Jan. 6, 1953 J. L. SMITH 2,624,376

LOOP FORMING TOOL FOR HELICAL SPRINGS

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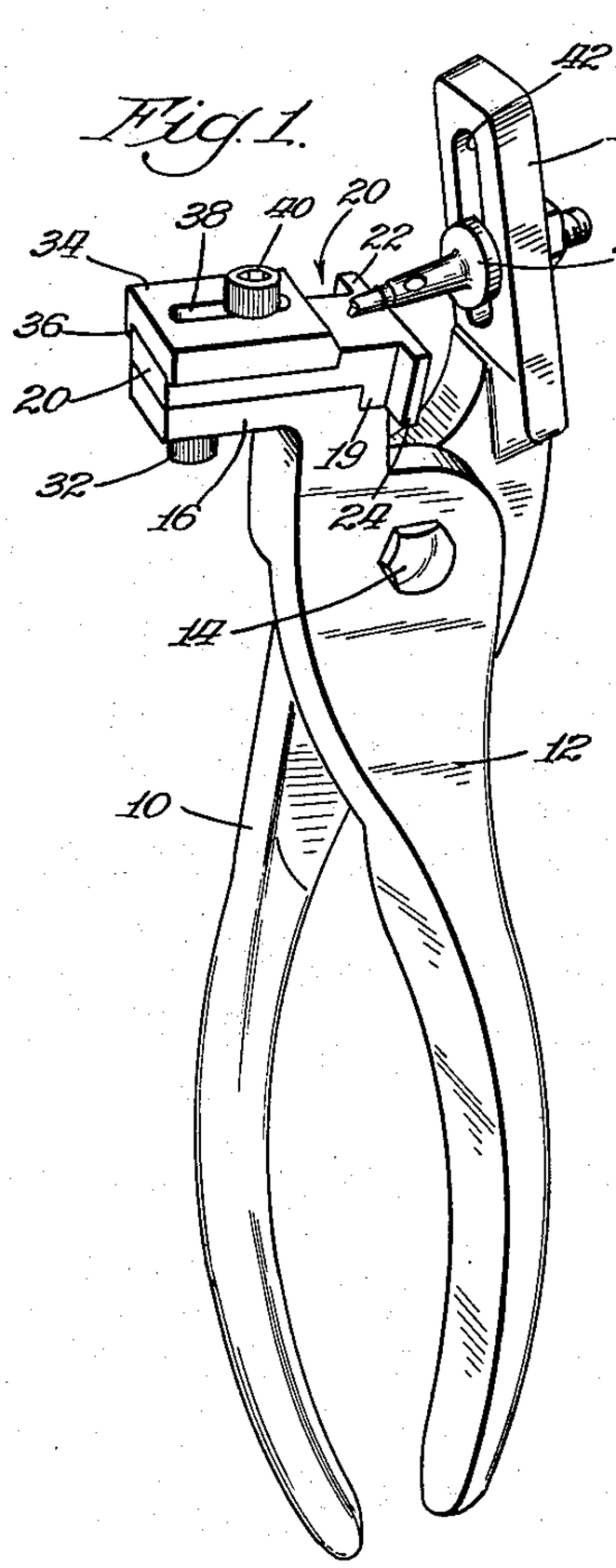

Fig. 1.

