A stapling tool drives U-shaped staples into a workpiece in such a manner that the crown of the driven staple is longer than the original staple crown. The tool includes a nosepiece structure defining a drive track into which successive staples are fed with the crown underlying the lower end of the staple driving blade. A rigid anvil element pivotally mounted in a cavity communicating with the drive track includes a planar part forming a part of the back wall of the drive track and an outwardly tapered or inclined lower end disposed beneath the crown and legs of a staple in the drive track. In a method of fastening shingles to gypsum type roof decking, the staple is driven downwardly by the blade so that the legs are cammed outwardly by the anvil to impart an outward curl thereto as they enter the shingle and decking. The crown portion then engages the tapered anvil and is elongated at the expense of the leg length during the remainder of the driving stroke, the anvil being pivoted out of the drive track as the crown is elongated. The legs are curled within the decking to provide increased holding power and to prevent breaking through the inner surface of the decking, thereby avoiding decomposition of the decking resulting from condensation. The increased crown length provides an increased staple hold-down area with a consequent increase in tear resistance.

6 Claims, 11 Drawing Figures
APPARATUS FOR DRIVING STAPLES

This invention relates to a staple driving tool and method and, more particularly, to such a tool including anvil means for elongating the crown of the staple as it is driven and a method of fastening articles such as shingles to gypsum type panels.

It has been proposed to use a gypsum roof decking board to provide, in conjunction with composition shingles, a fire resistant roof. Conventional round head roofing nails lack adequate holding power or withdrawal resistance in Gypsum type material. Wire staples driven in a conventional manner also tend to lack sufficient withdrawal resistance and frequently suffer from the added disadvantage of possessing insufficient crown area in contact with the shingle so that tearing may occur in high winds. It is not feasible to attempt to increase withdrawal resistance of either staples or nails by increasing their length because protrusion through the inner surface of the decking permits condensate to form on the metal of the fasteners. This condensate enters the gypsum material and causes deterioration of the decking.

Stapling tools are known or available using a moveable anvil structure extending into the drive track to impart an inward or outward curl to the legs of driven staples. As an example, U.S. Pat. Nos. 2,420,258 and 3,152,335 disclose such arrangements for use in fastening sheet or web material or paperboard cartons which do not offer enough support to staple legs to permit controlled curling to be obtained from configured points on the staple legs. The low driving power of these tools coupled with the fact that these tools are designed to use fine wire staples does not permit their use in building construction. In addition, staples driven by these tools possess no more than their original crown length.

Accordingly, one object of the present invention is to provide a new and improved tool for and method of fastening articles to gypsum panels.

Another object is to provide a method of fastening articles such as shingles to a gypsum panel in which the legs of the conventional U-shaped staple are curled into the panel without penetrating the inner surface and the crown of the staple is concurrently elongated at the expense of the length of the legs to provide increased hold-down area.

A further object is to provide a stapling tool with a moveable anvil within a staple driving track for curling the legs of a driven staple and for elongating the length of the crown thereof.

Another object is to provide a stapling tool in which a moveable anvil element is confined within a recess communicating with a drive track and in which a planar portion on the anvil element forms at least a part of the wall of the drive track.

In accordance with these and many other objects, an embodiment of the present invention comprises a pneumatically actuated fastener driving tool including a reciprocable drive element or blade, the lower end of which is slidably mounted within a drive track formed in a nosepiece structure secured to the lower end of the tool housing. A conventional staple magazine supplied with conventional U-shaped staples feeds successive staples into the drive track beneath the driver blade. The lower end of the drive track terminating in a surface adapted to be placed against a workpiece, such as a shingle to be secured to a drywall roof deck panel, is outwardly opened or flared. The drive track also includes a recess or cavity communicating with the back wall of the drive track in which is pivotally mounted at its upper end a rigid anvil element having a planar wall defining a portion of the back wall of the drive track. The lower end of the anvil element is outwardly tapered into the open portions of the drive track and downwardly tapered toward the front wall of the drive track. A compression spring interposed between the back of the anvil and a wall of the nosepiece biases the anvil to a position in which the side tapered portions underlie the legs of the staple and the forward tapered portion underlies the crown of the staple.

