

PATENT SPECIFICATION

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F2H 31A 31F 31G 6
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(54) METAL-PENETRATING STAPLES

(71) We, ILLINOIS TOOL WORKS INC., a corporation organised under the laws of the State of Delaware, United States of America, of 8501 West Higgins Road, Chicago, Illinois 60631, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to staples designed for use in fastening a plurality of workpieces, one of which is of sheet metal.

The use of composite structures, such as wood or fibrous material and sheet metal, has presented a number of problems relating to the fastening systems which can be used to attach such workpieces together. Large scale applications of such composite structures require a fastener which may be secured rapidly with a minimum amount of preparation. Therefore, conventional systems, such as bolts and rivets, are cumbersome and uneconomical. Nailing systems or power actuated stud systems may be utilized in fastening such structures; however, certain environments require a fastening system which will remain secured under certain adverse conditions, such as vibration and impact. Conventional studs and nailing systems will not perform well in such adverse conditions. One example of such an environment would be construction used in a truck trailer.

Conventional staples normally cannot be used to fasten sheet metal in such environments because they generally lack the structural strength to penetrate the metal. While certain staples may have such structural strength, they are designed in such a manner as to require high energy forces to drive them through the metal and do not perform well in the above mentioned adverse conditions.

According to this invention, a metal-penetrating staple is formed from sheet stock material and includes a crown portion and

pair of legs extending therefrom, the legs each including an entering point formed from a pair of camming surfaces of unequal length intersecting at an apex which is offset from the longitudinal mid-axis of the leg and on the opposite side thereof from the longer camming surface, one edge of each leg including means for locking the staple in an associated workpiece, the longer camming surface of the entering point being located on the same edge of the leg on which the locking means is located, the staple being resilient so that the locking means is able to spring into locking position when the staple is driven through a metal workpiece.

The accompanying drawings show examples of staples embodying the invention. In these drawings:

Figure 1 is a perspective view of a first staple, after it has been driven through a composite wood and metal workpiece;

Figure 2 is a front elevation of the staple used in Figure 1;

Figure 3 is a top plan view of the staple in Figure 2;

Figure 4 is a fragmentary cross-section of a composite wood and metal workpiece fastened by a second staple, showing the staple in its full divergent position and in its lock position;

Figure 5 is a top plan view of the staple used in Figure 4;

Figure 6 is a front elevation of the staple shown in Figure 5;

Figure 7 is a side elevation of the staple shown in Figure 5;

Figure 8 is a fragmentary cross section of a composite workpiece fastened by a third staple;

Figure 9 is a top plan view of the staple used in Figure 8;

Figure 10 is a side elevation of the staple shown in Figure 9; and

Figure 11 is a front elevation of the staple shown in Figure 9.

Referring to Figures 1 to 3, it will be seen that the first staple 10, which can be eco-

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nomically stamped from sheet metal stock, includes a crown 12, and a pair of legs 14 with entering points 16. The use of thin stamped material serves to reduce the driving energy necessary to penetrate a metal workpiece. For purposes which will be apparent later, each entering point includes a pair of camming surfaces 18 and 20 which are of dissimilar lengths. One longitudinal edge 24 on each leg includes locking means in the form of teeth 26 and 27. The longer camming surface 18 is associated with this longitudinal edge 24.

Figure 3 illustrates the generally arcuate cross-sectional configuration of the staple 10. This configuration enables the staple to be used with wood workpieces, such as 30 in Figure 1, and reduces the tendency of a staple to split the wood when it is driven into the wood.

The unique configuration of the entering point 16 in conjunction with the ratchet-like locking teeth 26 and 27 allows the staple to be particularly effective to penetrate through metal, such as the workpiece 32 in Figure 1. It has been found to be particularly advantageous to work-harden the staple as a means of giving it a spring-like characteristic. As the staple 10 is driven through the metal workpiece 32, the longer camming surfaces 18 tend to force the legs apart, as in Figure 1. When the staple reaches its desired penetration through the metal, the elastic memory of the legs will force the legs to tend to return to their original relative position, such as that in Figure 2. This springback of the legs, in conjunction with the teeth located on the inner edges 24 of the staple, provides a positive ratchet-like lock for the staple.

It should be noted that the double camming surfaces 18 and 20 are particularly important in the penetration of metal. The provision of the surface 20 extending from the apex 22 to the outer longitudinal edge 25 provides a sound structural backing for the apex to enable it to effectively penetrate the metal. The apex 22 is offset from the centre line of the leg. Without such an offset, the apex may be too blunt to penetrate the metal and still provide the proper camming features. It has been found that an apex having an included angle of about 45°, with the shorter camming surface extending at about 30° to the longitudinal axis, and the longer camming surface extending at about 15° to the longitudinal axis, will effectively penetrate the metal workpiece.

The placement of the legs 14 at an angle to each other as seen in Figure 3, as a result of the curvature of the crown 12, allows the divergence of the legs to be greater. This is due to the fact that the bending or divergence of the legs will occur, at least partially, out of the plane of the legs.

