Aug. 29, 1961 F. J. HORTON 2,998,045

SPRING FORMING AND CUT-OFF MACHINE

Filed March 18, 1958 3 Sheets-Sheet 1

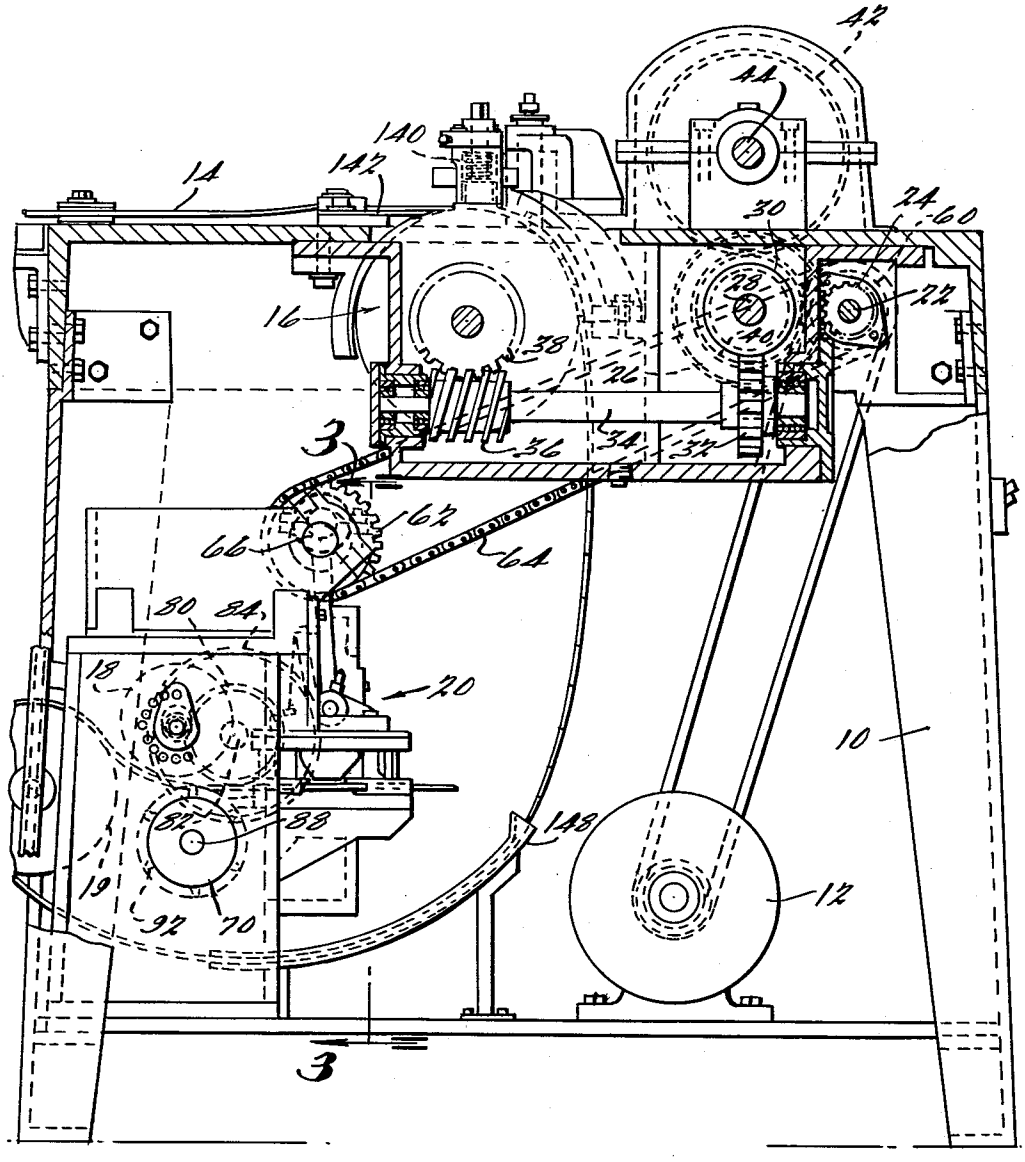

Fig. 1.