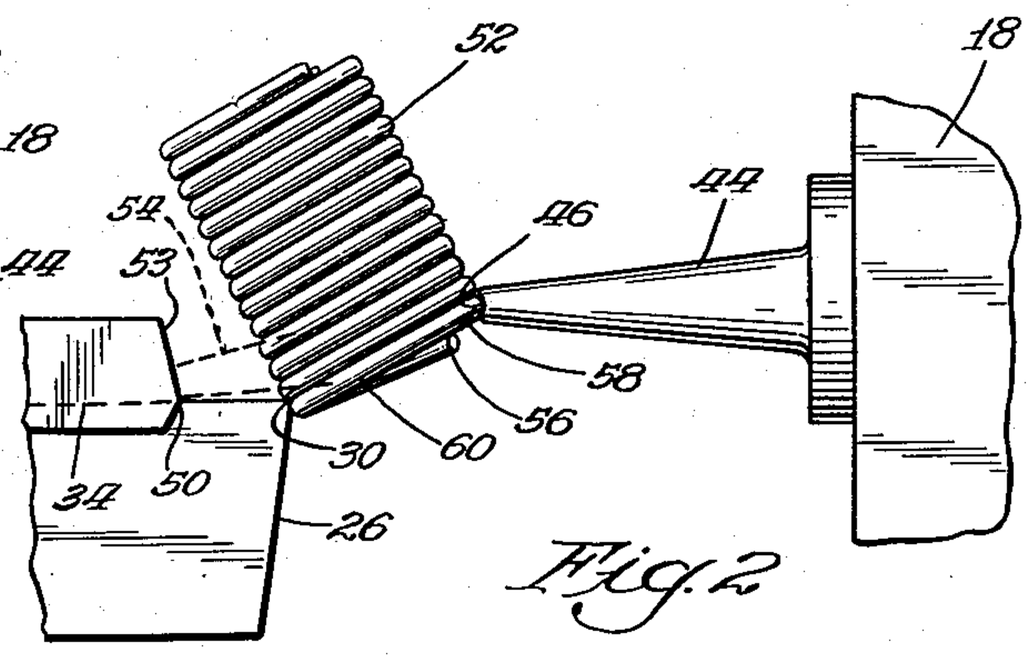

Fig. 2

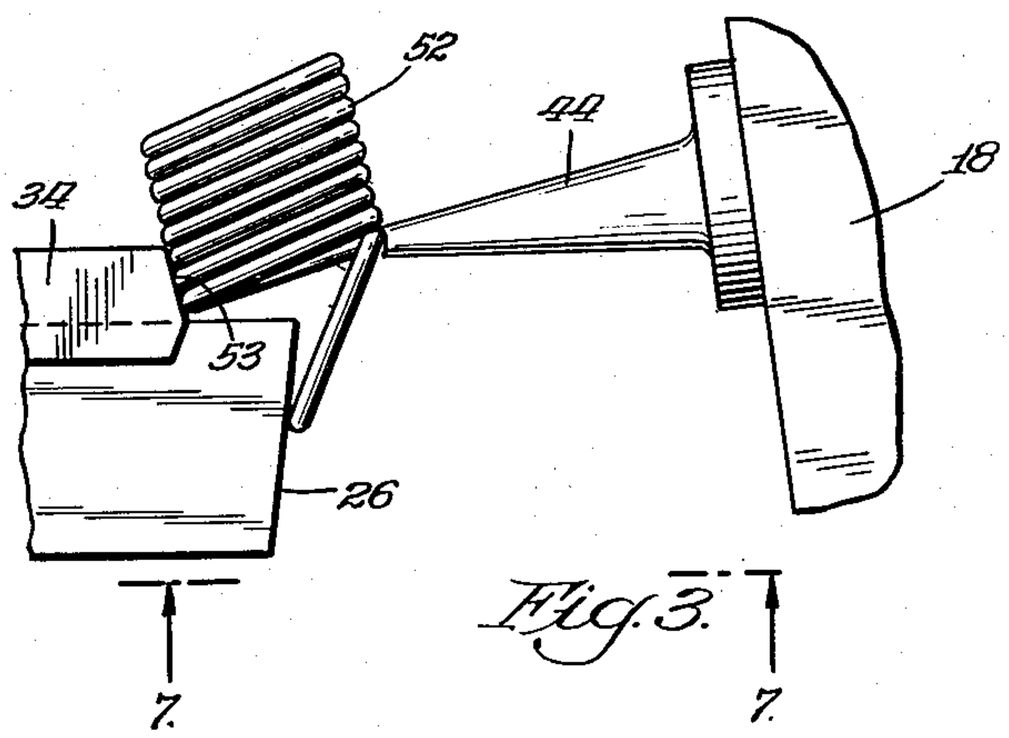

Fig. 3.

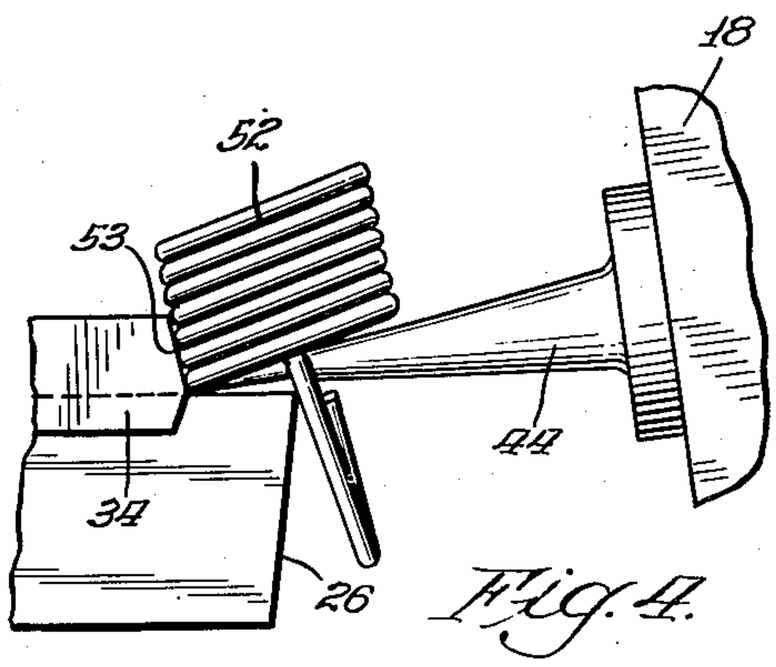

Fig. 4.

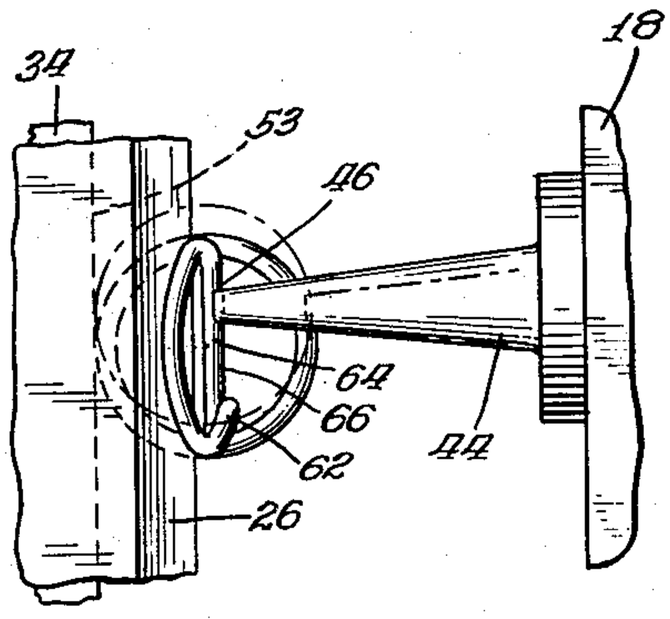

Fig. 7.

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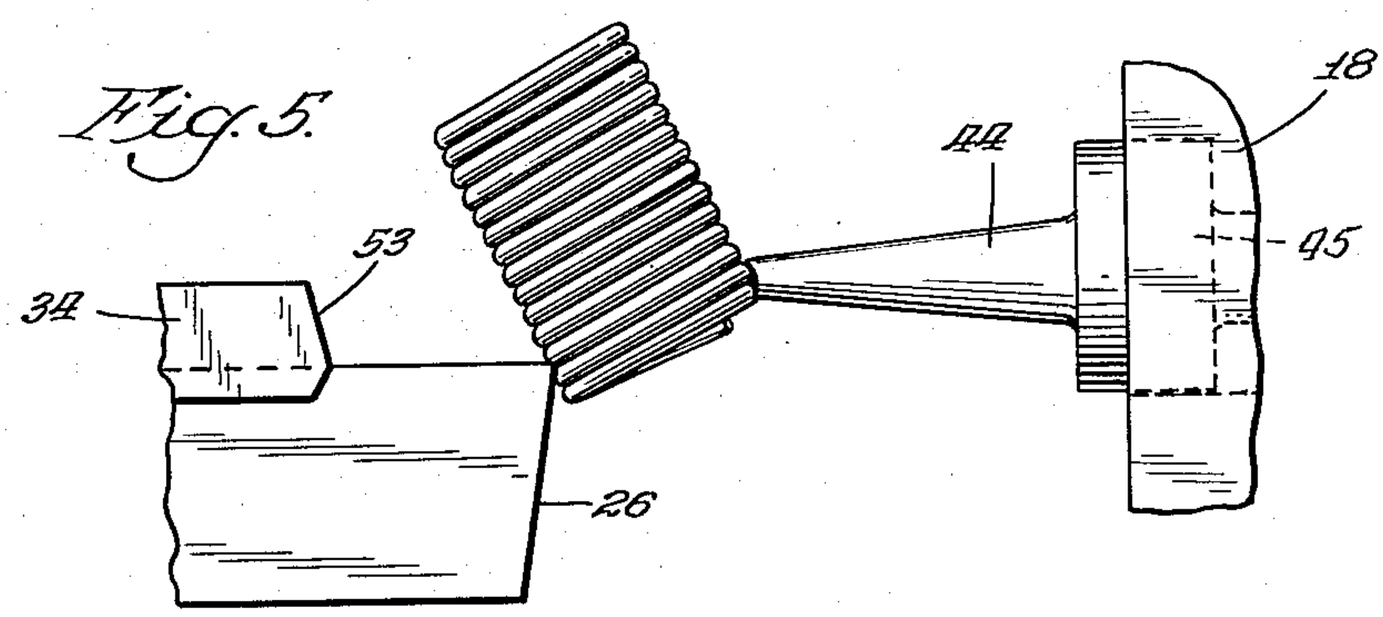
Fig. 5.



