April 23, 1963 C. N. MELLOWES 3,086,228

APPARATUS FOR PRODUCING LOCK WASHERS

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Fig. 1.

Fig. 2.

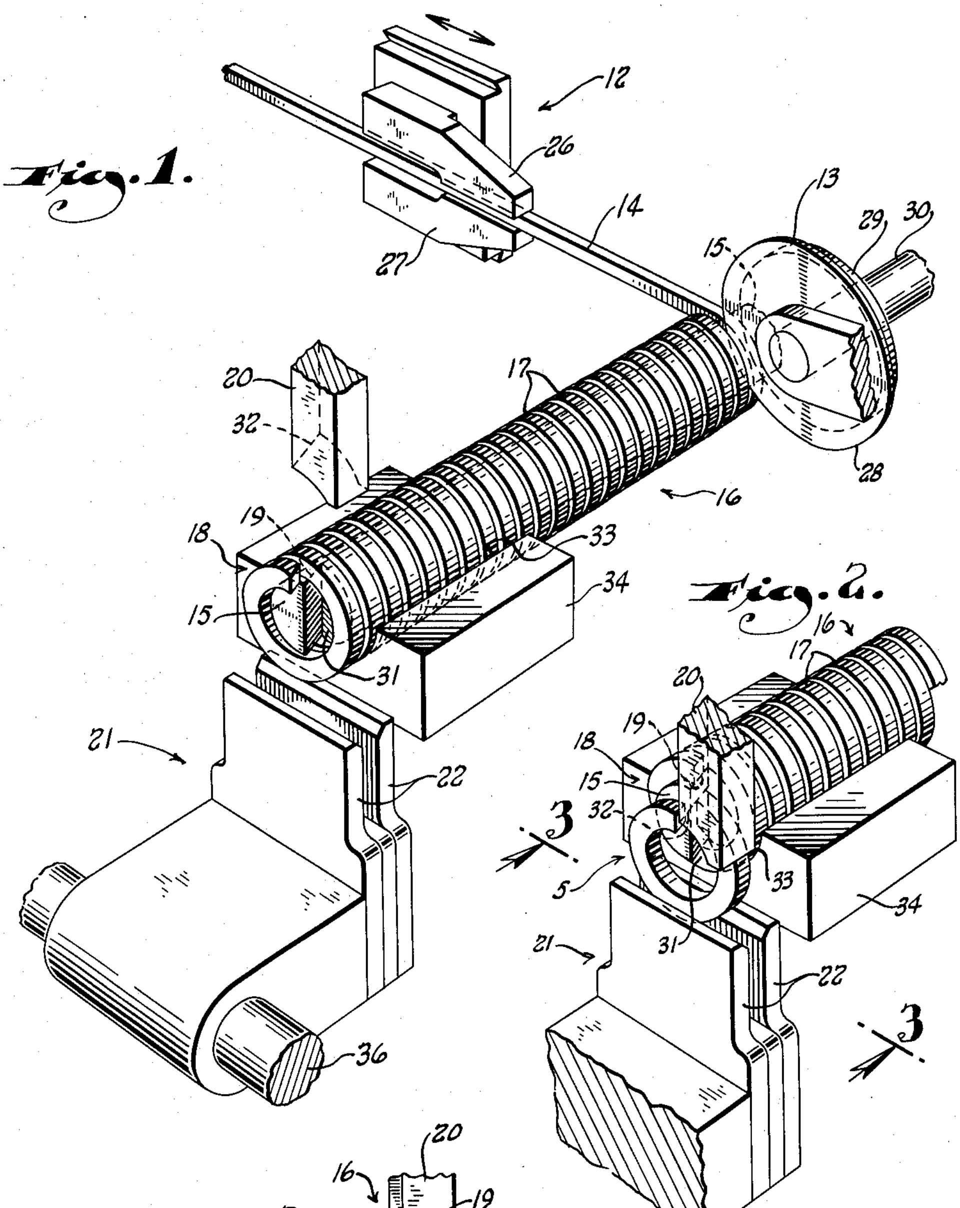
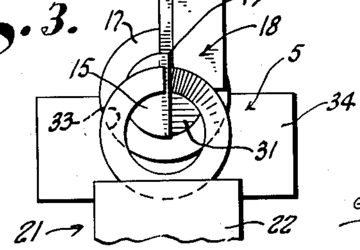


Fig. 3.



