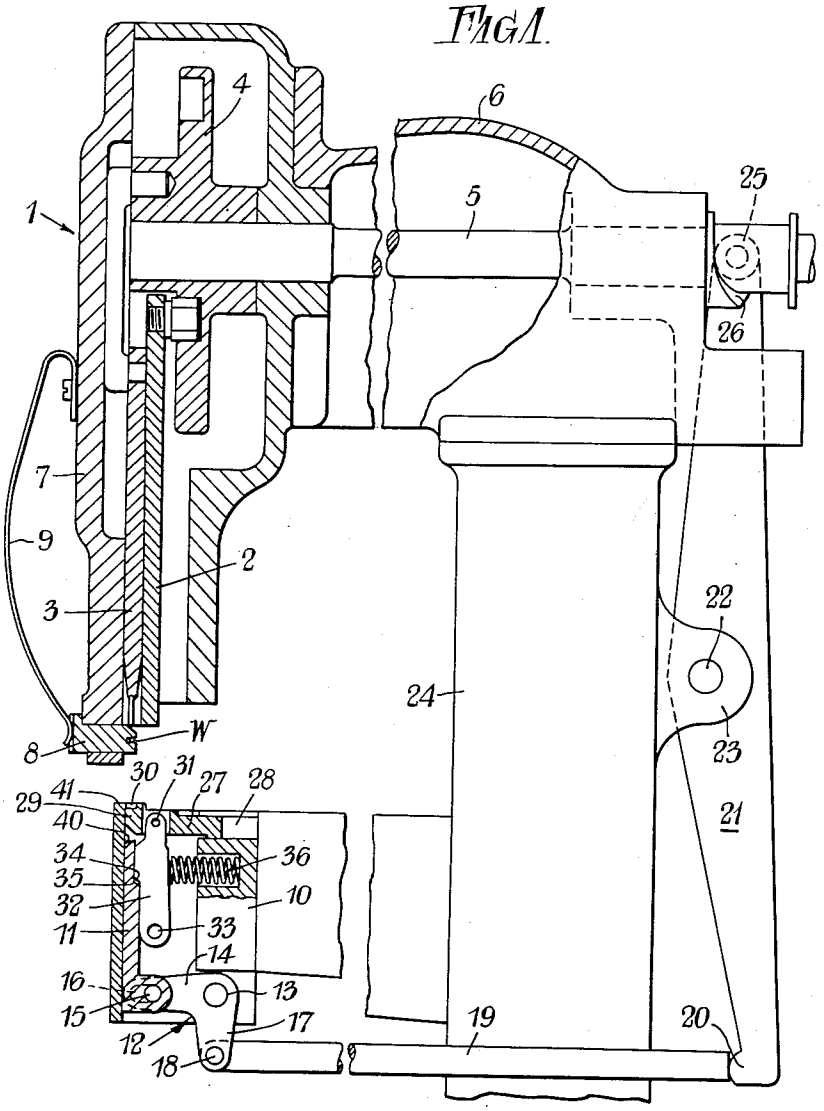
April 18, 1961 J. I. NASMITH ET AL 2,979,722

WIRE STITCHING OR STAPLING MACHINES AND THE FORMATION OF WIRE STAPLES

Filed March 27, 1959 3 Sheets-Sheet 1

FIG 1.



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FIG. 2.

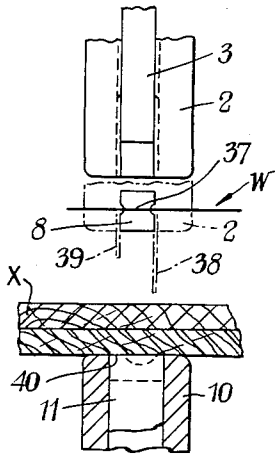


FIG. 3.

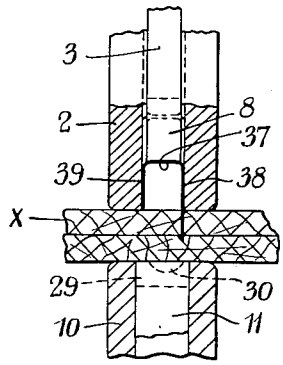


FIG. 4.