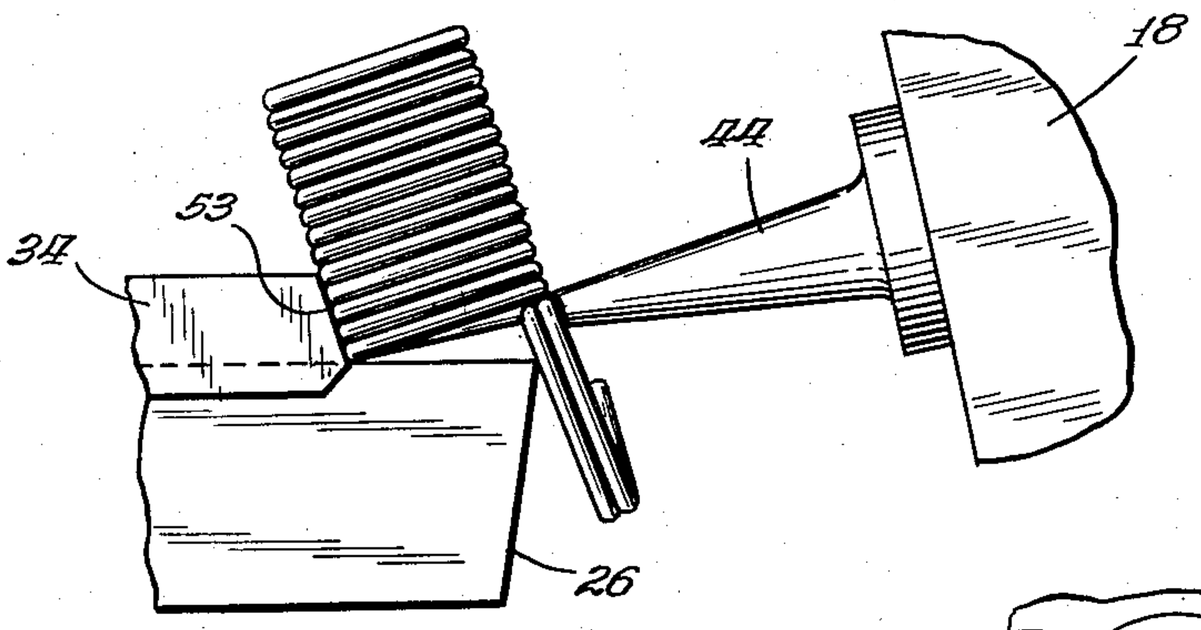


Fig. 6.

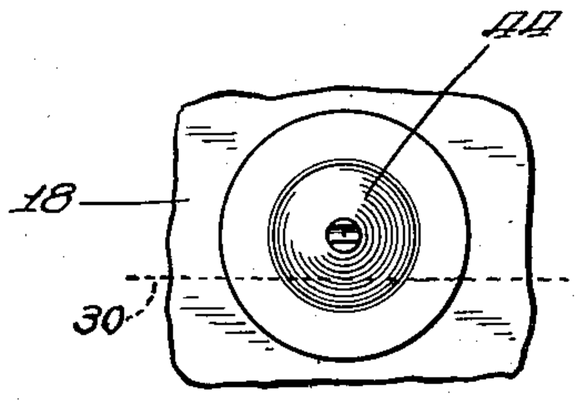


Fig. 8.

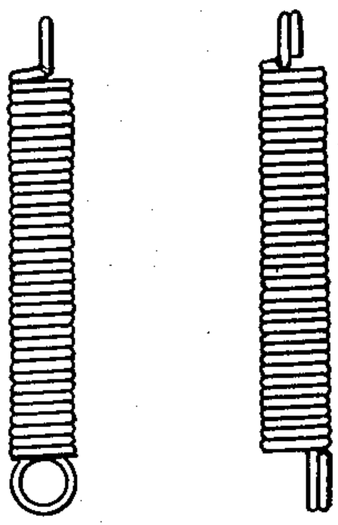


Fig. 9.

Fig. 10.

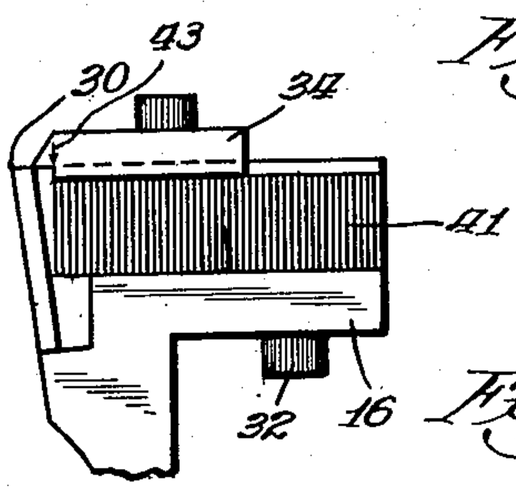


Fig. 11.

Fig. 12.