When the tool is to be used to secure a shingle to a gypsum panel or other workpiece, the operation of the tool initiates downward movement of the driver blade and the engaged staple. The ends of the depending legs first engage the anvil and are cammed outwardly so that they enter the shingle adjacent the ends of the anvil. Continuing downward movement of the driver blade forces the legs through the shingle and curls these legs within the underlying gypsum panel. Toward the end of the drive stroke, the crown engages the forward inclined portion of the anvil and starts to elongate the crown by converting contiguous portions of the legs into the crown. As the driver blade reaches the end of its stroke, the anvil is cammed rearwardly out of the drive track, and the driver blade flattens the portion of the staple wire disposed between the points of entry of the legs into the shingle, thus completing the elongation of the crown. In this manner, the shingle is securely fastened to the drywall material by curling the legs within the drywall material to achieve increased holding power without either increasing the length of the staple legs or penetrating the inner surface of the panel. At the same time portions of the staple legs are converted into an elongation of the crown so that a greater hold-down area is provided with the consequent increase in tear resistance.

Many other objects and advantages of the present invention will become apparent from considering the following detailed description in conjunction with the drawings in which:

FIG. 1 is a fragmentary side elevational view illustrating a staple driving tool in conjunction with workpieces to be joined together, such as a shingle and gypsum panel;

FIG. 2 is an enlarged fragmentary end view of the tool and workpieces shown in FIG. 1 and illustrating the tool in a normal condition;

FIG. 3 is a sectional view taken along line 3—3 in FIG. 2;

FIG. 4 is a sectional view taken along line 4—4 in FIG. 2;

FIG. 5 is a sectional view taken along line 5—5 in FIG. 2;

FIG. 6 is a fragmentary sectional view similar to FIG. 2 illustrating the tool at the beginning of a staple driving stroke;

FIG. 7 is a view similar to FIG. 6 illustrating the tool in a position during a driving stroke in which the staple legs begin to enter the first workpiece to be fastened;

FIG. 8 is a fragmentary sectional view similar to FIGS. 6 and 7 illustrating the condition of the staple
driving tool when the crown of the staple reaches an anvil; FIG. 9 is a fragmentary sectional view similar to FIGS. 6-8 illustrating the condition of the tool when the staple is fully driven; FIG. 10 is a sectional view taken along line 10—10 in FIG. 9; and FIG. 11 is an exploded perspective view of a nosepiece assembly of the stapling tool.

Referring now more specifically to FIG. 1 of the drawings, therein is illustrated a fastener or staple driving tool which embodies the present invention and which is indicated generally as 20. The tool 20 includes a housing 22 having a rearwardly extending handle portion 22A and a forward and generally vertically extending head portion 22B, to the lower end of which is secured a nosepiece assembly indicated generally as 24. A conventional staple or fastener magazine indicated generally as 26 feeds successive U-shaped staples 28 (FIG. 2) from a strip or stick thereof into a drive track 30 formed in the nosepiece structure 24 beneath the lower end of a driver blade 32 (FIG. 3) which is also slidably received within the drive track 30.

When the tool 20 is operated, as by actuating a trigger 34 (FIG. 1), the driver blade 32 moves downwardly to engage a crown portion 28A of the staple 28 disposed in the drive track 30 and to move this staple downwardly. As the staple 28 moves downwardly, the lower ends of two depending staples legs 28B engage inclined surfaces on an anvil 36 so that these legs are driven through and curled within a pair of articles to be joined such as a shingle 38 overlying a gusset type panel or roof deckling element 40. At the conclusion of the driving stroke (FIG. 9), the staple legs 28B are curled within the elements 38, 40, and the crown portion 28A of the staple has been elongated to provide a greater hold-down area. In this manner, the conventional staple 28 with a given crown size, length, or width, can be used to secure articles such as shingles 38 to drywall roof decking 40 by curling the legs 28B within the articles 38, 40 and by elongating the crown portion 28A to provide increased hold-down area.

