support block, said tool having a wedge-shaped portion provided with a wire deflecting surface on one side thereof, means operable during movement of the support block toward its advanced position to guide the tool along the side of said guide to the forward end thereof and to thereafter move the tool to position its deflecting surface across the axis of the guide bore to engage and deflect said portion of the moving wire, said last named means including interengaging cam surfaces associated respectively with said guide and tool for guiding said tool along a fixed path toward the forward end of the guide and including also resilient means associated with the tool support block and tool for maintaining said cam surfaces in engagement during movement of the tool to the forward end of the guide by movement of the support block toward advanced position and operable on further movement of the support block into advanced position to move the tool with respect to the support block to position its wire deflecting surface across the axis of the guide bore, and means for moving said support block in timed relationship with the operation of said feed means.

2. An apparatus for progressively shaping longitudinally moving wire into articles having different portions of different predetermined shape, said apparatus including a fixed wire guide having a rear end and a forward end, said guide having a bore terminating at its forward end in a rigid feed orifice, feed means for successively forcibly projecting lengths of wire longitudinally through said bore and orifice, means for shaping the moving wire into the articles including a first wire deflecting tool mounted adjacent the guide, said tool having a wire deflecting surface and said tool being movable along a first path from a retracted position to an advanced position to position its deflecting surface across the axis of the guide bore to engage and deflect in one direction a portion of a moving wire length being forcibly projected from the orifice against said surface to form a coil, means operable following completion of said coil for forming a curved connecting loop at the trailing end of said coil including a tool support block mounted adjacent the guide separately from said first deflecting tool, said support block being movable along a second and different path from an retracted position to an advanced position adjacent the forward end of the guide, a second wire deflecting tool movably mounted on said support block having a wedge-shaped portion provided with a wire deflecting surface on one side thereof, and means operable on movement of said support block toward advanced position to move said second tool along a third path to move the wedge-shaped portion of said second tool beween the last formed portion of the coil and the side of the guide adjacent the orifice to engage and swing the coil bodily about the forward end of the guide and to thereafter position the deflecting surface of said second tool across the axis of the guide bore to deflect a following portion of the wire length in another direction to form said curved connecting loop, said last named means including interengaging cam surfaces associated respectively with said guide and second tool for guiding said second tool along said third path and resilient biasing means associated with said support block and second tool for maintaining said cam surfaces in engagement during movement of said support block from retracted toward advanced position and for positioning said second tool with its deflecting surface across the axis of the guide bore on movement of said tool support block into said advanced position, and means for moving said first tool and said support block in timed relationship with the operation of said feed means.

3. An apparatus for progressively shaping longitudinally moving wire into articles having different portions of different predetermined shape as set forth in claim 2, wherein an adjustable stop is associated with said tool support block and said second tool for adjusting the position of the second tool deflecting surface axially of the guide bore relative to the orifice when said tool support block is in said advanced position.

4. An apparatus for progressively shaping longitudinally moving wire from a substantially continuous supply into articles having different portions of different predetermined shape, said apparatus including a fixed wire guide having a rear end and a forward end, said guide having a bore terminating at its forward end in a rigid feed orifice, and having a substantially flat coiling surface on one side thereof adjacent the forward end of the guide, feed means for successively forcibly projecting lengths of wire from such supply longitudinally through said bore and orifice, means for shaping the moving wire into coil springs of the type having curved connecting loops at either end thereof and a coil spring body intermediate said connecting loops, including a first loop forming tool, a coil body forming tool, and a tool support block each separately mounted adjacent said guide, said tools and support block each being movable along a separate path from a retracted position to an advanced position adjacent said forward end of the guide and each of said tools having a wire deflecting surface extending across the axis of the guide when the tools are in their advanced positions, a second loop forming tool pivotally mounted on said support block, the tool having biasing means for biasing the tool against said one side of the guide and having a wedge-shaped portion with the apex thereof directed toward said forward end of the guide and a wire deflecting surface on the side of said portion adjacent said one side of the guide, means for moving said first loop forming tool to advanced position to position its deflecting surface across the axis of the bore to engage and deflect in one direction a leading portion of a wire length being forcibly projected from the orifice against said surface to form a first connecting loop at one end of the spring and for then retracting said tool, means operable on retraction of said first loop forming tool for moving said coil body forming tool to advanced position to position its deflecting surface across the axis of said bore to engage and deflect against said coiling surface in a second direction a following portion of the wire length being forcibly projected against the tool surface to form a coil body and for then retracting said body forming tool, means operable on retraction of the coil body forming tool for moving the tool support block toward advanced position to slide the second loop forming tool along said coiling surface to the forward end of the guide to move the wedge-shaped portion between the last formed coil of the coil body and the coiling surface to engage said last formed coil to swing the coil body and first connecting loop bodily about the forward end of the guide, the biasing means thereafter moving said tool on the support block to position the deflecting surface of said tool across the axis of the bore to engage and deflect a trailing portion of the wire length being forcibly projected thereagainst from the orifice to form a curved connecting loop at the other end of the spring, the support block then being retracted, means operable on retraction of said tool support block for severing the wire adjacent the orifice, and means for operating said feed means, tool moving means, tool support block moving means and severing means in timed relationship.