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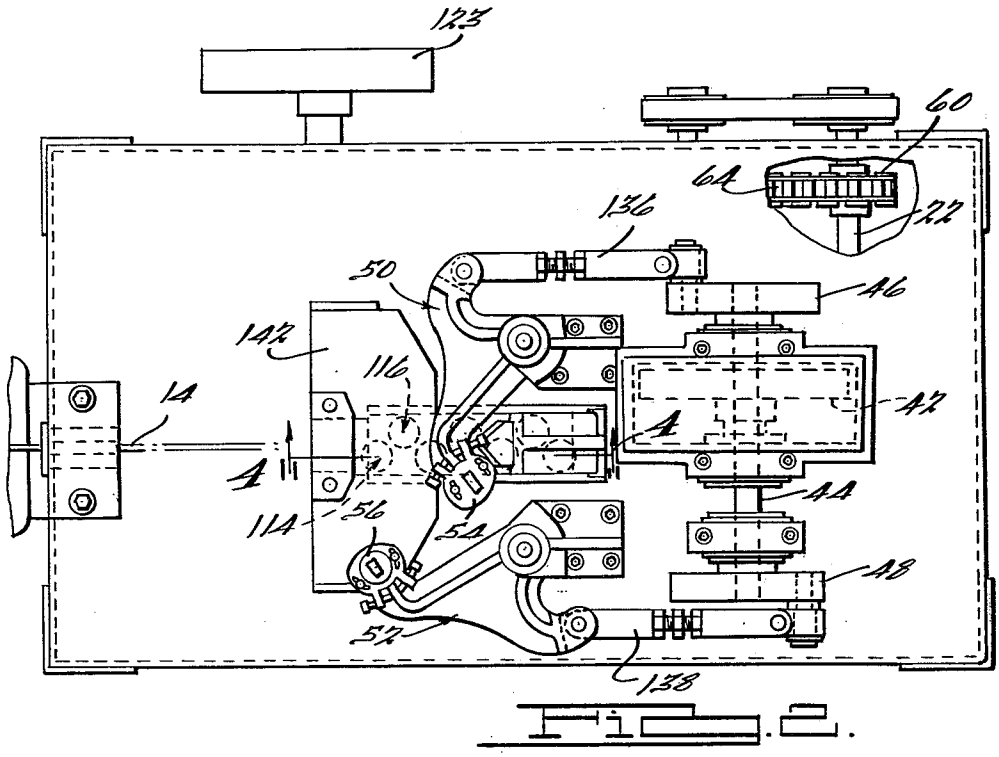

FIG. 2.

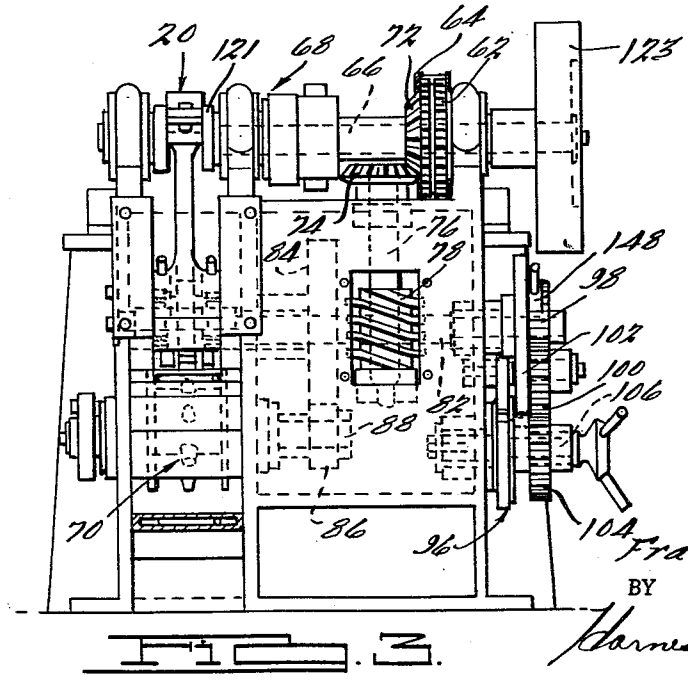

FIG. 3.