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LOOP FORMING TOOL FOR HELICAL SPRINGS

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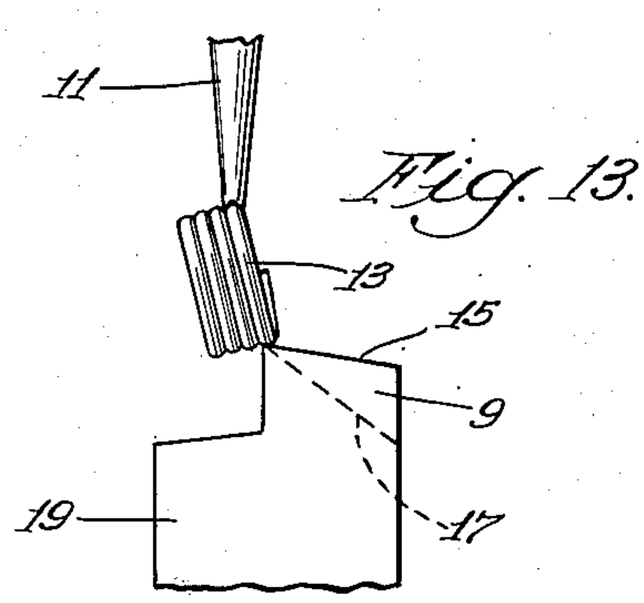


Fig. 13.

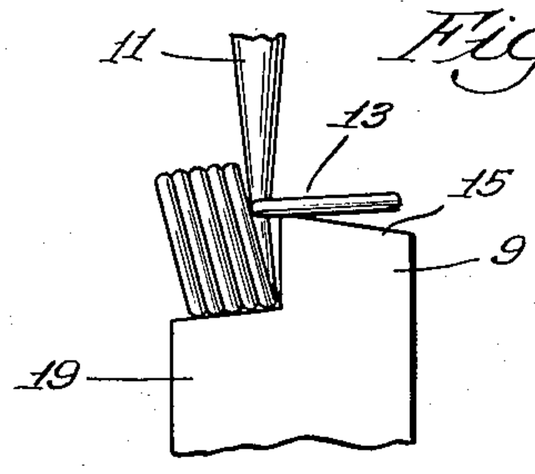
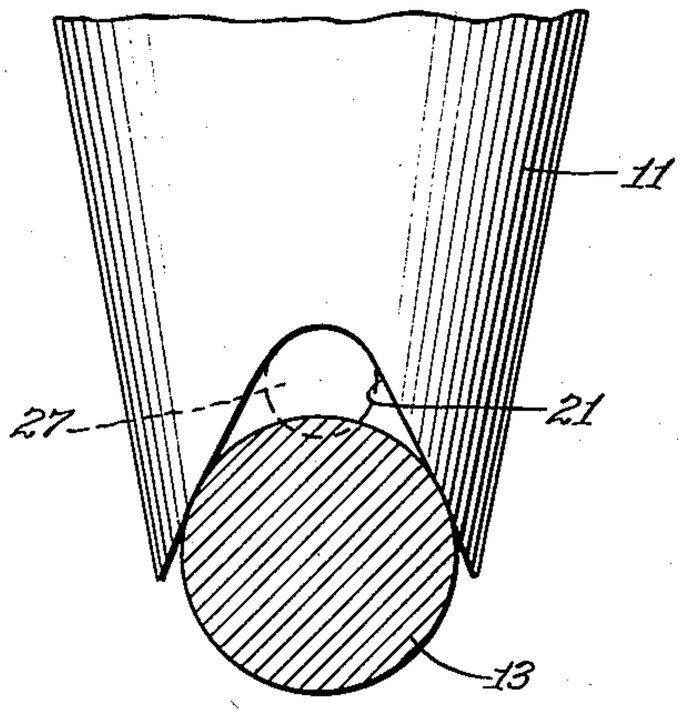


Fig. 14.

Fig. 15.



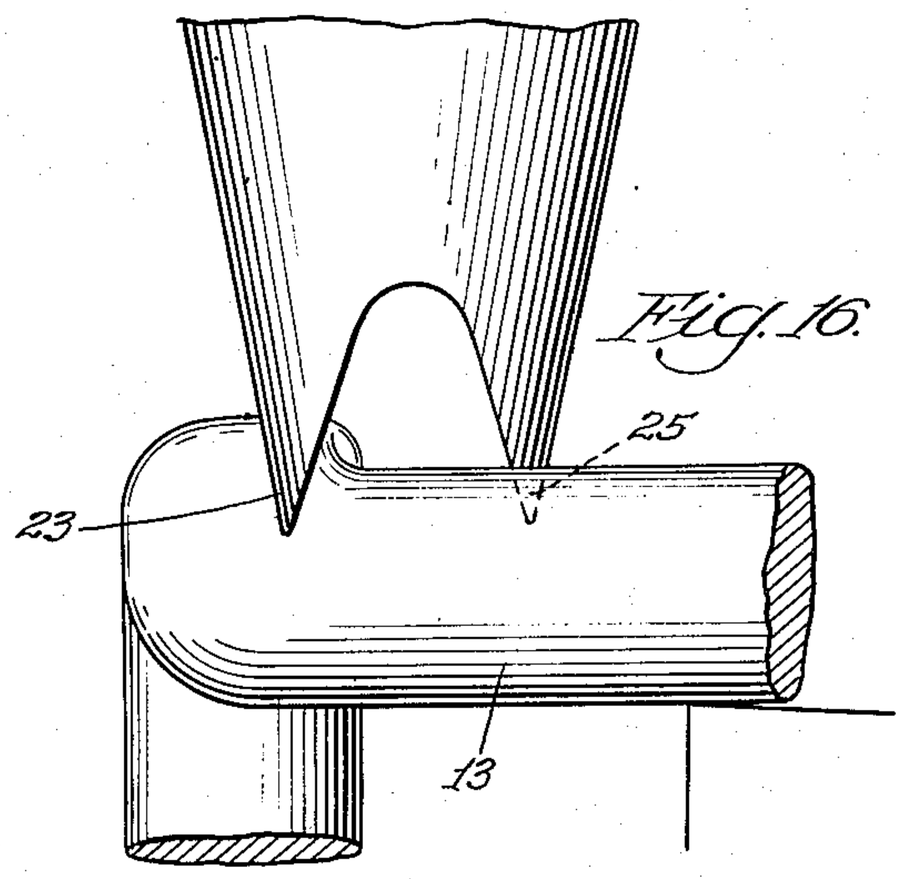


Fig. 16.