The fastener driving tool can be of any suitable construction well known in the art such as that shown in U.S. Pat. No. 3,043,272, and the staple magazine 26 similarly can be of any suitable construction well known in the art such as that shown in U.S. Pat. No. 3,056,137. The staples 28 can be of any suitable known type such as a 1700 Series staple available from Fastener Corporation of Franklin Park, Illinois. In one embodiment constructed in accordance with the present invention, the staples 28 are formed of 16 gauge wire stock and possesses a crown portion 28A that is one inch in width or length. The roof decking board of gussum or other comparable material can be of any suitable dimension. In accordance with one embodiment the decking board is three-quarters of an inch in thickness. The upper article or shingle 38 can be of any suitable structure such as a fire-resistant composition. The tool 20 of the present invention can also be used where the underlying panel 40 comprises the usual plywood or roofing planks.

The nosepiece structure 24 is secured to the staple magazine 26 and the lower end of the head portion 22B of the tool housing 22. The structure 24 is formed of a rear element 42 and a front wall element 44 (FIG. 11). The rear element 42 is secured to the front end of a U-shaped housing 26A of the magazine assembly 26, as by a pair of machine screws 46 (FIG. 4) passing through openings 48 in the member 42 (FIG. 11). The member 42 is provided with an opening indicated generally as 50 through which the staples 28 are fed from the magazine assembly 26. A recess 52 defines the side and back or rear walls of the drive track 30 and has a width equal to the width of the crown portion 28A. The front wall of the drive track 30 is provided by the back wall of the front member 44 which is secured in an abutting relation to the front wall of the member 42 by a plurality of machine screws 54 received within openings 56 in the member 44. The lower end of the drive track defined by the members 42, 44 is outwardly tapered or flared, as indicated generally at 30A (FIGS. 2 and 11), at the lower or workpiece engaging surface of the nosepiece structure 24 which is indicated generally as 24A (FIG. 1).

The anvil 36 is mounted within a recess or cavity indicated generally as 58 (FIGS. 3 and 11) formed in the member 42. The lower end of the cavity or chamber 58 is outwardly flared or inclined, as indicated at 58A (FIG. 11). The anvil 36 is pivotally mounted within the cavity 58 by a pivot or drive pin 60 passing through an opening 62 in the upper end of the anvil 36 with its ends carried by the member 42 (FIGS. 5 and 11). A compression spring 64 disposed within a recess 66 (FIG. 3) in the member 42 normally biases the anvil 36 to the normal position shown in FIG. 3 which is determined by a flat stop surface 36A (FIGS. 3 and 11) bearing against the back wall of the member 44 which defines the front wall of the drive track 30.

The anvil element 36 also includes an intermediate portion forming a planar wall surface 36B (FIGS. 3 and 11). When the anvil 36 is held in its normal position (FIG. 3), the planar wall surface 36B completes the definition of the back wall of the drive track 30. To provide means for curling the legs 28B of the staple 28 into the workpieces 38, 40, the lower end of the anvil element 36 includes a pair of downwardly and outwardly inclined surfaces 36C along its side edges. The surfaces 36C are closely received within the outwardly open portion 58A of the cavity 58 in which the anvil 36 is located and that is spaced from the outwardly flared or open portions 30A of the drive track with a clearance sufficient to accommodate the legs 28B of the staple 28 (see FIG. 2). To provide means for assisting in the elongation of the crown portion 28A and also to provide means for camming the lower portion of the anvil 36 out of the drive track 30, the lower front wall of the anvil 36 is provided with an outwardly and downwardly inclined portion 36D (FIGS. 2 and 11). The surface 36D terminates in the stop surface 36A. In the normal position of the anvil 36, the inclined surface 36D, the side edges of which incline outwardly, underlies the crown portion 28A of the staple 28 in the drive track 30.

When the tool 20 is operated by depressing the trigger 34, the pneumatic power unit or motor initiates downward movement of the driver blade 32 from the normal position shown in FIGS. 2 and 3 so that the driver blade engages the crown portion 28A of the staple 28 in the drive track 30 substantially completely across its length or width. Continuing downward movement of the driver blade 32 breaks the staple 28 away from the remaining staples in the strip and moves this staple downwardly in the drive track 30 until the lower
ends of the legs 28B engage the surfaces 36C (FIG. 6). Continuing downward movement of the blade 32 and the engaged staple 28 slides the lower ends of the legs 28B along the surfaces 36C to bend these ends outwardly about fulcrums on the member 44 indicated at 70 in FIG. 7. In this manner an initial curl is imparted to the low ends of the legs 28B at the time and prior to the time at which the lower ends of the legs 28B first enter the upper workpiece 38.