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Filed March 18, 1958 3 Sheets-Sheet 3

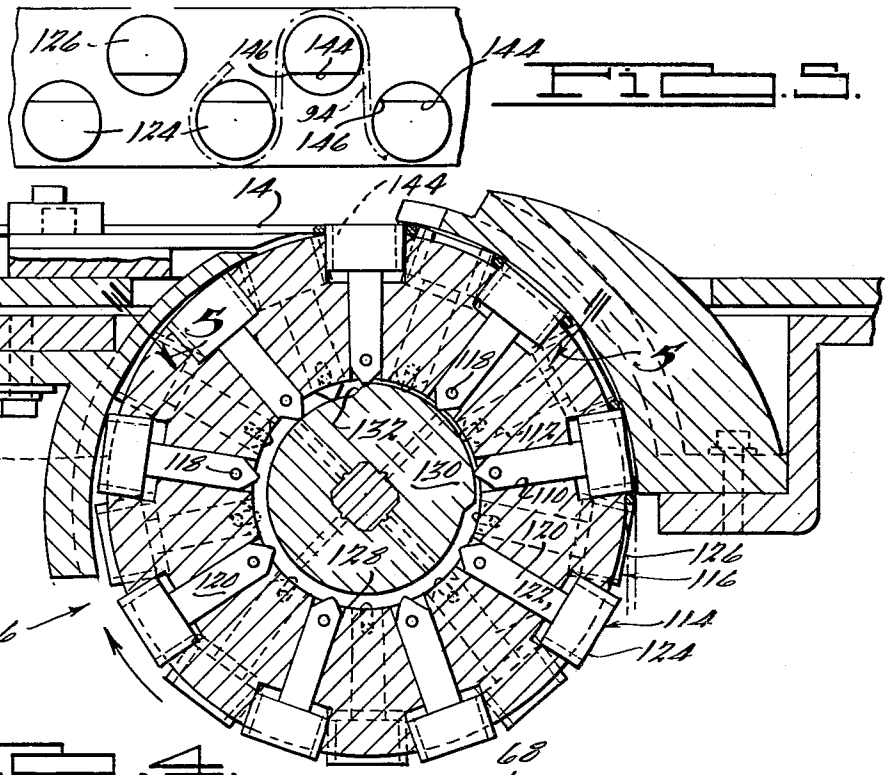

FIG. 5.

FIG. 4.

