Aug. 21, 1945. H. W. KOST 2,383,133

METHOD OF FORMING FASTENING DEVICES

Filed Jan. 31, 1942 2 Sheets-Sheet 1

FIG 1

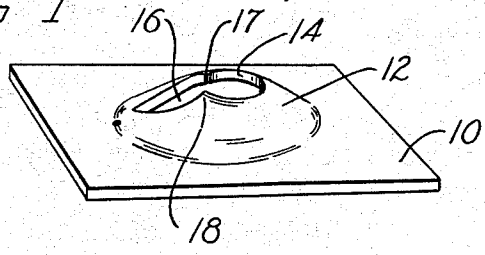


FIG 2

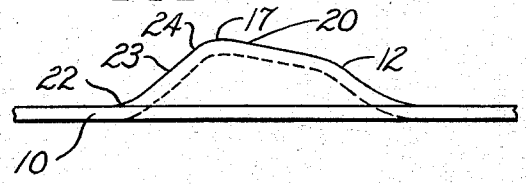


FIG 5

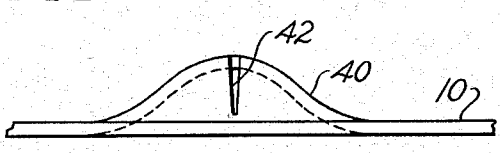


FIG 3

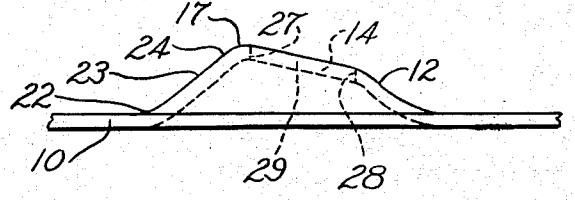


FIG 6

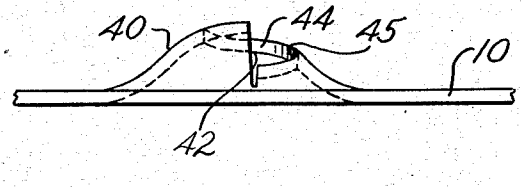


FIG 4

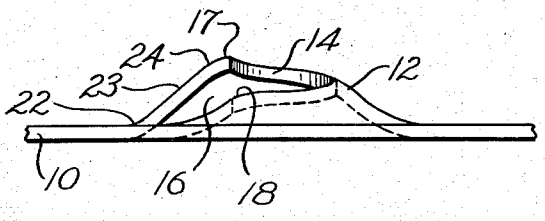
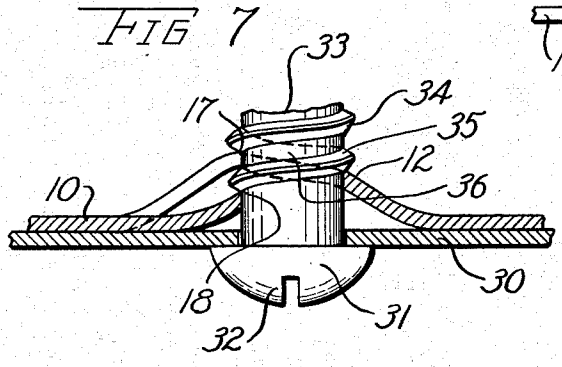


FIG 7



INVENTOR
HAROLD W. KOST
BY Malcolm W. Fraser
ATTORNEY

Aug. 21, 1945. H. W. KOST 2,383,133

METHOD OF FORMING FASTENING DEVICES

Filed Jan. 31, 1942 2 Sheets-Sheet 2

Fig. 10.

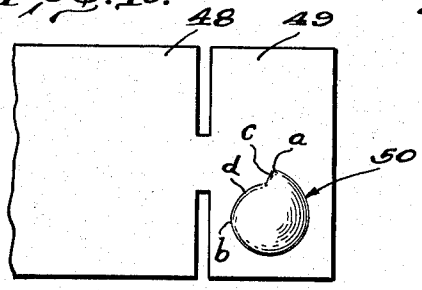


Fig. 11.

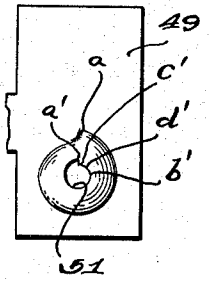


Fig. 12.

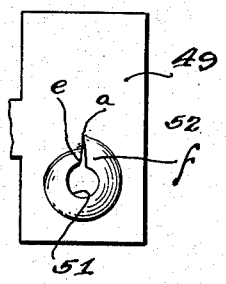


Fig. 8.