As the driver blade 32 moves further in a downward direction, the staple legs 28B are directed into the workpieces 38, 40 with the direction imparted by the bearing of these legs on the opposed fulcrums defined by the points 70 and the lower edges of the surfaces 36C so that the staple 28 is in generally the position shown in FIG. 8 when the undersurface of the crown portion 28A of the staple reaches the upper edge of the surface 36D. Because of the rather substantial nature of the workpieces 38, 40, the legs 28B are firmly supported within the workpieces 38, 40, and it has been determined that there is very little tendency for the staple legs 28B to tear enlarged openings in these workpieces. During the next increments of downward movement of the blade 32, the crown 28A of the staple rides along the surface 36D, and by engagement with the edges formed by the juncture of the surfaces 36A, 36C, and 36D an upper portion of the legs 28B is rolled into a horizontal plate to elongate the length or width of the crown portion 28A.

This phenomenon provides a portion of the elongation of the crown 28A. It is also believed that as the staple 28 is driven from the position shown in FIG. 8 to the position shown in FIG. 9 there is a tendency for the juncture of the legs 28B with the crown portion 28A to form slight “humps” or bulges projecting upwardly above the plane of the upper surface of the crown 28A. When the driver blade 32 reaches its lowermost position as shown in FIGS. 9 and 10, the final impact of the blade 32 is seating the crown portion 28A on the upper surface of the workpiece 38 as tends to flatten or remove these bulges because the inserted portions of the legs 28B within the workpieces 38, 40 are firmly supported and cannot be displaced laterally. Thus, the final increment in the elongation of the crown portion 28A is believed to result from forcing the legs 28B further into the workpieces 38, 40 along their previously determined lines of movement so that the bulges at the junctures between these legs and the crown are essentially pulled flat.

The engagement of the crown portion 28A of the staple 28 with the inclined surface 36D also permits the further function of camming or displacing the anvil 36 about the pivot pin 60 against the bias of the compression spring 64 to the retracted position illustrated in FIG. 10. This retraction of the anvil 36 permits the final downward movement of the driver blade 32. The stop surface 36A in the displaced position shown in FIG. 10 guides the crown 28A to prevent lateral distortion or displacement at the end of the driving stroke. Further, the compression spring 64 is made strong enough that the anvil 36 cannot easily be retracted from the drive track 30 and provides enough biasing force to provide the initial elongation of the crown portion 28A, referred to above. When the power unit in the tool 20 retracts the driver blade 32 to its normal position (FIG. 3), the compression spring 64 biases the anvil 36 back to its normal position, and the magazine assembly 26 supplies the next staple 28 to be driven to the drive track 30 beneath the lower end of the driver blade 32.

Accordingly, the tool 20 and the method of the present invention provide an improved method for securing articles by providing the elongated crown portion 28A of the staple 28 in conjunction with the curling of the legs 28B within the workpieces 38, 40. As an example, a single Series 1700 staple with a 1-inch crown was driven through two composition shingles into a % inch plywood panel and subjected to a static 20 pound load in tension. The shingles tore away from the staple in periods ranging from one to 3 minutes. As a further comparison, a single round head shingle nail (7/16 inch dia. head, % inch shank of 0.120 inch dia.) was driven through two shingles into % inch plywood and subjected to the same 20 pound static load in tension. The shingles tore away from the head of the shingle nail in periods of around one minute. The same Series 1700 staple was then driven through two shingles into % inch plywood in accordance with the present invention so that the legs 28B were curled within the shingles and the % inch plywood and the crown portion 28A expanded from its standard 1-inch width or length to a width or length of 1 and % inches. The shingles were then subjected to the static 20 pound load with the result that the shingles tore away from the staple 28 after an average elapsed time of ten minutes.