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APPARATUS FOR PRODUCING LOCK WASHERS

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Fig. 4.

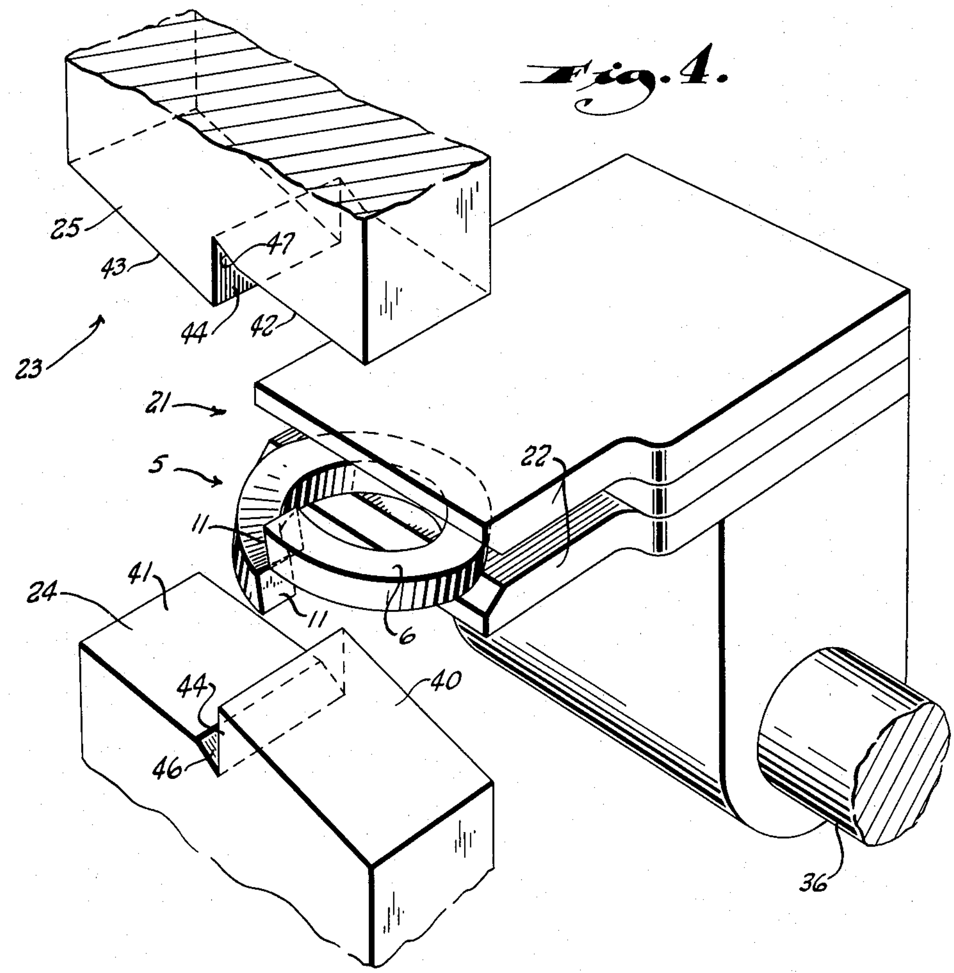


Fig. 5.