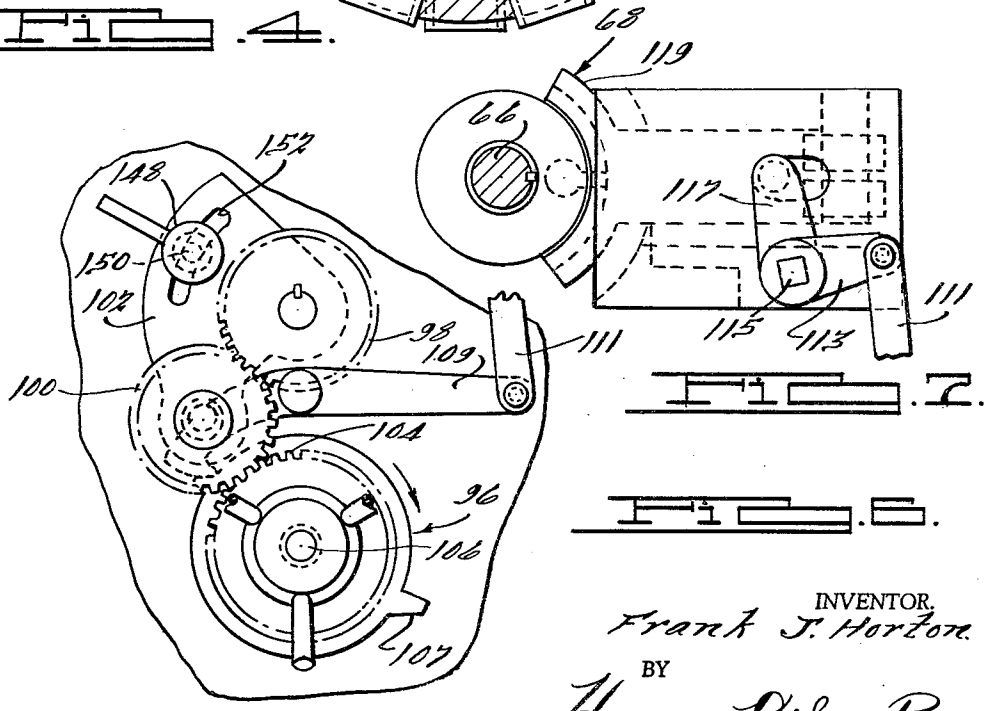

FIG. 7.

FIG. 6.

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SPRING FORMING AND CUT-OFF MACHINE

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5 Claims. (Cl. 153—15)

This invention relates to improved apparatus for forming sinuous wire spring elements of the type described in the Kaden Patent No. Re. 21,263 and having transverse straight portions connected by alternately oppositely facing loop portions. More particularly, the invention relates to improved apparatus for forming spring elements of this type having relatively large loop portions and relatively short straight portions.

The apparatus of the present invention is similar in many respects to the apparatus described in the Horton patent, No. 2,188,406 and reference may be had to that patent for a detailed description of the construction and operation of portions of the apparatus shown therein that are also included in the embodiment described in the present specification.

The apparatus described in the above-identified Horton patent has in practice given excellent results. It is somewhat limited, however, with regard to variations in the relative sizes of the loop and straight portions of spring stock that can be formed thereon. The present invention provides means for forming on a machine of this general type sinuous spring elements having relatively long loop portions and relatively short straight portions.

In the machine of the present invention, straight wire stock of selected spring material is guided over the circumferential face of a drum and is bent back and forth around loop forming pins mounted radially in the drum. The pins are positioned in two axially spaced and angularly offset rows, and are radially reciprocatable in the drum. As the drum rotates, the pins are successively projected by an internal cam above the circumferential face of the drum for engagement by the wire stock. The pins are specially shaped, having relatively small diameter inwardly extending shanks for engagement with the internal cam, and relatively large diameter outer heads, which are specially shaped for optimum bending of the wire stock. The drum is intermittently advanced, and after each advance one of a pair of pusher members is swung laterally across the drum, bending the wire stock around the last projected pin. The pusher members alternate in their action, bending the stock successively in opposite directions to form a sinuous spring element having alternately oppositely facing loop portions. The loop-formed stock is then bent longitudinally, cut to desired lengths, and is preferably normalized as by heat treating.

For reasons discussed in the application of Henry Hopkes, Jr., entitled, "Sinuous Spring Strip," Serial No. 721,601, filed March 14, 1958, and assigned to the present assignee, it has now been found desirable to make such spring elements having relatively short transverse straight portions and relatively long loop portions. In the illustrated preferred embodiment of the invention, the radially extending pins, which are carried by the drum and about which the wire stock is bent to form the loops are shaped to permit forming the loop portions on a large radius relative to the length of the transverse straight portions. The pins have relatively large diameter head portions at their outer ends and relatively small diameter inwardly extending shanks which engage a cam mounted within the drum.

According to a further feature of the invention, the head portions of the pins are provided with axially facing flats which unexpectedly have been found to improve the bending of the stock and to permit production of spring elements in which the transverse straight portions are

more nearly parallel and the loop portions are of more uniform curvature.