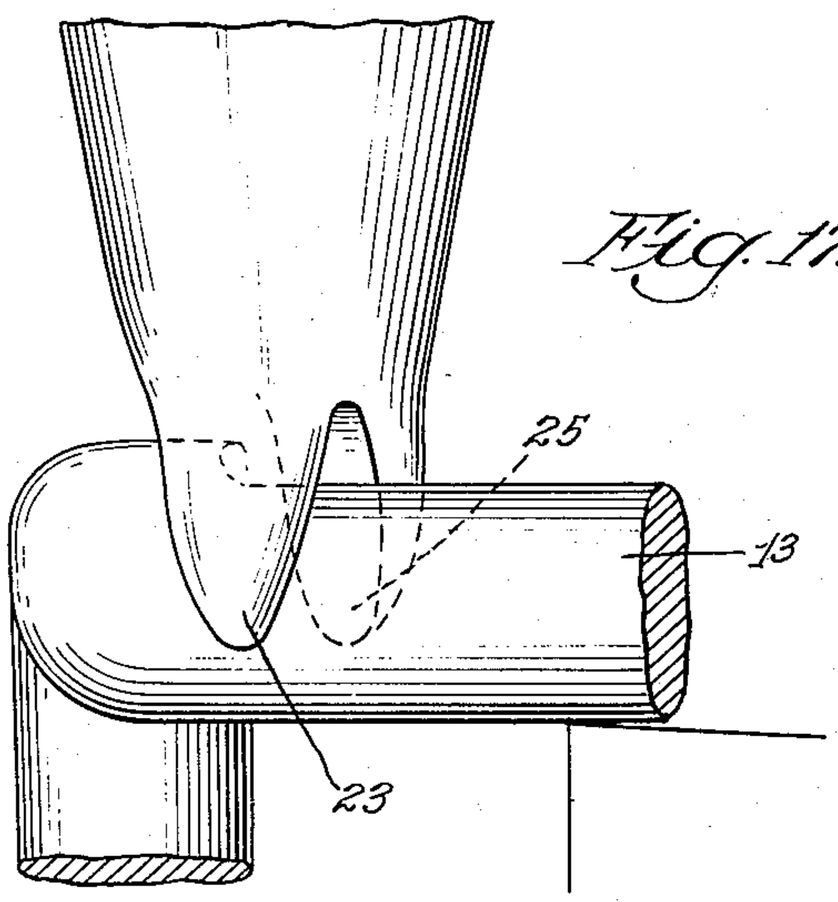


Fig. 17.

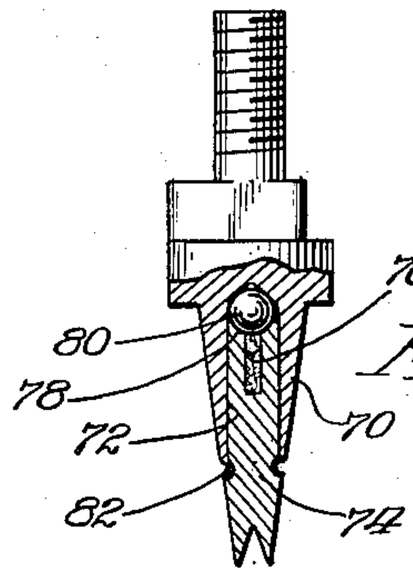


Fig. 18.

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UNITED STATES PATENT OFFICE

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LOOP FORMING TOOL FOR HELICAL SPRINGS

Joseph Leigh Smith, Glen Ellyn, Ill.

Application January 10, 1947, Serial No. 721,339

9 Claims. (Cl. 140—103)

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This invention relates to a hand tool for forming a loop or a hook centrally or at one side of the end of a helical spring. The loop may be formed of a single turn or of a plurality of turns. The invention also relates to a method of forming a hook or loop on the end of a helical spring.

Spring wire is difficult to bend by hand. It is particularly difficult to shape a neat hook or loop on the end of a helical spring without spreading one of the loops of the spring with consequent weakening or reduction in the life of the spring. The difficulty of forming end loops on springs is responsible for the present practice of marketing helical springs of various lengths and diameter having factory-formed loops or hooks on each spring end. Vast quantities of helical springs are used by manufacturers and by repairmen and it would seem feasible and economical for these users to stock springs of a given diameter and have the workmen cut off such length as is wanted and form a loop on it. Under present practice, the user is frequently short the one size spring he wants and is obliged to make his own spring by cutting down a spring in stock and shaping on its end some kind of a loop.

The principal object of this invention is to provide a method of forming a loop or hook on the end of a helical spring so that the strength exerted by the hand of an average man through a pliers-type tool will be sufficient to form the loop quickly and easily. While applicant's method partially follows certain prior art with which he is acquainted, it differs in that it provides more leverage on the tool punch during the bending operation than is presently provided by the punch and anvil relationship on existing factory kick presses. More specifically, referring to Figure 13, in time-accepted factory loop-forming operations, 9 is a side view of an anvil mounted on the die block of a kick press and 11 is a punch having a transverse groove therein mounted on the punch plate. In Figure 14, there is illustrated the end of a loop-forming stroke. Here the punch is bending that portion of the wire joining the end loop to the body of the helical spring over the edge of the anvil. The body of the spring has engaged an anvil stop 19, also mounted on the die block. In order to force the punch past the die block while still so close to it, more strength is required than is available in the ordinary type of hand tool. A feature of applicant's invention is moving the punch past the edge of the anvil at a distance substantially greater than the diameter of the wire of the spring. The minimum distance is illustrated in Figure 4, and

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preferably the distance is one-third to one-half the diameter of the helical spring.

A second object of this invention is to push the end loop in the direction of the loop-forming surface of the anvil so as to facilitate initial bending of the end loop from the main body of the spring. Again referring to Figure 13, when the punch 11 first engages the end loop 13 its force is exerted at almost right angles to the loop-forming surface 15. The kick press exerts ample, steady force which causes the loop 13 to be deflected across the surface 15. When a hand attempts to exert such force, it is not steady and the spring tends to jump out from between the punch and anvil. An alternative solution of this problem is not provided by placing the surface 15 along the line 17 because this shifts the major bending operation to the short interval when the punch moves past the anvil edge. One of the features of applicant's invention is a punch head which moves along a path approaching the loop-forming surface of the anvil at a more obtuse angle than that made by the present paths of punch heads.