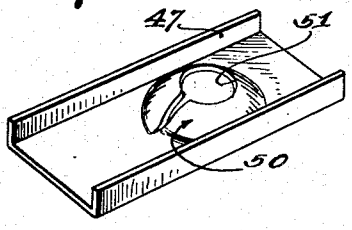
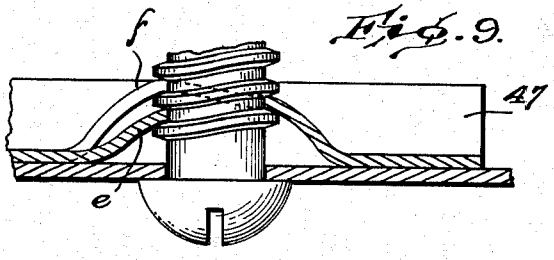


Fig. 9.



Harold W. Kost
INVENTOR.

BY Malcolm W. Fraser
ATTORNEY

Patented Aug. 21, 1945

2,383,133

UNITED STATES PATENT OFFICE

2,383,133

METHOD OF FORMING FASTENING DEVICES

Harold W. Kost, Birmingham, Mich., assignor to Detroit Harvester Company, Detroit, Mich., a corporation of Michigan

Application January 31, 1942, Serial No. 429,030

4 Claims. (Cl. 113—116)

This invention relates to fastening devices, and is particularly directed to a method of forming sheet metal structures or elements for self-locking threaded engagement by a screw. More particularly, the invention is concerned with the production of the self-locking thread and adjacent portions of the structure or element by a succession of comparatively simple operations or steps.

An object of the invention is to produce a method of forming a self-locking thread in sheet metal structures or elements whereby a round screw-thread receiving aperture is obtained.

In one aspect this invention provides a method of forming a sheet metal structure or element for self-locking engagement by a screw in which a portion of the metal is pressed out of the normal plane of the sheet to produce an imperforate substantially frusto-conical protuberance, a hole is pierced in the end wall with the circumferential wall of the hole disposed perpendicular to the plane of the sheet, the protuberance is slit from one edge of the hole to a point adjacent the base of the protuberance. The metal at one side of the slit is pressed in a direction toward the sheet so that a portion of the wall of the opening is formed into the inner or lower portion of a helix which extends progressively and uniformly to the outer or higher portion of the helix. During the final pressing operation, the edge wall of the opening is held in a position perpendicular to the sheet.

Further objects and advantages of the invention reside in the steps and sequence of steps hereinafter more fully described and for purposes of illustration but not of limitation, embodiments of the invention are shown on the accompanying drawings in which

Figure 1 is a perspective view of a sheet metal element having a self-locking thread formed in accordance with the present invention;

Figure 2 is a side elevation of a sheet metal element having a protuberance formed therein and illustrating the initial step in the present method;

Figure 3 is a view similar to Figure 2 and illustrating the second step of piercing the top of the protuberance;

Figure 4 is a view similar to Figure 2 illustrating the step of radially slitting the wall of the protuberance and forming the adjacent edge portions of the material adjacent the aperture;

Figures 5 and 6 are side elevations of a sheet metal structure adapted for the production of the element in accordance with a modified method constituting a part of the present invention;

Figure 7 is a detailed sectional view of the self-locking thread formation shown in the preceding figures with a screw applied thereto;

Figure 8 is a perspective view of a fastener having upstanding longitudinal flanges;

Figure 9 is an enlarged longitudinal sectional view of the fastener shown on Figure 8 mounted on a supporting panel and with a screw applied thereto; and

Figures 10, 11 and 12 are top plan views showing respectively the steps employed in producing a fastener according to Figures 8 and 9.

Referring to Figure 1 of the drawings, a sheet metal element adapted for threaded engagement by a screw and produced by the method of the present invention has been illustrated in the form of a substantially square body 10, which is intended to be representative of all structures or elements which are suitable for production in accordance with the present invention. It is to be understood that the body 10 may take the form of a large panel or sheet which has formed therein one or more of the self-locking thread formations so that the same may be of any desired shape different from that disclosed.

The body 10 has formed therein a protuberance designated in its entirety by the numeral 12, in the top or apex of which has been pierced a hole or aperture 14 and a radially extending slot or slit 16, which is provided in the wall of the protuberance, and extends from the edge of the aperture 14 to a point adjacent the base of the protuberance. The edge or wall of the opening 14 is shaped or developed, in the manner hereinafter appearing and by means of suitable tools, to take the form of a helix of a length substantially equal to one convolution of the thread of a screw which is to be associated with the self-locking thread formation. Accordingly, at a point 17, which is at the juncture of the aperture and the slot, is provided the high part of the developed helix and at a point 18 is provided the low part of the helix. The high point 17 and the low point 18 of the helix are axially spaced a distance equal to the pitch of the thread of the screw, which is to be associated with the structure or element represented by the member 10.

It is to be understood that many difficulties arise in the production of a structure such as has been illustrated in Figure 1, and it will be appreciated that the problem of so forming the aperture and adjacent portions of the metal, embraces a number of difficulties in order to produce a

structure that will positively and uniformly engage the inner surface or base of a screw thread without detrimental distortion of the structure or severing of the screw thread upon tightening.