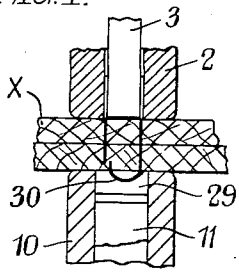


FIG. 5.

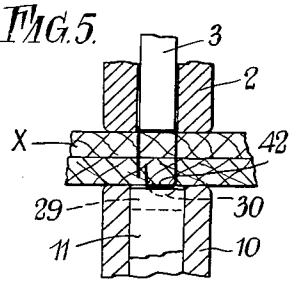
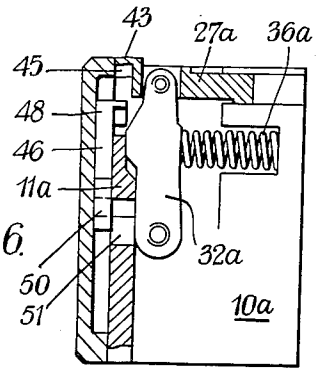


FIG. 6.



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FIG. 7.

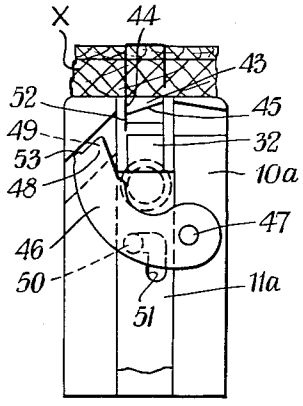


FIG. 8.

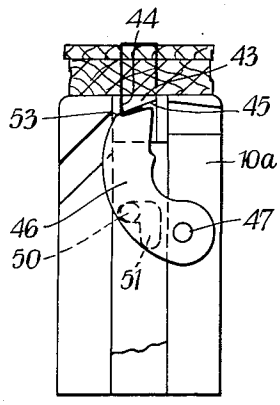


FIG. 9.

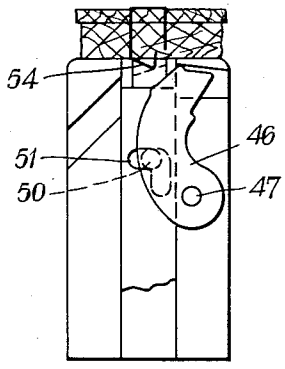
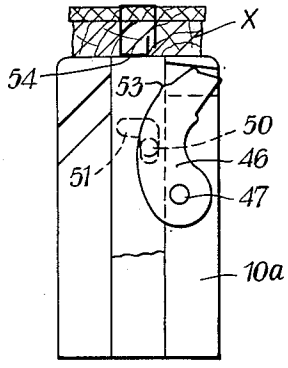


FIG. 10.



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WIRE STITCHING OR STAPLING MACHINES AND THE FORMATION OF WIRE STAPLES

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7 Claims. (Cl. 1—2)

This invention relates to wire stitching or stapling machines and to the formation of wire stitches or staples (herein referred to generally as staples).

Hitherto, substantially U-shaped wire staples have commonly been employed for fastening together workpieces, these conventional staples having a part, commonly referred to as the "crown," which lies substantially flat along the upper side of the work and which has at its ends a pair of side legs which extend from the crown through the work, the end portions of both legs emerging on the underside of the work and being folded over so that the free extremities of the legs are disposed adjacent each other and are exposed on the underside of the work. In certain cases such as, for example, where the workpieces are of wood, the conventional form of wire staple is not always satisfactory for the reason that the under surface of the work may be damaged due, for example, to the emergence of both legs of the staple and/or to the presence of the exposed extremities of the legs on the underside of the work.

An object of the present invention is to provide for the production of an improved form of wire staple so as to reduce or obviate difficulties, such as those indicated above, which may arise in the fastening of workpieces together by wire staples.