Accordingly, the main objects of the invention are: to provide improved spring forming apparatus for making sinuous spring elements having alternate straight and loop portions, the straight portions being relatively short and the loop portions being relatively long as compared to previous spring elements of this type; to provide improved spring forming apparatus of this character including forming pins mounted for radial reciprocation in an indexible drum, each one of the pins having a relatively narrow radially inwardly extending shank and a relatively large outer head; to provide improved spring forming apparatus of this type including loop forming pins having head portions of truncated disc-like form, each head portion having a flat thereon, and means for bending spring stock around the arcuate portion and partly around the flat of the head; and in general to provide improved apparatus of the aforementioned type which is relatively simple in design, durable in service and inexpensive to manufacture.

Other objects and advantages of the invention will become apparent in the following description taken in conjunction with the drawings, wherein:

FIGURE 1 is a front elevational view, partly in section of a spring forming and cut-off machine according to the present invention;

FIG. 2 is a plan view of the machine shown in FIG.1, with portions thereof broken away;

FIG. 3 is a cross-sectional view taken along the line 3—3 of FIG. 1;

FIG. 4 is a cross-sectional view taken along the line 4—4 of FIG. 2;

FIG. 5 is a view taken along the curved section line 5—5 of FIG. 4;

FIG. 6 is a fragmentary rear elevational view of the machine shown in FIG. 1, and illustrating particularly the gearing for the timer which actuates the cut-off portion of the machine; and

FIG. 7 is a fragmentary elevational view of the machine shown in FIG. 1, particularly showing the connection to the clutching device through which the cut-off portion is energized.

Operation as a whole.—Referring first to FIG. 1, a spring forming machine according to a preferred embodiment of the present invention includes a frame **10** upon which the operative parts are mounted, including in the present instance a drive motor **12**. Straight wire stock **14** enters the machine from the left as viewed in FIG. 1, passes over and partly around a loop forming drum **16** where it is bent into sinuous form and given a longitudinal curvature. The stock **14** then passes downwardly and is guided between a pair of re-forming wheels **18** and **19** and then through a punch assembly generally designated **20** where it is cut to length. The re-forming wheels **18** and **19** are adjustable to control the longitudinal curvature imparted to the stock **14**, thereby to control its spring characteristics. The punch assembly **20** is actuated in timed relationship to the rotation of the loop forming drum **16** and provision is made to adjust the time relationship in order to vary the length of the spring elements.

Referring now to FIGS. 1, 2, and 3, both the loop forming and cut-off sections of the machine are driven by a single motor **12** which is connected to drive a transverse shaft **22**. The loop forming drum **16** is driven through a gear train as follows: a spur gear **24** fixed to the shaft **22** for rotation therewith; a second spur gear **26** fixed on a rotatable intermediate shaft **28** and in mesh with the first spur gear **24**; a helical gear **30** also fixed on the intermediate shaft **28**; a second helical gear **32** fixed on a rotatable longitudinal shaft **34** and in mesh with the first helical gear **30**; a drive worm **36** keyed to the shaft **34**, and in mesh with a worm wheel **38**, which is secured to

the drum 16. The worm 36 is of special form to impart intermittent drive to the drum 16 even though the entire gear train up to and including the worm 36 is driven continuously. The worm 36 is given a lead through only a portion of its circumference so that even though it is driven continuously it imparts an intermittent drive to the worm wheel 38 and thus to the drum 16.

Another spur gear 40 is fixed upon the intermediate shaft 28 and meshes with a spur gear 42 mounted on an upper rotatable shaft 44 for driving a pair of crank wheels 46 and 48 which are fixed on the opposite ends of the upper shaft 44 and connected to reciprocate a pair of opposed bell cranks 50 and 52. The bell cranks 50 and 52 carry pusher members 54 and 56 which are alternately swung across the drum 16 to bend the stock 14.

The actuation of the punch assembly 20 is timed with respect to the operation of the loop forming mechanism. The reforming and cut-off section of the machine is driven through a chain 64 trained between a sprocket 60 fixed on the transverse shaft 22, and a sprocket 62 fixed on another shaft 66. The cut-off punch assembly 20 is driven by the shaft 66 through a clutch 68, the construction and operation of which is described in detail in the hereinabove referred to Horton patent, No. 2,188,406.