Another object of this invention is to lengthen the life of the groove of a punch on a hand tool. Referring to Figure 15, when the punch first engages the end loop, the wire seats deeply in the groove 21 because it is approximately parallel to the groove. As the punch approaches the anvil, the end loop is bent at right angles to its original position, the wire twisting in part in the groove. As this twisting and bending occurs, the wire works itself outwardly against the punch tips 23 and 25. These tips wear quickly. This wear is not serious in the factory art for several reasons. Firstly, a factory has a punch and die set for each size of wire and by utilizing an oversize groove for the wire, i. e., the dotted wire 27 in Fig. 15, the wire will not be cammed out of the slot by the twisting action, and hence the tips 23 and 25 are worn slowly if at all. Moreover, grinders for resharpening the tops of punches are available in a factory. In the case of applicant's hand tool, the life of the punch was of grave importance. Of necessity, the punch groove must accommodate a wide range of wire weights, and the condition illustrated in Fig. 16 will frequently occur. Much spring wire is as hard as the hardened groove in the punch, and applicant has in the course of turning fifty loops, on comparatively large diameter wire springs, so bent over the tip 23 that it no longer quickly separated two loops from each other as required at the beginning of the loop-forming operation.

One of the features of this invention is a rotatable or swivel punch which rotates around its own axis so as to take the position illustrated in Fig. 17. An incidental advantage of the swivel punch is that the spring loop is not so likely to jump out of the groove. In a hand-held and operated tool, anything that tends to steady the work in the tool is advantageous.

Another object of this invention is to provide an anvil stop that is adjustable. In the factory art each anvil and its associated anvil stop is designed for a spring of selected diameter. Applicant provides a single anvil for a wide range of springs together with an adjustable anvil stop and gauge therefor. This adjustable anvil stop makes it possible to position a loop on a wide range of spring diameters at one side of the spring or at any selected position in the cross-sectional end thereof.

Another object of this invention is to provide means for passing the punch head past the anvil at any of several selected points spaced therefrom. By this spacing, helical springs of different diameters can be more effectively handled and the desired leverage heretofore mentioned obtained.

These and such other objects as may hereinafter appear are attained in an embodiment of the invention shown in the accompanying drawings, wherein:

Fig. 1 is a perspective view of the device;

Fig. 2 illustrates the punch and the anvil at the beginning of a loop-forming stroke;

Fig. 3 illustrates the punch and the anvil at the intermediate position of the loop-forming stroke;

Fig. 4 illustrates the punch and the anvil at the end of the loop-forming stroke;

Fig. 5 illustrates the position of the punch and the anvil at the beginning of a stroke for forming the loop at one side of the helix;

Fig. 6 illustrates the position of the punch and anvil at the end of the stroke for forming a loop at one side of the helix;

Fig. 7 is a view from the bottom of Fig. 4 shortly before the loop reaches the position shown in Fig. 4;

Figs. 8, 9 and 10 illustrate different types of loops and hooks and different types of positioning on the spring;

Fig. 11 is an enlarged view of the end of the punch;

Fig. 12 is a side view of the punch showing the graduated scale for the anvil stop;

Fig. 13 is a schematic side view of an existing punch and anvil at the beginning of a loop-forming stroke;

Fig. 14 is a view of the equipment shown in Fig. 13 at the end of a loop-forming stroke;

Fig. 15 is an enlarged view showing a large wire seated in the groove of a fixed punch at the beginning of a loop-forming stroke;

Fig. 16 is an enlarged view showing the relationship of the end loop and the groove of a fixed punch at the end of a loop-forming stroke;

Fig. 17 is an enlarged view of the relationship of the end loop and the applicant's swivel punch at the end of a loop-forming stroke; and,

Fig. 18 is a view in section of applicant's improved swivel punch.

The tool

Continuing to refer to the drawings, applicant's device comprises a pair of plier-like handles **10** and **12** pivoted on a bolt **14**, but in place of the customary jaws, handle **12** carries

an anvil holder **16** while handle **10** carries a punch holder **18**. The anvil holder **16** carries a transverse recess **29** into which seats a loop-forming anvil **20**. The loop-forming anvil **20** viewed from above in Fig. 1, is T-shaped, formed by outwardly extending elements **22** and **24**, the outer surface of which forms with the top of the anvil a single flat surface called the loop-aligning surface and designated by the numeral **26**, see Fig. 2. The loop-aligning surface **26** meets the spring-guiding surface **28** at a slightly acute angle forming what is called herein the spring-loop cleaver **30**. The anvil **20** is removably held to the anvil holder **16** by a set screw **32**. Disposed on the outer surface of the anvil **20** is an adjustable anvil stop **34** which has a longitudinal recess **36** which fits over the anvil and acts as a guide while the recess **36** acts as a slide. Positioned in an elongated slot **38** in the anvil stop **34** is a set screw **40** which seats in the anvil **20**. By means of this set screw **40**, the position of the anvil stop **34** may be varied with respect to the loop cleaver **30**. The rear wall of the anvil, referring to Fig. 12, carries a scale **41** marked off in one-thirty-second gradations. The arrow **43** on the anvil stop is the criterion for the position of the anvil stop with respect to the cleaver edge **30**.

The punch holder **18** carries an elongated slot **42** in which rides a shank of a punch **44**. The shank of the punch **44** carries two parallel surfaces which engage the sides of the slot **42** and thereby hold the punch in a selected position. The punch has a transverse semi-cylindrical groove therein **46**, and in referring to Fig. 11, it will be observed that the groove **46** is parallel to the cleaver edge **30** suggested by the dotted line in Fig. 11. Applicant has experimented with canting the groove slightly to more readily accommodate the direction of the spring loops but any advantage from such setting has been offset by the straightening of the loop wire when centered.

Applicant's swivel punch is illustrated in cross section in Fig. 18. Here the punch designated by the numeral **70** is centrally bored at **72** so that **70** is really a punch holder. The punch itself **74** is drilled at one end to form an oil chamber **76** and the end itself is concave to receive a ball thrust **80**. The oil chamber **76** is packed with a wicking and oil to lubricate the ball. The annular groove **82** has swedged into it the lower thin portion of the punch holder **70** and this holds the punch and punch holder in assembled relationship. The punch is free to turn and follow the curvature of the spring wire.

Forming a centrally disposed loop or hook

The ability to adjust the punch with respect to the loop cleaver and to adjust the anvil stop with respect to the loop cleaver is responsible for the wide availability of this tool for forming loops and hooks on springs of various diameters and of various weights of wire, and for forming a loop or hook centrally of the spring or at one side thereof. Before explaining the principle which a user must master in order to correctly use this tool, a few illustrations will be helpful.