The provision of ears 40 serves to increase

the surface contact area for the head of the staple which decreases the possibility that the wood will pull out from under the staple.

Figures 4 to 7 illustrate a second staple 10a. The staple 10a includes a longer camming surface 18a and a shorter camming surface 20a on each leg. In this staple the crown 12a lies in a plane perpendicular to the longitudinal directions of the legs. Thus the crown 12a lies flat on top of the adjacent wood layer 28a. The width of the crown is greater than the width of the legs. The consequent enlarged crown area 12a is extremely helpful in retaining the wood and preventing the wood from pulling out from beneath the staple. This staple is shown with a laminated structure including wood layers 28a and 30a as well as a metal sheet 32a.

In operation, the staple 10a performs in a manner similar to the staple shown in Figures 1 to 3. As the legs 14a penetrate the metal 32a, the longer camming surfaces force the legs to deflect in a scissor-like fashion as shown in dotted lines in Figure 4. When the staple has penetrated a predetermined depth, which is generally determined by the abutment of the crown 12a on the uppermost panel 28a, the spring-like legs tend to return to their original positions. In this staple, a single tooth is formed by the longer camming surface 18a and a shelf surface 34. The shelf surface 34 extends generally perpendicular to the longitudinal edge of the leg and is positioned between the apex 22a and the crown 12a. The thickness of the laminated workpiece may determine the exact distance of the shelf surface 34 from the crown 12a.

The staple 10a also provides locking surfaces movable in a plane perpendicular to the planes of the legs, as well as in planes generally parallel to or coincident with the planes of the legs. This is accomplished by biasing each tooth 26a, 27a out of the plane of the respective leg. This secondary locking structure may be accomplished by a slit 38 and a hinge-like portion 36 connecting the tooth 26a or 27a to the leg 14a.

Figures 8 to 11 show a third staple 10b which is similar to the staple 10a except that one longitudinal edge of each leg is provided with a plurality of ratchet-like teeth 26b or 27b. This staple should also be hardened to give the legs the proper spring-like bias which enables the ratchet-like teeth 26b or 27b to snap back and lock beneath the metal panel.

WHAT WE CLAIM IS:—

1. A metal-penetrating staple formed from sheet stock material including a crown portion and pair of legs extending therefrom, the legs each including an entering point 130

nomically stamped from sheet metal stock, includes a crown 12, and a pair of legs 14 with entering points 16. The use of thin stamped material serves to reduce the driving energy necessary to penetrate a metal workpiece. For purposes which will be apparent later, each entering point includes a pair of camming surfaces 18 and 20 which are of dissimilar lengths. One longitudinal edge 24 on each leg includes locking means in the form of teeth 26 and 27. The longer camming surface 18 is associated with this longitudinal edge 24.

Figure 3 illustrates the generally arcuate cross-sectional configuration of the staple 10. This configuration enables the staple to be used with wood workpieces, such as 30 in Figure 1, and reduces the tendency of a staple to split the wood when it is driven into the wood.

The unique configuration of the entering point 16 in conjunction with the ratchet-like locking teeth 26 and 27 allows the staple to be particularly effective to penetrate through metal, such as the workpiece 32 in Figure 1. It has been found to be particularly advantageous to work-harden the staple as a means of giving it a spring-like characteristic. As the staple 10 is driven through the metal workpiece 32, the longer camming surfaces 18 tend to force the legs apart, as in Figure 1. When the staple reaches its desired penetration through the metal, the elastic memory of the legs will force the legs to tend to return to their original relative position, such as that in Figure 2. This springback of the legs, in conjunction with the teeth located on the inner edges 24 of the staple, provides a positive ratchet-like lock for the staple.

It should be noted that the double camming surfaces 18 and 20 are particularly important in the penetration of metal. The provision of the surface 20 extending from the apex 22 to the outer longitudinal edge 25 provides a sound structural backing for the apex to enable it to effectively penetrate the metal. The apex 22 is offset from the centre line of the leg. Without such an offset, the apex may be too blunt to penetrate the metal and still provide the proper camming features. It has been found that an apex having an included angle of about 45°, with the shorter camming surface extending at about 30° to the longitudinal axis, and the longer camming surface extending at about 15° to the longitudinal axis, will effectively penetrate the metal workpiece.

The placement of the legs 14 at an angle to each other as seen in Figure 3, as a result of the curvature of the crown 12, allows the divergence of the legs to be greater. This is due to the fact that the bending or divergence of the legs will occur, at least partially, out of the plane of the legs.

The provision of ears 40 serves to increase

the surface contact area for the head of the staple which decreases the possibility that the wood will pull out from under the staple.

