STAPLING MACHINE FOR MAKING ELECTRICAL CONNECTIONS AND OTHER FASTENINGS

Inventor: Arthur Graf, 323 W. 43rd St., New York, N.Y. 10036

Filed: Dec. 24, 1970

References Cited
UNITED STATES PATENTS

ABSTRACT

Metal stock sequentially cut, folded and clinched about a pair of electrical leads in a stapling machine into which the stock is fed. A pair of relatively movable, metal deforming elements are advanced along a track by link connections to a common crank pin rotated by a drive shaft during each cycle to perform the metal deforming operations with sufficient impact.

7 Claims, 13 Drawing Figures
This invention relates to a machine for performing a plurality of sequential operations on metal stock and more particularly to a staple making and clinching machine.

Machines for making staples from continuous stock withdrawn from a storage reel are well known. In this type of machine, a strip of metal is severed from the stock, folded into a staple and clinched by means of a reciprocating tool within a clinching die into which electrical leads are inserted. Thus, the leads of electric wire may be physically as well as electrically interconnected by means of the foregoing type of staple machine. The size of these machines vary in accordance with the size of the staples and the loading associated therewith.

A particular problem arises in establishing a connection to plastic coated electrical leads such as utilized in motor windings, resistors, etc. Inasmuch as it is difficult to remove the coating from the wire lead, a more suitable solution would be to provide an improved type of staple machine of relatively small size having the capability of producing and clinching connector staples to plastic coated electrical leads establishing suitable electrical contact without prior removal of the plastic coating.

In accordance with the present invention, the improved staple machine is provided with a vertically reciprocable driver element for clinching a staple within an underlying, stationary clincher die. The driver element is slidably mounted within a staple forming element having cutting and folding edges by means of which sections of metal stock are sequentially severed and folded into staples prior to being clinched. Both the staple forming and clinching elements are connected by drive links to a common crankpin extending integrally from a wide bearing supported crank disc having a rotational axis perpendicular to and intersecting the vertical path along which the forming and clinching elements are reciprocated. The crank disc, reinforced to sustain impact loading, is supported by a wide bearing independently of a main drive shaft of the staple machine to which it is splined separately from a drive gear also secured to the shaft for transmitting motion through a train of gears to feed rollers located adjacent to a stock guide through which the stock is fed to the cutting edge of the staple forming element. The staple machine when so constructed, is capable of imparting sufficient impact force to the staples when being clinched within the clincher die in order to cause the protrusions or prongs formed on one side thereof to pierce plastic coated leads of electrical wire. The high impact capability of the staple machine is alternatively useful in meeting different metal deforming requirements. For example, with the same basic machine and some minor alterations, a staple considerably larger or double the size of commercial staples may be produced thereby avoiding the necessity for a larger staple machine.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof,

wherein like numerals refer to like parts throughout, and in which:

FIG. 1 is a side elevational view of a staple machine constructed in accordance with the present invention;
FIG. 2 is an enlarged side elevational view of the staple machine with parts broken away and shown in section;
FIG. 3 is a sectional view taken substantially through a plane indicated by section line 3—3 of FIG. 2;
FIGS. 4—7 are partial sectional views showing the metal deforming portions of the staple machine in different operational phases;
FIG. 8 is a perspective view showing an electrical connection established in accordance with the present invention;
FIG. 9 is a transverse sectional view taken substantially through a plane indicated by section line 9—9 in FIG. 8;
FIG. 10 is a partial sectional view taken substantially through a plane indicated by section line 10—10 in FIG. 8;
FIG. 11 is a transverse sectional view through the metal stock taken substantially through a plane indicated by section line 11—11 of FIG. 2; and
FIG. 12 is a perspective view of some of the disassembled parts of the staple machine.

FIG. 13 is a sectional view of a portion of the machine as shown in FIG. 3, modified somewhat.