Accordingly, the invention further provides a wire stapling machine comprising a stitching head having elements for forming and driving into a workpiece, a generally U-shaped wire staple having one side leg longer than the other so that, as the staple is driven into the work to engage the crown with one face thereof, the shorter leg is embedded in the work and the longer leg passes completely therethrough and a part of such leg emerges from the opposite face of the work, the machine further comprising clinching mechanism including means operable in timed relationship with the forming and driving elements, for positively pre-shaping the emergent staple leg to the required form, and co-operating means for driving said pre-shaped staple leg back into, and against the adjacent surface of, the work.

For a better understanding of the invention and to show how it may be carried into effect, embodiments thereof will now be described, by way of example, with reference to the accompanying diagrammatic drawings, in which:

Figure 1 is a partial side elevation, partly in vertical section, of a wire stapling machine according to one embodiment of the invention,

Figure 2 is a detail view in transverse section, of a part of Figure 1,

Figures 3 to 5 are views similar to Figure 2 and illustrating sequential stages in the operation of the machine,

Figure 6 is a fragmentary side view in vertical section, illustrating a modification of the embodiment shown in Figure 1,

Figure 7 is a transverse sectional view corresponding to Figure 6, and

Figures 8 to 10 are views similar to Figure 7 and illustrating sequential stages in the operation of the modified embodiment.

The embodiment of Figure 1 comprises a wire stapling machine which can be used for securing together workpieces of wood, the machine having a stitching head which may be, for instance, as described in United States patent specification No. 2,530,312 and which in the accompanying drawings is indicated generally in simplified form at **1**, the stitching head including a staple forming element **2** and a staple driving element **3** arranged for vertical reciprocating movement in a common plane and adapted to be operated by a rotatable cam plate **4** disposed at the forward end of a drive shaft **5** rotatably mounted in a tubular frame **6** which carries the stitching head. The stitching head has a front cover **7** in which is mounted a bender or loop bar **8** adapted, when in an outer or retracted position, to receive a fed length of wire W, there being provided cut-off knives (not shown) for cutting the fed wire to form the wire blank W. The loop bar **8** is urged inwardly by a leaf spring **9** secured at its upper end to the cover **7**, so that, during operation of the mechanism, successive wire blanks can be displaced by the loop bar into the path of the forming and driving elements. The wire feed and cut-off mechanism (not shown) are of conventional construction and are so arranged that successive wire blanks W fed to the loop bar will have, at one side of the loop bar, a laterally projecting portion which is greater in length than the projecting portion at the other side of the loop bar. It will be understood that the wire feed mechanism may be adjusted to alter the length of wire fed so that the relative lengths of the projecting portions can be increased or decreased as required, according to the thickness of the workpiece; similarly, the cut-off mechanism may be arranged for adjustment in the appropriate direction relatively to the loop bar, according to the required length of the staple blank. Moreover, the wire feed and cut-off mechanism are operated in well known manner, in timed relationship with the staple forming and driving elements so that during the forming and drivng of a staple into the work, a fresh length of wire is fed to the loop bar and cut off ready for a succeeding staple forming and driving operation. Any staple forming mechanism however can be adapted to the purposes of the invention.

Beneath the stitching head **1** there is disposed a work support **10** within which is housed clinching mechanism comprising a vertically displaceable clinching element **11** movable up and down in timed sequence with the operation of the staple forming and driving elements. For this purpose, there is provided a bell crank lever **12** pivotally mounted at **13** in the work support and having, at the end of one arm **14** thereof, a cam pin and slot connection with the clinching element **11**, the latter carrying a pin **15** which engages in an elongated hole or slot **16** formed in the arm **14**. The other arm **17** of the lever **12** is pivotally connected at **18**, to the front end of a push rod **19**, the rear end of the push rod being engaged by an abutment **20** at the lower end of a rocker **21** pivotally mounted intermediate its ends upon a pivot pin **22** carried by lugs, one of which is shown at **23**, extending rearwardly from an upright support column **24** of the machine. The rocker has at its upper end, a cam follower **25** which engages a rotary cam **26** mounted on the drive shaft **5** of the stitching head and adapted to swing the rocker about the pivot pin **22** for actuation of the clinching element **11** in timed relationship with the operation of the staple forming and driving elements.