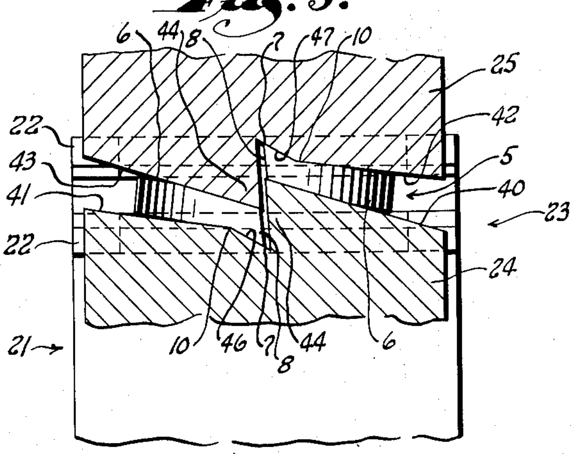
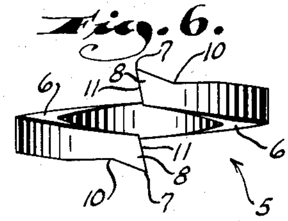


Fig. 6.



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APPARATUS FOR PRODUCING LOCK WASHERS

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1 Claim. (Cl. 10—73)

This invention relates to the art of making lock washers, and it is the purpose of this invention to provide an improved apparatus for producing lock washers of the type that have sharply pronounced radial edges which face in opposite axial directions at the arcuate ends of the washer.

Though lock washers of the type herein concerned have been made for some time, past methods and apparatus for producing them left much to be desired. Reasonably high rates of production consonant with the more or less simple nature of lock washers were virtually impossible with past manufacturing methods that involved the use of separate machines for carrying out the various steps of the process. The transfer of partially completed washers from one machine to another not only slowed production but also required the expenditure of considerable manual labor. This, of course, objectionably added to the cost of manufacture.

In contrast, it is the object of this invention to provide an improved way of making lock washers of the character described, which way makes possible the production of the washers on a single machine at higher rates and lower costs. Stated another way, it is an object of this invention to provide an improved, substantially simple unitary apparatus or machine for producing lock washers of the character described.

The method involved in the practice of this invention briefly comprises winding wire stock into a continuous helical coil in a way that effects periodic advance of the coil in one axial direction and successive presentation of its convolutions to a cutoff punch by which they are severed from the coil to produce partially finished lock washers. Each of the washers thus severed from the coil comprises one complete convolution of wire having smooth opposite helical faces that extend uninterruptedly to the arcuate ends of the washer. As the successive convolutions are severed from the coil, a transfer mechanism takes hold of them and places them in a forming die where their opposite helical faces are coined or forged to produce the desired sharp radial edges which project axially outwardly from the arcuate ends of the finished washer.

One of the features of the invention resides in the fact that the transfer mechanism not only positively grips each convolution as it is severed from the coil in a way which leaves its interrupted portion unobstructed, and transfers it to the forming die, but in addition holds the severed convolution or ring while the forming die acts thereon.

With the above and other objects in view, which will appear as the description proceeds, this invention resides in the novel construction, combination and arrangement of parts substantially as hereinafter described and more particularly defined by the appended claim, it being understood that such changes in the precise embodiment of the hereindisclosed invention may be made as come within the scope of the claim.

The accompanying drawings illustrate one complete example of the physical embodiment of the invention

constructed according to the best mode so far devised for the practical application of the principles thereof, and in which:

FIGURE 1 is a more or less diagrammatic perspective view of that portion of the apparatus which effects winding of wire stock into a continuous helical coil, and the severing of successive convolutions from the coil, and showing a portion of the mechanism for transferring convolutions cut from the coil to the forming die;

FIGURE 2 is a fragmentary perspective view similar to FIGURE 1 but illustrating the manner in which descent of the cutting punch during the cutoff operation also effects lodging of the severed, partially finished washer between fingers on the transfer mechanism;

FIGURE 3 is a fragmentary elevational view taken on the plane of the line 3—3 in FIGURE 2;

FIGURE 4 is a fragmentary perspective view of another portion of the apparatus, illustrating the manner in which the transfer mechanism effects delivery of partially finished washers to the forming die;

FIGURE 5 is a detail sectional view of the forming or coining die, showing its jaws closed upon a washer therein to effect the coining operation and completion of the lock washer; and

FIGURE 6 is a side elevational view of the finished lock washer per se.