Referring now more particularly to the drawings, FIG. 1 illustrates the improved staple machine of the present invention generally denoted by reference numeral 10. The machine housing generally referred to by reference numeral 12 is suitably bolted to a frame 14 for alignment above a stationary clincher die 16. As is well known in staple machines of this type, a laterally retractable anvil 18 is positioned so that strips of metal are folded thereover to form a staple. Once the staple is formed, the anvil 18 is laterally withdrawn so that the staple may be deformed or clinched by means of a tool on the clincher die. The staples are formed from severed sections of metal stock 22 fed from a storage reel (not shown) to the guide 20 by means of feed rollers 24 located adjacent to the guide.

Referring now to FIGS. 2 and 3 in particular, the feed rollers 24 are drivenly connected by the gear train 26 to the drive gear 28 fastened to a main drive shaft member 30. The drive gear 28 is fastened to the drive shaft 30 in axially spaced relation to the inner end 32 of the drive shaft and independently of a crank disc 34 to which the end of the drive shaft is splined. As a result of this arrangement, a smaller gear 28 may be utilized as compared to prior art arrangements capable of transmitting motion through the gear train 26 at the proper speed to the feed rollers 24 which may thereby be located closer to the stock guide 20 into which the stock 22 is fed. The crank disc 34 on the other hand may be made of any desired thickness and will be directly supported by a wide sleeve bearing 36. The usual overlying support of the crank disc on the drive shaft is thereby avoided in favor of direct support adjacent to the location of impact forces.

A common crankpin 38 projects axially forward from the crank disc 34 within a cavity 40 formed within the housing 12 in communication with a track guide slot 42 closed by a cover wall 44 which is secured to the housing by means of fasteners 46. The crankpin 38 is formed integral with the disc 34 to avoid any weaken-
ing bores in the disc. The crankpin is rotated about the axis of the drive shaft 30 within the cavity 40 and transmits motion through a pair of drive links 48 and 50 also located within the cavity as more clearly seen in FIGS. 2, 3 and 12. The ends of the drive links 48 and 50 remote from the common crankpin 38, are pivotally connected to studs 52 and 54 associated with a pair of vertically reciprocable, metal deforming tool elements 56 and 58. The guide slot and the tool elements may be enlarged as shown in FIG. 13 in order to produce staples of different size including sizes ordinarily requiring a basically larger machine.

The tool element 56 is operative to sever the metal stock and fold the severed section about the anvil 18. It includes an upper mounting block portion 60 from which the stud 52 projects somewhat offset from the longitudinal axis which coincides with the path of travel when the element is assembled within the machine. A lower track portion 62 of the tool element is formed with a track slot 64 and terminates at an abutment stop face 66 spaced from the stop face 68 on the lower side of the upper portion 60. The tool element 58 is slidable along the surface 70 of the tool element 56 between the stop surfaces faces 66 and 68.

The tool element 58 includes a connecting block portion 72 from which the stud 54 projects somewhat offset from the longitudinal axis of both tool elements assembled within the track slot 42. The mounting block portion 72 is adapted to be slidably displaceable along the surface 70 of the element 56 between the stop surfaces 66 and 68 and is connected by means of a pin 74 to the driver portion 76 of the element which is slidably received within the track slot 64 for projection from the lower end thereof.