The clinching mechanism comprises also positive actuated shaping means including a clinch forming element **27** arranged for sliding movement in a horizontal slideway **28** formed in the work support, the front end portion of the clinch forming element **27** constituting a

die plate 29 formed in its upper surface with a curved die recess 30. The arrangement is such that, during a staple driving operation, the clinch forming element 27 will be moved forwardly to bring the die recess 30 into position beneath the staple, so as positively to pre-shape the part of the longer leg of the staple element emerging from the lower face of the work, by bending said emergent part laterally in the plane of the staple and to cause the end of said emergent part to be directed upwardly so as to re-enter the work. The clinch forming element 27 is pivotally connected at 31 to the upper end of a rocker member 32 pivoted at its lower end on a pivot pin 33 mounted in the work support. The member 32 has a cam face 34 engageable by a corresponding cam face 35 on the clinching element 11 so that, when the latter is moved upwardly to clinch a staple, the rocker member 32 is displaced against the action of a spring 36 to move the clinch forming element 27 rearwardly away from the plane of the staple forming and driving elements whereas, upon downward movement of the clinching element 11, the rocker member 32 is freed for forward rocking movement under the action of spring 36, thereby to move the clinch forming element 27 into position for engagement of the longer leg of the staple in the die recess 30.

In operation, a wire blank W carried by the loop bar 8 is displaced inwardly into the path of the staple forming and driving elements and during rotation of the cam plate 4, the driving element 3 moves down to engage the crown part 37 (Figure 2) of the blank W supported by the loop bar. Thereafter the forming element 2 moves down to bend the laterally projecting portions of the blank at right-angles to the crown thereby to form a generally U-shaped staple having, as shown in broken lines in Figure 2, one leg 38 longer than the other leg 39. The forming and driving elements continue to move down together until the lower face of the forming element 2 contacts the upper surface of the work X, to permit the staple to be driven by the driving element 3 into the work. As the driving element moves down during its driving stroke, it displaces the loop bar 8 outwardly into its retracted position, to receive a fresh cut-off blank of wire for the next succeeding stitching cycle.

During the forming and the initial driving stages (Figures 2 and 3), the clinching element 11 housed in the work support, is positioned with its upper end 40 flush with the top surface 41 of the work support 10. As the staple is driven, the longer leg 38 of the staple first penetrates the work (Figure 3) followed by the shorter leg 39. Thereupon, the bell crank lever 12 rocks about its pivot 13 and causes the clinching element 11 to move downwards and to allow the clinch forming element 27, under the action of the associated spring-urged member 32, to be moved forwardly to bring the die recess 30 into the path of the leg 38. Thus, as the leading end of the longer leg 38 of the staple emerges from the underside of the work X, it engages in the curved die recess of the clinch forming element and is positively shaped by being displaced laterally toward the shorter leg 39 to form, in the plane of the staple, a return bend beneath the work, so that the free end of the emerging leg is directed upwardly and caused to enter the lower surface of the work at a point beneath the upper crown part of the staple and laterally inwardly offset slightly from the shorter leg, as shown in Figure 4. Upon completion of the downward movement of the driving element 3, the clinch forming element 27 is withdrawn into its inoperative position and the clinching element 11 moves upwardly (see Figure 5) so as positively to drive the lower crown part 42 of the staple flush against the under surface of the work X, thus completing the formation and driving of the staple. The staple forming and driving elements then move upwardly on their return strokes and the loop bar 8 is then able to move inwardly carrying with it the previously fed staple blank W ready for the next forming and driving operation.