The particular type of lock washer 5 with which this invention is concerned is illustrated in FIGURE 6. Like conventional lock washers, it comprises one complete helical convolution of wire having a rectangular cross section. Its opposite helical faces 6, however, terminate in pronounced radially extending sharp edges 7 which face in opposite axial directions and improve the action of the lock washer in use. The sharp edges 7 lie at the apexes of points 8 formed on the axially offset arcuate ends of the convolution, each point having sides that define an acute angle. The outer side of each point is formed by a shallow indentation 10 in the adjacent helical face of the washer, and the inner sides 11 of the points comprise the surfaces at the extremities of the washer. Each of the sides 11 of the points, of course, lies at an obtuse angle to the unindented face of the washer.

According to this invention, lock washers like that described and shown in FIGURE 6 are made by periodically winding wire stock into single complete convolutions to form an elongated helical coil consisting of continuously integral helical convolutions of uniform diameter and spacing, and utilizing said periodic winding of the stock to effect intermittent advance of the coil in one axial direction and the successive presentation of each complete convolution thereof to a cutoff zone where it is severed from the coil. The invention further utilizes the severing operation to make possible the transfer of each convolution thus cut from the coil to a station where the final step of the method is performed, namely, the coining of indentations in the opposite helical faces of each convolution, adjacent to its axially offset arcuate ends, to produce the desired radially extending sharp edges at the ends of the then finished lock washer.

Referring now more particularly to the apparatus of this invention, it should first be noted that although the apparatus comprises a single unitary machine, only its main components have been more or less diagrammatically shown in the accompanying drawings for the sake of simplicity and ease of understanding. These components include a reciprocable wire gripping vise generally

designated 12 which cooperates with a forming tool 13 to effect winding of substantially straight wire stock 14 gripped by the vise onto a stationary mandrel 15. The wire thus wound onto the mandrel is formed into an elongated helical coil 16 consisting of uniformly spaced convolutions 17 all of the same diameter.

The forming tool 13 also cooperates with the wire gripping vise 12 to effect periodic advance of the coil along the mandrel 15 to a cutoff zone generally designated 18, to successively bring each convolution 17 of the coil over a shearing edge 19 formed on the extremity of the mandrel remote from the forming tool 13. A punch 20 movable past the shearing edge 19 cooperates with the latter to sever from the coil each convolution as it is brought to the cutting zone 18. The punch 20, in its cutting stroke, also loads each convolution thus severed from the coil into the bite of transfer mechanism 21 having spaced apart fingers 22 to grippingly receive the convolutions.

The purpose of the transfer mechanism 21 is to successively deliver the rings or partially finished washers severed from the coil to a forming die generally designated 23, comprising a stationary lower jaw 24 and a movable upper jaw 25.

The mandrel 15 comprises a fixed elongated rod mounted in a horizontal position and having a circular cross section of uniform diameter. The wire gripping vise 12 is constrained to horizontal reciprocatory motion, by means not shown, toward and from one side of the mandrel, at a location remote from the cutoff zone 18. The vise, of course, is provided with cooperating upper and lower jaws 26 and 27, respectively, between which the wire stock 14 may be tightly gripped, and it will be appreciated that one of the jaws is movable toward and from the other, into and out of an operative position at which it cooperates with the other jaw to tightly grip the wire stock 14.

The forming tool 13 is in the form of a disc having directly axially adjacent large and small diameter peripheral portions 28 and 29, respectively, freely rotatably mounted on a shaft 30 which is parallel to the mandrel 15. The forming tool, however, is located at the side of the mandrel remote from the wire gripping vise 12.