In order to form a centrally disposed loop, the anvil **34** is moved to the position indicated in Fig. 2, the distance from the base **50** of the anvil stop to the loop cleaver **30** being slightly more than one-half the diameter of the coil **52**. The punch **44** moves in an arc around the bolt **14** and

it is adjusted so that the groove **46** engages the face of the anvil stop **34** as indicated by the dotted line **54**. This has been found to be a good practical position for a punch which is mounted on a straight punch holder such as **18**, and when the helical spring is formed of light or heavy but comparatively soft wire. Where the wire is heavy and tough, best results are obtained by having the punch head pass the cleaver **30** by a distance of one-third to one-half the diameter of the spring. Referring to Fig. 5, the slide **45** on the punch **44** is indicated at the lowermost extremity of the slot **42**.

With the adjustments thus made, the helix is positioned so that the end **56** is close to the point **58** which is the point engaged by the groove **46** of the punch **44**. The number of degrees of arc that spaces the end **56** of the helix from the point **58** determines the size of the opening in the hook if a hook is wanted. In forming the hook, the spring **52** is positioned on the loop cleaver of the anvil so that the latter is between the last loop and the second to the last loop. The groove **46** of the punch **44** engages the last loop **60** at the point **58** which is diametrically opposite to the point of contact of the loop **60** to the cleaver **30**. As the punch advances toward the anvil, the last loop **60** is cammed by the surface **26** away from the helix which moves into the position shown in Fig. 3. During this movement, the part of the loop engaged by the punch does not move appreciably out of alignment with the balance of the helix. During the spreading of the end loop from the main body of the helix, the wire between the points **64** and **66** twists, including that portion engaged by the groove **46**. The groove is highly polished to facilitate this twisting and has been heat treated.

When, however, the helix engages the anvil stop, the punch continues to follow through with the result that the wire starts to bend at point **62**, see Fig. 7. Concurrently with this bending, the wire between the points **64** and **66** tends to straighten so that either the punch must slide laterally along the wire or the helix must move laterally. In fact, the helix rolls slightly as it moves to the right, see Fig. 7, and this rolling is possible because the helix-engaging surface **53** is very smooth. The bending at **62** continues until the loop has been centered on the helix, or a little to one side of the helix, as the user prefers. Concurrently with this bending, the wire continues to twist between the points **64** and **66**. The total twisting is approximately a ninety-degree twist and more than half of the twisting is completed before the bending commences.

The amount of advance of the punch toward the anvil stop slightly exceeds the desired angularity between the loop **60** and the axis of the helix for the wire tends to spring back slightly. Thus, in order to get a ninety-degree angle loop with the axis of the helix, the punch may bend the loop **60** over the loop cleaver so that the angle is about 100 to 110 degrees. Operators acquire sufficient dexterity to produce very accurate results.

In order to form a closed single loop, the best way is to position, referring to Fig. 2, the end **56** immediately adjacent the point **58** which is engaged by the punch. Where this is done, the end **56** will be touching the base of the loop at approximately the point of its major bend, namely **62**, see Fig. 7, and the sharp end of the wire will be depressed in the end of the helix so that it will not tear the hand. It will be noted that the path of the punch head is inwardly of the end of the loop so that the base of the loop or hook is inside the end of the helical spring.

In order to form a double loop, the end of the helix is placed in approximately the same position illustrated in Fig. 2, but the groove engages two loops (or on larger wire just the second loop) and the loop cleaver is positioned between the second loop and the third loop. In this case both the twisting and the bending occur in the second loop and frequently where small springs are having double loops turned on them, the second loop tries to pump out of the groove. In the case of heavier springs having a wire with a diameter approximating that of the groove, the groove is brought into engagement with the second loop only and while this slightly distorts the end loop from the second loop it nevertheless produces a satisfactory double closed loop because the end loop springs back into registry with the second loop.

Forming a side loop

The forming of a side loop is illustrated in Figs. 5 and 6. In this operation, the anvil stop **34** is moved so that the distance from its lower portion **50** to the loop cleaver **30** is just about equal to the diameter of the coil. On the closing stroke, the end loop **60** is spread into the position illustrated in Fig. 6 and then a slightly additional pressure upon the end loop so as to bend it over the loop cleaver sets the loop which may be at any desired angle with respect to the straight side of the helix.

Method of forming a holding loop or hook on the end of a helical spring

From the foregoing it is evident that applicant first twists a portion of the wire, i. e., between points **64** and **66** in Fig. 7, while that portion remains in cylindrical alignment with the main body of the spring. If the applicant is forming a holding loop or hook at the side of the helix, this terminates his method of forming a loop. If on the other hand, applicant wishes to position the loop centrally of the end of the helix, he then further presses the punch toward the anvil. The main body of the spring cannot further advance because it has engaged the anvil stop. Consequently, the wire is bent at the point **62** in Fig. 7. The farther the punch head is from the cleaver edge, the greater the leverage there is for bending and twisting the wire. Applicant sets his punch up to one-third the diameter of the spring away from the cleaver edge, or to engage the juncture of the anvil stop and the anvil, as illustrated by the dotted line **54** in Fig. 2.

In forming a side loop such as is illustrated in Fig. 10, the anvil stop is unnecessary. In this situation, the punch may be positioned so that the inside edge of the groove just clears the cleaver edge. If the radius of the wire being bent is substantially less than the radius of the groove **46**, the loop on the end will not be quite in a plane parallel to the axis of the helical spring. If, however, the diameter of the wire is sufficiently great so that the wire engages the cleaver edge and not the groove on the punch, the angle between the loop will be almost ninety degrees.

Applicant's tool works equally well for left-hand and right-hand springs.

In the drawings, the cleaver edge is always shown as very sharp. An examination of the springs formed over such a cleaver edge shows

a slightly diagonal groove in the case of certain springs made of a softer wire. Applicant on some of his models has stoned down the sharpness of the cleaver edge and has found that the stoned edge does not leave this undesirable diagonal groove in the spring with possible weakening of the spring. The cleaver need be just sufficiently sharp so as to seat in the valley between two loops of a spring.

It will be noted, in referring to Fig. 4, that the effect of the arcuate path of the punch 44 is to push the inside edge of the end loop inside the plane defining the last loop on the spring. Where a completely closed loop is being formed, the end of the spring 56 will be just inside the same plane.