The stock 14 is driven over the re-forming wheels 18 and 19 through the punch assembly 20 by a cogwheel 70 which is driven synchronously with the drum 16 through a gear train including a bevel gear 72 fixed upon the shaft 66 for rotation therewith and in mesh with a bevel gear 74 fixed upon a rotatable vertical shaft 76. A worm 78 generally similar to the worm 36 hereinabove described is fixed on the vertical shaft 76 and meshes with a worm wheel 80 (FIG. 1) fixed on a rotatable transverse shaft 82 which also carries a spur gear 84. The spur gear 84 meshes with a second spur gear 86 fixed on a transverse shaft 88 upon which the cogwheel 70 is also fixed.

The sinuous stock 14 is trained over the re-forming wheels 18 and 19 and urged against the cogwheel 70 for drive thereby. The teeth 92 of the cogwheel fit between the transverse straight portions 94 of the stock and push thereagainst to advance the stock.

The operation of the punch assembly 20 is controlled by the clutch mechanism 68, the construction and operation of which is described in detail in the aforementioned Horton patent and which is actuated by a timer wheel 96 (FIGS. 3 and 6). The timer wheel 96 is driven synchronously with the other parts of the machine from the shaft 82, which as hereinabove described is intermittently advanced by the worm 78. As perhaps best shown in FIG. 3, the timer wheel 96 is driven through a first spur gear 98 fixed on the right-hand end of the shaft 82, and in mesh with an idler gear 100 which is rotatably mounted on an adjustable plate 102. The idler gear 100 meshes with a third spur gear 104, which is fixed upon the shaft 106 to which the timer wheel 96 is keyed. This third gear 104 is replaceable to vary the intervals at which the punch assembly is actuated.

The punch assembly 20 is actuated automatically to cut off the stock 14 after a predetermined number of incremental advances thereof, as counted by the timer wheel 96, which is provided with a projecting cam-shaped tooth 107. A rocker arm 109 rides upon the rim of the timer wheel 96 and is normally positioned as shown in FIG. 6. The rocker arm 109 is connected by a connecting bar 111 to an arm 113 fixed upon a shaft 115 and turns the shaft 115 when the rocker arm 109 is pivoted by the cam tooth 107. The shaft 115 carries a second arm 117 which is pin-in-slot connected to a clutch slide member 119 for actuating the clutch 68.

When the cam tooth 107 is driven beneath the rocker arm 109, the rocker arm is pivoted and draws downwardly on the connecting bar 111, momentarily pulling the clutch slide member 119 to the right as viewed in FIG. 7, and thereby connecting the shaft 66 to the punch assembly 20. The length of the cam tooth 107 is selected to be shorter than the peripheral travel imparted to the timer wheel 96 by a single revolution of the worm 78, so that the actuation of the clutch assembly 68 is completed during a single incremental advance of the timer wheel. The arrangement is described in detail in the hereinabove referred to Horton patent. It is sufficient to state herein, however, that even though the clutch slide member 119 is actuated only momentarily, a driving connection is established between the shaft 66 and the punch assembly 20 for one complete revolution of the eccentric 121 which drives the punch assembly 20. A flywheel 123 is preferably fixed on the shaft 66 to maintain smooth operation despite the imposition of the sudden load of the punch assembly 20.

The loop forming mechanism.—Referring now particularly to FIGS. 4 and 5, according to the present invention the drum 16 is provided with two axially spaced and angularly offset rows of radial bores 110 and 112, the outer ends of which are enlarged, or countersunk. The loop forming pins 114 and 116 are slidably fitted within the bores 110 and 112, respectively, and are held against outward escape by retaining pins 118, which are fitted in the loop forming pins 114 and 116 near the inner ends thereof, and which extend into relatively short grooves (not separately designated) in the bores 110 and 112.