As set forth above, the tool 20 and the improved fastening method of the present invention has particular applicability with respect to fastening shingles or other articles to panels or workpieces of gypsum construction. By curling the legs 28B of the staple 28 into the gyspum material such as the workpiece 40, the leg length of the staple 28 that can be used is increased with the consequent increase in withdrawal resistance. Further, this increased leg length does not result in perforating the inner surface of the workpiece 40. If fasteners of comparable length, either staples 28 driven without curling or conventional fasteners such as roofing nails, are used with such length that they penetrate or pass through the inner surface of the panel, changes in temperature permit moisture in the air to condense on the protruding metal on the inside of, for instance, a roof. This moisture migrates into the gyspum material and results in its deterioration and the loss of holding power.

As an illustration of the relative withdrawal values from gyspum material, a Series 1,700 staple with a 1-inch crown was driven into a ½ inch sheet of gyspum material using a conventional driving tool which does not curl the legs 28B or elongate the crown 28A. The same staple was driven into the same gyspum material using the tool 20. As a further control, a conventional round head roofing nail of the type specified above was also driven into the same gyspum material. These three types of fasteners were then subjected to a withdrawal resistance or pull test on a Tinus Olsen tensile machine with the withdrawal rate set at one-tenth of an inch per minute. The conventional Series 1700 staple showed an average initial withdrawal resistance of 30 pounds. The Series 1700 staple driven in accordance with the present invention showed a 20% rate of average initial withdrawal resistance of 60 pounds. The conventional roofing nail showed an average withdrawal resistance of 13 pounds.
Although the present invention has been described with reference to a single illustrative embodiment, it should be understood that numerous other modifications and embodiments can be devised by those skilled in the art that will fall within the spirit and scope of the principles of the present invention.

What is claimed and desired to be secured by letters Patent of the United States is:

1. A tool for driving generally U-shaped staples into a workpiece wherein the staples each includes a crown portion of a given width from which a pair of legs depend, said tool comprising:
   a nosepiece structure for the tool having a drive track for slidably receiving the driver element and a staple with the staple disposed below the driver element, said drive track having an outwardly open lower end adapted to be disposed adjacent to the workpiece,
   a movably mounted anvil element having an outwardly flared portion disposed in the outwardly open lower end of the drive track, said outwardly flared portion having first oppositely inclined portions in the plane of the drive track for deflecting outwardly the legs of the staple and a second inclined portion below the crown portion of the staple and tapering downwardly to a width greater than said given width, said anvil element being movable into and out of the drive track, and biasing means for biasing the anvil element into the drive track and retaining the second inclined portion in the path of movement of the crown portion as the staple is driven for long enough for the second inclined portion to elongate the crown portion to a width greater than said given width by changing a portion of the staple legs into crown portions.

2. The tool set forth in claim 1 in which the nosepiece structure defines an enclosed recess communicating with the drive track, and the anvil element is pivotally mounted within the recess and includes a planar portion forming at least a part of a wall of the drive track.

3. The tool set forth in claim 2 in which the nosepiece structure includes a front wall structure defining the front wall of the drive track, and the anvil element includes a locating surface ad-

4. The tool set forth in claim 2 in which the biasing means includes a compression spring located within the recess and disposed between the anvil element and the nosepiece structure, said compression spring engaging the anvil element in a position aligned with said planar portion.

5. A tool for driving U-shaped staples with depending legs joined by a crown of given width into a workpiece comprising:
   a nosepiece structure defining a closed drive track slidably receiving the driver element and a driven staple, said nosepiece structure defining a front wall of the drive track and a portion of a back wall of the drive track, said nosepiece structure also defining a cavity opening through the back wall of the drive track, said cavity and said drive track being outwardly open at their lower ends adjacent a workpiece engaging end of the nosepiece structure,
   a rigid anvil structure disposed in said cavity and pivotally mounted on the nosepiece structure adjacent its upper end, said anvil structure having a tapered structure at its lower end disposed in the outwardly open portion of the drive track and cavity and adapted to engage the front wall of the drive track, at least part of said tapered structure having a width exceeding said given width, and a resilient biasing means disposed in the cavity for biasing the tapered structure of the anvil toward the front wall of the drive track and for retaining the tapered structure in the path of movement of the staple long enough for the tapered portion to elongate the crown portion to a width greater than said given width, said biasing means being disposed between and bearing against the nosepiece structure and an intermediate portion of the anvil structure.

6. The tool set forth in claim 5 in which the anvil structure includes a planar intermediate portion defining a part of the back wall of the drive track.

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