Figures 4 to 7 illustrate a second staple 10a. The staple 10a includes a longer camming surface 18a and a shorter camming surface 20a on each leg. In this staple the crown 12a lies in a plane perpendicular to the longitudinal directions of the legs. Thus the crown 12a lies flat on top of the adjacent wood layer 28a. The width of the crown is greater than the width of the legs. The consequent enlarged crown area 12a is extremely helpful in retaining the wood and preventing the wood from pulling out from beneath the staple. This staple is shown with a laminated structure including wood layers 28a and 30a as well as a metal sheet 32a.

In operation, the staple 10a performs in a manner similar to the staple shown in Figures 1 to 3. As the legs 14a penetrate the metal 32a, the longer camming surfaces force the legs to deflect in a scissor-like fashion as shown in dotted lines in Figure 4. When the staple has penetrated a predetermined depth, which is generally determined by the abutment of the crown 12a on the uppermost panel 28a, the spring-like legs tend to return to their original positions. In this staple, a single tooth is formed by the longer camming surface 18a and a shelf surface 34. The shelf surface 34 extends generally perpendicular to the longitudinal edge of the leg and is positioned between the apex 22a and the crown 12a. The thickness of the laminated workpiece may determine the exact distance of the shelf surface 34 from the crown 12a.

The staple 10a also provides locking surfaces movable in a plane perpendicular to the planes of the legs, as well as in planes generally parallel to or coincident with the planes of the legs. This is accomplished by biasing each tooth 26a, 27a out of the plane of the respective leg. This secondary locking structure may be accomplished by a slit 38 and a hinge-like portion 36 connecting the tooth 26a or 27a to the leg 14a.

Figures 8 to 11 show a third staple 10b which is similar to the staple 10a except that one longitudinal edge of each leg is provided with a plurality of ratchet-like teeth 26b or 27b. This staple should also be hardened to give the legs the proper spring-like bias which enables the ratchet-like teeth 26b or 27b to snap back and lock beneath the metal panel.

WHAT WE CLAIM IS:—

1. A metal-penetrating staple formed from sheet stock material including a crown portion and pair of legs extending therefrom, the legs each including an entering point 130



5 formed from a pair of camming surfaces of
 10 unequal lengths intersecting at an apex which
 is offset from the longitudinal mid-axis of
 the leg and on the opposite side thereof from
 the longer camming surface, one edge of each
 leg including means for locking the staple in
 an associated workpiece, the longer cam-
 ming surface of the entering point being
 located on the same edge of the leg on which
 the locking means is located, the staple being
 resilient so that the locking means is able
 to spring into locking position when the
 staple is driven through a metal workpiece.

2. A metal-penetrating staple in accord-
 15 ance with Claim 1, wherein each locking
 means is able to resiliently deflect in two
 generally perpendicular directions.

3. A metal-penetrating staple in accord-
 20 ance with claim 2, wherein each locking
 means includes at least one tooth which ex-
 tends outward from the longitudinal edge of
 the respective leg and also extends at an
 angle to the plane including the longitudinal
 edges of that leg.

4. A metal-penetrating staple in accord-
 25 ance with any of claims 1 to 3, wherein the
 longer camming surface of each entering
 point intersects with a shelf surface extend-
 ing outwards from the edge of the respec-
 30 tive leg, the longer camming surface and
 shelf surface forming at least part of the
 locking means for each leg.

5. A metal-penetrating staple in accord-
 35 ance with claim 4, wherein the shelf surface
 is separated from the longitudinal edge to
 allow the shelf edge to flex transversely of
 the plane of the generally flat leg.

6. A metal-penetrating staple in accord-
 40 ance with claim 1, wherein each locking
 means includes a plurality of teeth extending
 from the one longitudinal edge of each leg.

7. A metal-penetrating staple in accord-
 45 ance with any of claims 1 to 6, wherein the
 camming surfaces of each leg intersect at an
 apex having an included angle of about 45°,
 the shorter camming surface extending at
 about 30° to the longitudinal axis of the
 leg and the longer camming surface extend-
 ing at about 15° to the longitudinal axis of
 the leg.

8. A metal-penetrating staple in accord-
 50 ance with any of claims 1 to 7, wherein the
 material of the crown portion lies in a plane
 substantially perpendicular to the longi-
 tudinal directions of the legs.

9. A metal-penetrating staple in accord-
 55 ance with claim 8, wherein the crown and
 leg portions are generally of the same thick-
 ness, and the width of the crown is greater
 than the width of the legs.

10. A metal-penetrating staple in accord-
 60 ance with claim 1, wherein the legs and
 crown portion are generally curved in cross
 section.

11. A metal-penetrating staple in accord-
 65 ance with claim 1, wherein the longitudinal
 edges which include the locking means face
 one another, thus permitting the legs to di-
 verge upon entering a workpiece while being
 biased towards one another to force the
 70 locking means to lockingly engage the under
 surface of a workpiece.

12. A metal-penetrating staple in accord-
 75 ance with claim 1, substantially as described
 with reference to Figures 1 to 3, Figures 4
 to 7, or Figures 8 to 11 of the accompany-
 ing drawings.

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