The loop forming pins 114 and 116 have relatively small diameter shanks 120 and 122, respectively, and relatively large heads 124 and 126, and may be of either unitary or composite construction as desired. The shanks 120 and 122 extend into the central bore 128 of the drum and their inner ends are positioned to be engaged by a stationary cam 130 which is mounted within the drum 16 and is shaped to drive the pins 114 and 116 radially outwardly as the pins are successively carried to a substantially vertical position at the top of the drum, and to hold the pins in an extended position through approximately 90° of rotation of the drum, the direction of rotation of the drum being clockwise as indicated by the arrow in FIG. 4. The rise 132 of the cam is relatively steep so that the entire radially outward travel of each pin as effected by the cam 130 is accomplished during a single increment of advance of the drum 16.

The wire stock 14 is held by the mechanism about to be described in a transverse position during each rotational advance of the drum 16, while one of the pins 114 and 116 is extended to its operative position. The stock 14 is then bent around the pin and acquires the curvature of the head 124 or 126 thereof, being moved to a generally opposite transverse position, after which the drum 16 is again advanced to bring a pin 116 or 114 in the opposite row into its extended position. As perhaps best illustrated in FIG. 5, the wire stock 14 is bent back and forth, first around a pin in one row, then reversely around a pin in the opposite row, then again around a pin in the one row, and so on.

The stock 14 is bent in this manner by the pusher members 54 and 56 (FIG. 2) which are operated synchronously with the drum 16 and which are alternately driven over the face of the drum, pushing the wire stock 14 back and forth as the pins 114 and 116 are advanced. The pusher members 54 and 56 are mounted at the ends of the bell cranks 50 and 52, which are driven through adjustable connecting rods 136 and 138 by the crank wheels 46 and 48. The lengths of the connecting rods 136 and 138 are adjusted to control the amount of bending of the wire stock, as required to produce a desired permanent set therein, and to allow for variations in the spring back characteristics of various grades of stock material. The pusher members 54 and 56 are urged downwardly toward the drum by springs 140 (FIG. 1). When the bell cranks are retracted, the pusher members 54 and 56 slide upon a wear plate 142 over which the wire stock 14 travels, and which is positioned above the level of the pins 114 and 116 when the pins are retracted, and slightly below the topmost surface of the pins when the pins are extended in their operative positions.

When the pins **114** and **116** are extended as they ride up upon the cam rise **132**, the last advanced pusher member **54** or **56** is slightly retracted from its most advanced position, and lies at least partially over the pin **114** or **116** that is being extended by the cam **130**, so that the extending pin forces the pusher member **54** or **56** upwardly, compressing the spring **140** and raising the pusher member sufficiently for it to clear the edge of the wear plate **142**. Simultaneously with the retraction of the one pusher member **54** or **56**, the opposite pusher member **56** or **54** is advanced, swinging in behind the most recently extended forming pin **114** or **116** and bending the wire stock **14** in the reverse direction. The mode of operation is generally similar to the operation of the machine described in the hereinabove identified Horton patent, and that patent may be referred to for a more detailed description of the timing relationships involved.

Heretofore, in machines of this type having loop forming pins of uniform diameter, it has not been feasible to bend the stock to the presently desired form, that is, having relatively large loops and relatively short, transverse straight portions. Generally, in previous such machines the straight portions of the stock were at least about three times as long as the loop radius. With the present arrangement, the straight portions may be made about equal in length to the loop radius, or even shorter if desired. The relatively large heads **124** and **126** of the pins are relatively short and do not extend radially into the drum sufficiently far to interfere with one another. The relatively small diameter shanks **120** and **122** extend inwardly to the cam **130**, and are sufficiently small so that there is no interference between the adjacent ones of the pins.

In developing the apparatus of the present invention, it was found that when the loop portions are made large relative to the gauge of the stock, the loops tend to be of nonuniform curvature and to spring back excessively after the bending force is withdrawn. It was found, unexpectedly, that this condition was relieved, and improved loop curvature achieved by providing flats **144** on the axially inwardly facing sides of the heads **124** and **126** of the pins. During the loop forming operation, the wire stock **14** apparently bends partly over the flats **144**, breaking slightly around the edges **146** thereof.