5. An apparatus for progressively shaping longitudinally moving lengths of wire from a substantially continuous supply into coil springs of the type having a

central coil body and substantially closed circular connecting loops at each end thereof, said apparatus including a support, an elongated wire guide fixedly mounted at one end on the support and having a bore terminating at the other end in a rigid feed orifice, the guide having a substantially flat coiling surface along one side terminating at one end thereof at said other end of the guide and a coil body receiving recess formed on the opposite side of the guide, feed means for successively drawing lengths of wire from the supply and for forcibly projecting them longitudinally through said bore and orifice, a first rocker arm pivotally mounted on said support having a first loop forming tool rigidly mounted thereon and provided with a wire deflecting surface, the arm being movable along a first path from a retracted to an advanced position to position said deflecting surface across the axis of the guide bore to engage and deflect a leading portion of a wire length being forcibly projected from said orifice thereagainst to form a first substantially closed circular connecting loop, a second rocker arm pivotally mounted on the support for rotation about an axis substantially at right angles to the axis of rotation of said first rocker arm having a body coiling tool rigidly mounted thereon and provided with a wire deflecting surface, said second arm being movable along a second path from a retracted to an advanced position to position the deflecting surface of the coiling tool across the axis of said bore to engage and deflect a following portion of the wire length being forcibly projected from said orifice thereagainst to form a coil body having its axis substantially perpendicular to said coiling surface, means for swinging said coil body and first connecting loop bodily about said other end of said guide and into said recess and for forming a second substantially closed circular connecting loop at the trailing end of said coil body including a third rocker arm pivotally mounted on said support for rotation from a retracted to an advanced position about an axis substantially parallel to but spaced from the axis of rotation of said first rocker arm, a wedge-shaped second loop forming tool pivotally mounted on said third rocker arm and having a wire deflecting surface, means interposed between said third rocker arm and tool for biasing said tool against said coiling surface on

the guide, the tool during initial movement of said third rocker arm toward advanced position sliding along said coiling surface to said one end thereof and wedging between the coiling surface and the last formed coil of the coil body to swing the coil body and first connecting loop bodily about the end of the guide toward said recess, and thereafter, on further movement of said third rocker arm into advanced position, being moved on the rocker arm by said biasing means to a loop forming position with the deflecting surface of the tool across the axis of said bore to engage and deflect a trailing portion of the wire length being forcibly projected thereagainst from the orifice to form a second substantially closed connecting loop, while completing bodily swinging movement of said coil body and first connecting loop into said recess, and an adjustable stop associated with said second loop forming tool and third rocker arm for adjusting said loop forming position of said second loop forming tool, means for sequentially moving said rocker arms to sequentially effect engagement of said first loop forming tool with a leading portion of a moving wire length, engagement of the body coiling tool with a following portion of the moving wire length, and movement of the second loop forming tool along said coiling surface to engage and swing the coil body about said other end of the guide and to engage and deflect a trailing portion of the wire length to form said second connecting loop, means operable on completion of the second loop for severing the wire adjacent the orifice, and means for operating the feed means in timed relationship with the operation of said rocker arm moving means and severing means.

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