While the large diameter peripheral portion 28 of the forming tool may be contiguous to the mandrel, its smaller diameter peripheral portion 29 is spaced from the exterior of the mandrel a distance not less than the thickness of the wire stock 14. This smaller diameter peripheral portion of the forming tool is disposed so as to be directly opposite and in the path of reciprocatory motion of the wire gripping vise 12. Consequently, wire stock gripped in the jaws of the vise will be forced lengthwise between the mandrel and the peripheral portion 29 of the forming tool during the feedstroke of the vise at which it approaches the mandrel.

The disposition of the forming tool at a slightly higher elevation than the mandrel and at the side thereof remote from the wire gripping vise causes the wire stock fed toward the mandrel by the vise to be curled around the mandrel to form continuously integral convolutions on the successive feed strokes of the vise. These convolutions are of uniform diameter and are accurately spaced apart by the large diameter peripheral portion 28 of the forming tool, which also in effect causes the coil to be screwed axially along the mandrel, in intermittent fashion, toward the cutoff zone 18. The intermittent axial motion of the coil thus occurs in timed relation with reciprocation of the wire gripping vise 12.

It will be appreciated that the length of the feedstroke of the vise 12 is determined by and substantially corresponds to the length of wire stock required to form one complete helical convolution 17 about the mandrel. It will also be appreciated that the jaws of the vise are alternately closed and released in timed relation with the reciprocatory motion of the vise. Thus, the jaws will be opened upon completion of a feedstroke of the vise and during its return to a position corresponding to the start of its feedstroke, and the jaws will be reclosed and clamped upon the wire stock just before the start of the next feedstroke.

From the description thus far, it will be apparent that each of the convolutions 17 of the coil of wire thus wound upon the mandrel will in turn be presented to the cutting zone 18, directly over the shearing edge 19, on successive feedstrokes of the vise 12. Consequently, descent of the punch 20 in timed relation to the reciprocation of the vise and the intermittent advance of the coil effects severing of successive complete convolutions from the coil.

Attention is directed to the fact that the shearing edge 19, which may be said to extend generally lengthwise of the mandrel, is preferably slanted or slightly oblique with respect to the axis of the mandrel, being formed by an undercut notch 31 in the extremity of the mandrel. The notch also opens to the side of the mandrel that faces the forming tool, and it extends substantially vertically across the extremity of the mandrel. The punch 20 is shaped to fit in the notch during its descent in a shearing operation at which an edge 32 on the punch cooperates with the shearing edge 19 to sever one of the convolutions brought to the cutoff zone 18.

As the coil of wire that is wound onto the mandrel approaches the cutoff zone 18, it enters an upwardly opening groove 33 in a block 34 which lies in a fixed position beneath the mandrel and extends clear out to the cutoff zone 18. As indicated in FIGURE 3, the groove 33 has a substantially semi-circular shape in cross section and a diameter which closely corresponds to that of the convolutions 17 of the coil. Consequently, the convolutions of the coil at the cutoff zone are supported internally by the mandrel and externally by the block 34, to assure proper severing thereof from the coil during descent of the punch.

As stated previously, the punch 20 is operated in timed relationship with the reciprocatory motion of the wire gripping vise 12. In other words, the cutoff punch is forced downwardly in its cutting stroke directly after each feedstroke of the wire gripping vise and the consequent advance of the next convolution 17 to the cutoff zone.

Inasmuch as the wire gripping vise has a feedstroke such as to effect the formation of one complete convolution 17 about the mandrel each time it approaches the mandrel, the coil which is thereby wound upon the mandrel may be said to be screwed forwardly by the flange 28 of the forming tool, toward the cutoff zone in an intermittent fashion, making one complete revolution as a consequence of each feedstroke of the wire gripping vise. Consequently, each of the convolutions is presented to the cutoff zone at the same relative position along its periphery as the next one.