It will be understood that during the driving of the staple, only the longer leg 38 of the staple emerges from the lower surface of the work so that there is but a single point at which the lower surface is disturbed as the leg emerges from the material. The single point of emergence of the leg will thus normally be completely surrounded by undisturbed material and this considerably reduces the damage to the underface of the workpiece. Moreover, the final clinching operation in which the lower crown 42 of the staple is pressed against the lower surface of the workpiece, serves to restore substantially the disturbance of the material produced by the emergence of the longer leg of the staple during the driving operation.

In accordance with a modified embodiment of the invention illustrated in Figures 6 to 10, there is provided a wire stapling machine which is similar to the machine of the first described embodiment but which has clinching mechanism arranged to effect a sharply defined bending of the longer leg of the staple beneath the work during a driving operation. Thus, in this modified embodiment, the clinch forming element 27*a* has at its front end a wedge-shaped part 43 presenting a lateral face 44 (see Figures 7 and 8) engageable with the emergent part of a staple leg and presenting also a lower inclined face 45 against which the free end portion of the emergent part of the staple leg can be folded to produce the sharp bend. The vertically displaceable clinching element 11*a* is operatively associated with a crescent-shaped arm 46 disposed in front of the clinching member and pivotally mounted on a pin 47 in the work support 10*a* for swinging movement in a plane parallel to the plane of the staple. The arm 46 has at its free end, a nose 48 formed with a lateral flange 49 and shaped to engage and bend the emergent part of the staple leg around the wedge-shaped part 43 of the clinch forming element 27*a*. The swinging movement of the arm 46 is effected in timed relationship with the operation of the staple forming and driving elements, there being between the arm 46 and the clinching element 11*a* a pin and slot connection comprising a pin 50 extending rearwardly from the arm and engaging in a generally arcuate slot 51 formed in the clinching element.

In operation, a staple having one leg longer than the other, will be formed and driven into the work X, substantially as described with reference to Figures 1 to 5, and during the driving operation, the clinch forming element 27*a* will be located in its normal forward position so that its wedge-shaped part 43 will be disposed beneath the staple. Thus, as the longer leg of the staple emerges from the lower face of the work, it will move down the lateral face 44 of the wedge-shaped part into the position shown in Figure 7. The clinching element 11*a* now commences to move upwardly to produce, by virtue of the pin and slot connection, swinging movement of the arm 46 in a clockwise direction, as viewed in Figures 7 to 10, causing the lateral flange 49 of the nose 48 to engage and bend the lower part 52 of the staple leg around and against the inclined face 45 of the wedge-shaped part 43, to form a hook in the plane of the staple, as shown in Figure 8. Upon further upward movement of the clinching element 11*a*, the member 32*a* is displaced against the action of spring 36*a* to move the clinch forming element 27*a* rearwardly from the plane of the staple, and the arm 46 continues its swinging movement causing a rib 53 at the trailing end of the nose and its flange, to engage and bend the upright portion of the projecting staple leg laterally about its point of emergence from the work thereby to displace the hook upwardly and to cause the point of the hook to penetrate the under surface of the work, as shown in Figure 9. As the nose of the arm 46 moves laterally away from the staple, the upwardly moving clinching element 11*a* engages the lower crown part 54 of the staple and presses this firmly into position flush with the under sur-

face of the work (Figure 10). Following the final clinching operation, the clinching element **11***a* commences its downward movement thereby causing the pivoted arm **46** to swing back into its initial position and to allow the clinch forming element **27***a* to return ready for the next succeeding stitching cycle.

We claim:

1. A wire stapling machine, comprising a stitching head having elements located in a staple-forming and driving plane for forming a generally U-shaped wire staple having one side leg longer than the other and for driving the staple into the upper face of the work to be stapled so that the shorter leg remains embedded in the work and the longer leg passes completely therethrough and part of such longer leg emerges from the opposite face of the work, the machine further comprising clinching mechanism operable in timed relationship with said forming and driving elements, said clinching mechanism including positively actuated shaping means for engaging and forming the emergent part of the longer leg with a pre-shaped laterally directed end portion disposed in the plane of the staple, said shaping means comprising a clinch-forming element, a forming part on said clinch-forming element, mechanism for sliding said clinch-forming element in a direction normal to the staple-forming and driving plane to displace said clinch-forming element into and from an operative position in which said forming part is located in said staple-forming and driving plane, and clinch-driving mechanism operatively associated with said shaping means for driving said pre-shaped end portion of said emergent staple leg into and against said opposite face of the work, to complete a stitch lying in a single plane, said clinch driving mechanism comprising a clinching element, means for moving said clinching element along a path substantally perpendicular to the work and to the path of movement of said clinch-forming element, and means operatively connecting said clinching element to said clinch-forming element for displacing said clinching element after the pre-shaping of the emergent part of the staple leg by said clinch-forming element, to drive said pre-shaped emergent part positively against the underside of the work and to move said clinch-forming element away from the plane of the staple.

2. A machine as claimed in claim 1, wherein said mechanism for moving said clinching element comprises a lever pivotally mounted on the machine frame, cam means for rocking said lever about its pivot, and link and lever means forming an operative connection between one end of the said pivoted lever and said clinching element.

3. A machine as claimed in claim 1, wherein the means operatively connecting said clinching element and said clinch forming element comprises a rocker element, a pivotal connection between one end of said rocker element and said clinch forming element, spring means engaging said rocker element and urging said rocker element into a position in which it normally holds said clinch forming element in its operative position, an abutment on said rocker element, and a cam face on said clinching element engageable with said abutment upon movement of the clinching element to drive the emergent part of a staple leg into and against the work, for displacing the clinch forming element against said spring means into its inoperative position.

4. A machine as claimed in claim 3, wherein the forming part of said clinch forming element comprises a die plate formed with a die recess, said die recess having a concave face for pre-shaping the emergent end portion of a longer staple leg by laterally displacing said emergent end portion toward the shorter leg of the staple to form a return-bent part of which the extremity is directed upwardly for driving by said clinching element into the underside of the work.

5. A wire stapling machine comprising a stitching head, a work support located beneath the stitching head, said stitching head having elements for forming a generally U-shaped wire staple having one side leg longer than the other and for driving the staple into one face of the work so that the longer leg passes completely therethrough and a part of such longer leg emerges from the opposite face of the work, the machine further comprising clinching mechanism operable in timed relationship with the forming and driving elements, said clinching mechanism including a clinch forming element arranged for horizontal sliding movement in said work support, a forming part on said clinch forming element, mechanism for slidingly displacing said clinch forming element into and from an operative position in which said forming part is located in the staple forming and driving plane for positively preforming the emergent part of the longer staple leg by lateral displacement of said emergent part in the plane of the staple, and clinch driving means including a clinching element mounted for vertical displacement in said work support, and means operatively connecting said clinching element to said clinch forming element for lifting said clinching element and driving said preformed emergent part into and against the underside of the work, to complete a stitch lying in a single plane.

6. A machine as claimed in claim 5, wherein the forming part of said clinch forming element comprises a bending block on said clinch forming element, said bending block having a lateral face engageable by the emergent part of the longer leg of a staple, and having also an underface against which the lower free end portion of said emergent part can be bent to produce a hook in the plane of the staple, a bending device mounted for rocking movement in the plane of the staple for bending said free end portion of the emergent staple leg against said underface to form said hook, means on said bending device for bending the emergent staple leg laterally about its point of emergence from the work toward the shorter leg of the staple to cause the point of the hook to reenter the work prior to engagement of said hook by said clinching element.

7. A machine as claimed in claim 6, wherein said bending member has a nose part for engaging and bending the emergent staple leg to form a hook at the end thereof, and a projection for engaging and displacing said hook laterally in the plane of the staple to cause the point of the hook to penetrate the underside of the work.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,979,722

April 18, 1961

John Irving Nasmith et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 54, after "work" and before the period insert -- so that, upon completion of the clinching operation, to form a stitch in a single plane --.

Signed and sealed this 17th day of October 1961.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents

USCOMM-DC