It will be apparent that during each rotational cycle of the crank disc 34, reciprocatory motion will be imparted through the common crankpin 38 and drive links 48 and 50 to the tool elements 56 and 58. During vertical reciprocation, the tool element 58 will be displaced relative to the tool element 56 between limits established by the stop faces 66 and 68. Further, relative movement of the tool elements 56 and 58 will be synchronized by virtue of the kinematic arrangement described so as to perform those sequential operations on the stock 22 necessary to form and clinch staples. Operation of the machine for this purpose is initiated by tripping of the machine in a conventional manner so as to impart rotation to the crank disc 34 through the drive shaft 30 from an initial position in which both of the tool elements 56 and 58 are in an upper retracted position. As the crank disc 34 is rotated from this initial position, the tool element 56 is downwardly displaced at a greater speed than the tool element 58 in order to cause a cutting edge 78 at one lower side of the tool element 56 to sever a section of the stock fed into the work space underlying the tool elements from the guide 20 as shown in FIG. 4. After a section of stock is severed during downward displacement of the staple forming tool element 56, it is folded about the anvil 18 as shown in FIG. 5 within the track slot 64. After the staple is formed as shown in FIG. 5, the anvil 18 is laterally retracted and the driver tool element 58 begins downward movement relative to the tool element 56 at a greater speed as shown in FIG. 6 so that its lower clinching face 80 may displace the staple into the stationary clincher die 16. At the end of the downward stroke of the tool element 58, the staple will be fully clinched within the pair of recesses 84 and 86 of the clincher die as shown in FIG. 7 with the planar end faces of the tool elements aligned in a plane in close adjacency to the die 16. Continued rotation of the crank disc will then retract the tool elements to the initial position in preparation for the next operational cycle when the staple machine is tripped once again by the operator. As the tool elements are retracted to the initial position, another section of the stock is fed into the machine and the anvil 18 returned to its operative position in a manner well known to those skilled in the art.

In the embodiment illustrated in FIGS. 4-7, the staple 82 is clinched to the leads 88 and 90 extending from a pair of electrical wires, the leads being placed within the recesses 84 and 86 for this purpose prior to tripping of the machine. As more clearly seen in FIG. 8, the lead 88 is completely bare while the lead 90 is coated with a plastic material 92. The stock material 22 as more clearly seen in FIG. 11, is provided on one side with sharp, longitudinal prongs or protrusions 94. Accordingly, when the staple 82 is clinched to the leads, the protrusions 94 pierce the plastic coating 92 and establish electrical contact with the lead 90. Thus, the staple not only establishes a physical connection between the leads but also a good electrical connection. The piercing of the coating 92 is made possible because of the impact imparted to the staple when being clinched by the tool element 58. Thus, the drive link arrangement interconnecting the tool elements with the crank disc not only accounts for proper timed movement of the tool elements as described in connection with FIGS. 4-7, but also enables the design of parts with the requisite strength and mechanical advantage to produce the necessary staple impact forces which are also capable of fusing electrical leads to the contacting surfaces of the staple. Also, utilizing the same casting for the housing 12, a dimensionally enlarged guide slot 42 may be formed to accommodate larger tool elements 56' and 58' as shown in FIG. 13 in order to produce dimensionally larger staples as well as to meet other requirements.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

What is claimed as new is as follows:
1. In a work deforming machine through which stock is adapted to be fed along a work path, a pair of work deforming elements, track means for guiding movement of said elements through predetermined strokes along parallel paths intersecting said work path, a drive member, bearing means rotationally supporting the drive member, drive means drivingly connecting said drive member to one of the work deforming elements for sequentially performing at least two operations during movement toward one end of said strokes, and link means connecting the drive means to the other of said work deforming elements for displacement relative to said one of the elements to perform a third operation as said one of the elements approaches said one end of the strokes.
2. The combination of claim 1 wherein said one of the elements slidably mounts the other of the elements
and includes means for limiting said relative displacement of said other of the elements.

3. The combination of claim 1 wherein said drive member comprises a crank disc from which the drive means and the linkage means extend axially, said bearing means directly engaging the crank disc in close adjacency to said paths of the work deforming elements.

4. The combination of claim 3 wherein said work deforming elements have planar end faces aligned with each other at said one end of the strokes.

5. The combination of claim 4 including a stationary member positioned in close adjacency to the end faces of the deforming elements at said one end of the strokes.

6. The combination of claim 1 wherein said work deforming elements have planar end faces aligned with each other at said one end of the strokes.

7. The combination of claim 6 including a stationary member positioned in close adjacency to the end faces of the deforming elements at said one end of the strokes.

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