As each of the convolutions or partially finished lock washers is severed from the coil by the punch, the punch presses it downwardly into the grip of the fingers 22 on the transfer mechanism 21. The transfer mechanism is mounted upon an oscillatory shaft 36 to swing back and forth therewith about a horizontal axis which is spaced beneath but normal to the axis of the mandrel. Each time one of the convolutions or partially finished washers is wedged downwardly into the grip of the fingers 22 of the transfer mechanism, the shaft 36 is oscillated in a counterclockwise direction as seen in FIGURES 1 and 4 to swing the transfer mechanism from a receiving position at which its fingers 22 are disposed vertically, to a coining position such as shown in FIGURE 4 at which the fingers are disposed horizontally.

The space between the fingers on the transfer mechanism is only slightly greater than the thickness of the wire stock so as to readily initially accept the uninterrupted lower portion of each partially finished washer as it is severed from the coil, but to assure that the washer will be wedgingly engaged between the fingers by reason

of its helical shape as the punch completes its shearing stroke and forces the lower half of the washer between the fingers.

Consequently, the washers are tightly held between the fingers during the time the transfer mechanism is swung from its receiving position shown in FIGURE 1 to its coining position shown in FIGURE 4.

When it reaches its coining position, the transfer mechanism presents the circumferentially interrupted portion of the partially finished lock washer held by its fingers to the coining die, laying it upon the lower jaw **24** of the die at a time when the upper jaw **25** is in an elevated position providing clearance for the transfer mechanism, and holding it in proper position.

With reference to FIGURE 4, it is to be understood that for the sake of clarity, the lower jaw **24** of the forming die has been shown displaced downwardly out of its normal position, and that it normally occupies a position directly under the washer held in the fingers of the transfer mechanism.

The lower jaw of the die has offset upwardly facing surfaces **40** and **41**, each of which is adapted to receive one of the axially offset end portions of the partially finished washer at one helical face thereof. The surface **41** is at a lower level and substantially in the plane of the lower arcuate end of the partially finished washer presented thereto, and the higher surface **40** is substantially in the plane of the other arcuate end portion of the washer.

The upper jaw **25** of the forming die has similar surfaces **42** and **43** which are offset with respect to one another and face downwardly. The surfaces **42** and **43** are respectively directly over the surfaces **40** and **41** on the lower jaw and cooperate therewith to axially embrace each end portion of the washer when the die is closed. The adjacent surfaces of both jaws are not only vertically offset but they lie at different slight acute angles to the horizontal, as seen best in FIGURE 5, so as to better receive the helically shaped arcuate end portions of the partially finished washer. A vertical step **44** which extends across the die in a direction normal to the axis of the rock shaft **36** of the transfer mechanism separates the surfaces on each jaw.

Near its junction with the step **44** the lower surface **41** of the lower jaw **24** is more steeply inclined downwardly to the step, as at **46**, and the surface **42** of the upper jaw is likewise more steeply inclined to the horizontal near its junction with the step **44**, as indicated at **47**. Consequently, when a partly finished washer is placed upon the surfaces **40** and **41** of the lower jaw of the forming die, with the arcuate extremities thereof directly adjacent to the step **44**, the upper jaw of the die may be brought down to close the die and effect deformation and completion of the opposite arcuate end portions of the washer.

Closure of the coining die in the manner described causes the aforementioned shallow indentation **10** to be formed in each helical face of the washer, near the arcuate ends thereof, and produces the points **8** and their pronounced sharp radially extending edges **7** which face outwardly in opposite axial directions at the arcuate ends of the washer. These edges, of course, are adapted to effectively bite into flat opposing surfaces between which the washer may be confined in use.

After completion of the coining step, the jaws of the forming die may be separated and the finished washer ejected from the bite of the transfer mechanism fingers so that the transfer mechanism may be swung back to its washer-receiving position shown in FIGURE 1. It will be understood, of course, that the jaws of the forming die are operated in timed relation with reciprocation of the vise and the punch, and that the transfer mechanism, which also operates in timed relation with those components of the apparatus, is always returned to its washer receiving position just before each cutting stroke of the punch.