Having thus disclosed my invention, what I claim is:

1. A center loop-forming tool comprising an anvil having a cleaver edge adapted to engage the crevice between adjoining loops of a helical spring, a punch holder movable toward said cleaver edge, a punch having an outwardly directed groove therein adapted to seat the wire of a loop of a helical spring at a point diametrically opposite to the point engaged by the cleaver edge rotatably mounted in the punch holder and on an axis substantially parallel to the movement of the punch, an anvil stop for the helical spring positioned adjacent the anvil and spaced from the cleaver edge, and means for moving the punch along a path past the cleaver edge toward the anvil stop.

2. A hand tool for forming center loops on the end of a helical spring comprising a pair of handles joined to each other on a pivot, an anvil on the work end of one handle, a cleaver edge facing the work end of the other handle and formed by the intersection of a loop-aligning surface and a spring-guiding surface, both on the anvil, the loop-aligning surface extending toward the pivot and the spring-guiding surface making an acute angle with the loop-aligning surface to form a cleaver edge, an adjustable anvil stop engaging the spring-guiding surface and movable toward the cleaver edge, means for fastening the anvil stop tightly to the spring-guiding surface at any selected position, and a punch mounted on the work end of the other handle for cooperative action with the anvil and anvil stop.

3. A hand tool for forming center loops on the end of a helical spring comprising a pair of handles joined to each other on a pivot, an anvil on the work end of one handle, a cleaver edge facing the work end of the other handle and formed by the intersection of a loop-aligning surface and a spring-guiding surface, both on the anvil, the loop-aligning surface extending toward the pivot and the spring-guiding surface making an acute angle with the loop-aligning surface to form the cleaver edge, an adjustable anvil stop engaging the spring-guiding surface and movable toward the cleaver edge, means for fastening the anvil stop tightly to the spring-guiding surface at any selected position, a punch mounted on the work end of the other handle for cooperative action with the anvil and anvil stop, said punch having a groove in its work surface for seating a wire of an end loop of a spring, and a gauge positioned on the anvil adjacent the anvil stop whereby the anvil stop may be accurately set at a selected distance from the cleaver edge.

4. A hand tool for forming loops on the end of a helical spring comprising a pair of handles joined to each other on a pivot, an anvil on the work end of one handle, a cleaver edge facing the work end of the other handle and formed by the intersection of a loop-aligning surface and a spring-guiding surface, both on the anvil, the loop-aligning surface extending toward the pivot and the spring-guiding surface making an acute angle with the loop-aligning surface, a punch mounted on the work end of the other handle and spaced from the pivot point so that it will engage the spring-guiding surface at a point spaced from the cleaver edge, and means for shifting the punch outwardly of its work end and locking it in a selected position so that it may pass the cleaver edge at a selected distance therefrom.

5. A hand tool for forming loops or hooks on the end of a helical spring comprising a pair of handles joined to each other on a pivot, an anvil on the work end of one handle, a loop cleaver edge on said anvil and facing the work end of the other handle, a slot in the last-mentioned handle work end, said slot being parallel to the length of the handle and open toward said cleaver edge, a punch holder directed toward the cleaver edge and mounted in said slot, means for fastening the punch holder at any selected position in said slot, and a punch having an axis transverse to the cleaver edge rotatably mounted in said punch holder.

6. A hand tool for forming loops or hooks on the end of a helical spring comprising a pair of handles joined to each other on a pivot, an anvil on the work end of one handle, a loop cleaver edge on said anvil and facing the work end of the other handle, a slot in the last-mentioned handle work end, said slot being parallel to the length of the handle and open toward said cleaver edge, a punch holder directed toward said cleaver edge and mounted in said slot, means for fastening the punch holder at any selected position in said slot, a punch having an axis transverse to the cleaver edge rotatably mounted in said punch holder, and a groove in the end of the punch and facing the cleaver edge.

7. A hand tool for forming loops or hooks on the end of a helical spring comprising a pair of handles joined to each other on a pivot, an anvil on the work end of one handle, a loop cleaver edge on said anvil and facing the work end of the other handle, an adjustable anvil stop adjacent one side of the anvil and adjustably spaced from the cleaver edge, a slot in the work end of the second handle, said slot being parallel to the length of the handle and open toward said cleaver edge, a punch directed toward the cleaver edge and mounted in said slot, and means for fastening the punch at any selected position in said slot whereby the spacing between the punch and the cleaver edge may be varied to suit the diameter of the spring.

8. A hand tool for forming loops or hooks on the end of a helical spring comprising a pair of handles joined to each other on a pivot, an anvil on the work end of one handle, a loop cleaver edge on said anvil and facing the work end of the other handle, an adjustable anvil stop adjacent one side of the anvil and adjustably spaced from the cleaver edge, a gauge on the anvil adjacent the anvil stop for measuring the distance of the anvil stop from the cleaver edge, a slot in the work end of the second handle, said slot being parallel to the length of the handle and open toward said cleaver edge, a punch directed toward the cleaver edge and mounted in said slot, and means for fastening the punch at any selected

position in said slot whereby the spacing between the punch and the cleaver edge may be varied to suit the diameter of the spring.

9. A center loop forming tool comprising an anvil having two plane surfaces intersecting at an acute angle to form a cleaver edge, a stop member positioned on one of said surfaces spaced from the cleaver edge, a punch having a groove in its work surface adapted to seat a strand of wire forming a loop of a helical spring, and means for moving the work surface of the punch toward that surface of the cleaver edge upon which the stop is mounted at an acute angle, whereby the cleaver edge will first peel off the end loop of a helical spring when pushed by the punch and will then twist and bend the wire and seat the end loop adjacent the end of the helical spring when the latter engages the stop.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
715,674	Lemon	Dec. 9, 1902
906,418	Harter	Dec. 8, 1908
971,238	Barrett	Sept. 27, 1910
1,242,392	Underwood	Oct. 9, 1917
1,261,550	Kilmer	Apr. 2, 1918
1,311,187	Sleeper	July 29, 1919
1,869,501	Peterson	Aug. 2, 1932
2,078,828	Baer	Apr. 27, 1933
2,268,824	Hicks	Jan. 6, 1942
2,334,505	Peterson	Nov. 16, 1943

FOREIGN PATENTS

Number	Country	Date
238,776	Great Britain	Aug. 27, 1925