For reasons that are not presently fully understood, this action restricts the spring back of the stock, making the loop portions of more nearly circular curvature, and making the straight portions more nearly perpendicular to the longitudinal axis of the sinuous stock. The provision of the flats **144**, therefore, is an important feature of the invention, permitting the manufacture of spring elements of improved characteristics.

What is claimed is:

1. A machine for forming a sinuous spring strip having approximately parallel transverse straight portions connected by alternately oppositely facing loop portions comprising a rotatable drum having a central axial bore and two axially spaced rows of radial bores opening within said axial bore and having enlarged shouldered portions opening outwardly through the circumferential face of said drum, said radial bores having an inner portion of smaller diameter than the outer portion thereof, loop forming pins positioned in said radial bores, each one of said pins having a relatively small diameter shank and a relatively large diameter head, means for rotating said drum, means for guiding spring wire stock toward said drum and bending it around the heads of said pins, and cam means within said central axial bore for axially moving said pins whereby the outer face of the heads of said pins is moved outwardly to have a sufficient portion of the head disposed above the circumferential face of said drum so as to permit the wire to bend around a portion thereof.

2. A machine for forming a sinuous spring strip having approximately parallel transverse straight portions connected by alternately oppositely facing loop portions comprising a rotatable drum having a central axial bore and two axially spaced rows of radial bores opening within said axial bore and having enlarged shouldered portions opening outwardly through the circumferential face of said drum, said radial bores having an inner portion of smaller diameter than the outer portion thereof, loop forming pins positioned in said radial bores and having relatively small diameter inwardly extending shanks and relatively large diameter outwardly facing heads, said heads having flats thereon, means retaining said shanks against rotation to have the flats of the heads in each row facing toward the opposite row, means for indexing said drum, means for guiding straight wire stock toward said drum and for bending it around the heads of said pins to form a sinuous spring strip, and cam means within said central axial bore for axially moving said pins.

3. In a machine for forming a sinuous spring strip having transverse straight portions and alternately oppositely facing loop portions, including means for bending straight wire stock alternately in opposite directions around anvil pins carried by an indexible drum, means for indexing said drum, means for actuating said bending means in timed relationship to the drum travel, a fixed cam mounted within said drum for driving said pins radially outwardly as said drum is indexed, an indexible drum having a central bore and fitted over said cam, said drum having two axially spaced and angularly offset rows of radial bores extending from the circumferential face to the axial bore thereof, loop forming pins slidably fitted within said radial bores, the outer portions of said bores and said pins being larger than the inner portions, the axial spacing between said two rows being less than the diameter of said outer portions and cam means within said central axial bore for axially moving said pins whereby the outer face of the heads of said pins is moved outwardly to have a sufficient portion of the head disposed above the circumferential face of said drum so as to permit the wire to bend around a portion thereof.

4. In a machine for forming a sinuous spring strip having transverse straight portions and alternately oppositely facing loop portions, including means for bending straight wire stock alternately in opposite directions around anvil pins carried by an indexible drum, means for indexing said drum, means for actuating said bending means in timed relationship to the drum travel, a fixed cam mounted within said drum for driving said pins radially outwardly as said drum is indexed, an indexible drum having a central bore and fitted over said cam, said drum having two axially spaced and angularly offset rows of radial bores extending from the circumferential face to the axial bore thereof, said radial bores having relatively small diameter inner portions and relatively large diameter outer portions, loop forming pins slidably fitted within said radial bores and having relatively small diameter shanks extending through said small diameter bore portions to contact said cam and relatively large diameter heads at their outer ends, said heads being of circular curvature and having flats positioned facing the pins in the opposite row, and means retaining said pins against rotation.

5. The invention as defined in claim 4 wherein the axial spacing between the planes defined by the axes of said pins is less than the diameter of said relatively large heads on the outer ends of the pins.

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