One of the main features of the method of forming lock washers as described is that the convolutions of the coil wound upon the mandrel are successively and intermittently presented to the cutoff zone as a consequence of the feed motion of the wire gripping vise. Another feature, of course, resides in the fact that the cutoff punch not only effects the severance of the coils as they are individually brought to the cutoff zone but that it also effects lodgement of each individual partly finished washer severed from the coil into the bite of the fingers on the transfer mechanism. In other words, whenever the wire gripping vise is moving toward the mandrel to feed wire stock onto the mandrel, the punch **20** and the upper jaw **25** of the die will be in their raised positions, and the transfer mechanism will be swinging in a counterclockwise direction with a partially finished washer gripped between its fingers, to deliver the washer to the forming die where the desired sharp edges are formed on the extremities of the washer.

The components of the apparatus of this invention are part of a single unitary apparatus, and they are operated in timed relation to one another in order to automatically carry out their respective functions. Thus, it will be apparent that the elimination of manual handling of either the wire stock, the wound coil, or the partially finished washers enables lock washers of the specific type described to be produced at higher rates and at lower cost than was heretofore possible.

From the foregoing description, taken together with the accompanying drawings, it will be readily apparent to those skilled in the art that this invention provides an improved method and apparatus for producing lock washers.

What is claimed as my invention is:

In apparatus for producing lock washers from a continuous length of wire stock: a fixed horizontally elongated mandrel having a vertically extending notch across one end thereof, said notch opening to one side of the mandrel and defining a shearing edge on the top of the mandrel extending generally lengthwise thereof; means for winding wire stock about the mandrel at a location spaced from said end thereof, comprising a forming tool mounted adjacent to the mandrel for helically coiling wire stock fed endwise between it and the mandrel, and a reciprocatory wire gripping vise which is adapted to be recurrently moved a predetermined distance toward the mandrel to endwise feed a length of wire stock between the forming tool and the mandrel sufficient to form one complete helical convolution about the mandrel, said forming tool effecting periodic advance of a coil of wire wound upon the mandrel toward said end of the mandrel as a consequence of the recurrent feeding of wire toward the mandrel, to thereby cause successive convolutions of the coil to be presented to said shearing edge on the mandrel; means for severing convolutions from the coil at the same relative locations along their peripheries, comprising a punch adapted to be recurrently moved downwardly into said notch in shearing relation to said shearing edge on the mandrel, in timed relation to presentation of the successive convolutions to the shearing edge, so as to cause the coil to be cut up into peripherally interrupted rings each having circumferentially adjacent but axially offset arcuate ends one of which is formed on one shearing stroke of the punch and the other of which is formed on the next shearing stroke of the punch; a forming die opposite said end of the mandrel, comprising complementary vertically separable coining jaws; means for successively transferring rings severed from the coil to the forming die, comprising a transfer member having spaced fingers between which an uninterrupted portion of a ring severed from the coil may be wedged, and means mounting said member for swinging movement about a horizontal axis normal to and beneath said end of the mandrel, between a receiving position at which said fingers are upright and in line with the punch to

receive and have the lower uninterrupted portion of a ring severed from the coil wedgingly lodged therebetween by the punch during its shearing stroke, and a lowered holding position at which said fingers hold the ring in place on the lower coining jaw; and coining means on said die jaws operable upon closure of the die to produce an indentation in each helical face of the ring, adjacent to its interruption, which indentations terminate at the ends of the ring in sharp radially extending edges that face outwardly in opposite axial directions.

References Cited in the file of this patent

UNITED STATES PATENTS

529,847	Barnett	Nov. 27, 1894
819,543	Hart	May 1, 1906
1,321,853	Sailer	Nov. 18, 1919
2,249,113	Chappuis	July 15, 1941
2,352,265	Kapple	June 27, 1944
2,410,204	Cummins	Oct. 29, 1946
2,867,824	O'Conner	Jan. 13, 1959