The foregoing and further difficulties in the production of such a structure, such as set forth in my Patent No. 2,169,182, dated August 8, 1939, have been overcome by the method of the present invention as particularly illustrated in Figures 2 to 4. In Figure 2, which illustrates the first step in the present method, the sheet metal structure is provided with an unperforated protuberance 12 having an irregular, generally cone-shaped contour. The protuberance has a top portion 20 disposed at an angle with respect to the normal plane of the base or body 10 providing at one side thereof the height or depth required for the high point 17, the adjacent wall of the protuberance including a smooth curved lower portion, indicated generally at 22, blending into the body 10 and from which the wall is inclined upwardly in substantially a straight line as at 23, and slightly inwardly curved as at 24 adjacent the high point 17. The opposite side of the protuberance conforms generally to that portion just described, but is of a lower over-all height for a purpose hereinafter appearing. The protuberance is formed by pressing a portion of the metal out of the plane of the body 10 with suitably shaped cooperating dies arranged so that considerably more metal is pressed out of the plane of the body 10 to produce the high point 17 than at the opposite side of the protuberance, such metal serving to embrace the upper portion of a developed helix or opening now to be described.

The protuberance is subsequently pierced or punched to provide an opening or aperture 14 disposed at an angle with respect to the plane of the body and having parallel or cylindrical edge or wall portions substantially perpendicular to the plane of the body, as shown in Figure 3. The hole or opening 14 is preferably produced by means of a cylindrical punch so that a perfectly round aperture, as viewed from the top thereof, is provided in the protuberance, spaced a substantial distance outwardly from the plane of the body 10. Due to the slight angularity of the top wall 20, however, it is to be noted that opposite walls of the aperture 14 are disposed at varying elevations as at 27 and 28, and that the intermediate wall 29 takes the form of a portion of a helix. Portion 28 is located intermediate the high and low parts of the helix to engage a central portion of the screw thread convolution, substantially diametrically opposite the high and low parts thereof. During the piercing operation the general contour of the initially formed protuberance is maintained so that the curvature of the wall portions indicated at 22, 23 and 24 corresponds to that provided by the initial forming operation, and the high point 17 is retained in the same relative position with respect to the base of the protuberance.

As illustrated in Figure 4, the pierced protuberance is subsequently provided with a slit at 16, and the material at one side thereof pressed downwardly so that a portion of the wall of the opening is formed into the lower portion or half of the helix and to position the low point 18 thereof. It is to be noted that during the slitting and forming operation the high point 17, as well as the upper portion of the helix, are maintained in their same relative positions and that the edge or wall of the aperture 14 is retained perpendicular to the plane of the body portion so that the roundness of the aperture is maintained. Furthermore, the diameter of the finished aperture 14 is the same as that of the initially formed opening. Thus, the forming operation serves to depress the metal adjacent a portion of the aperture downwardly to complete the lower half of the helix, it being noted that the lowest point of the helical wall is disposed above the normal plane of the body 10.

The operations just described are preferably performed in rapid succession by a plurality of successively operating dies and punches, though it will be understood that the several operations may be separately performed. Should it be necessary or advisable, an additional operation of restriking or reforming the developed structure may be performed in order to insure that no deformation has occurred.

Referring now to Figure 7, the structure produced in accordance with the foregoing description is shown in use, and it will be noted that the body 10 with its protuberance 12 is attached to an element 30 by means of a screw 31. The screw has a head 32 and a threaded body or shank 33 provided with a well known form of screw thread having angularly disposed sides 34 and 35 and a flat root surface 36. The wall of the developed hole or helix engages substantially an entire convolution of the thread provided on screw 31, the inner face or base 36 of the thread being in engagement with the opening 14 uniformly throughout its length. The cylindrical wall of the opening 14 is flush with the base of the screw thread from the extreme upper corner or edge to the extreme lower corner or edge. The high point 17 of the structure being inturned by the formation of the wall portion at 24 engages the upper portion of the screw thread while the low point 18 being pressed downwardly and inwardly engages the end of the thread convolution below that of the high point 17 while the intermediate portion of the helix engages the thread of the screw at an intermediate portion thereof. As the screw is tightened down, the protuberance 12 will be compressed or flattened to a certain extent with the result that the edge wall of the aperture 14 will be forced radially inwardly throughout its length to effect a binding action against the root surface 36 of the screw.

The thickness of the sheet metal body cannot exceed or even be equal to the pitch of the screw thread or the edge of the aperture would bind against the opposed sides of the screw thread. Likewise, forming operations cannot alter the thickness of the metal adjacent the opening or a similar result would occur. Therefore, by use of the foregoing method, the protuberance may be drawn to a thickness substantially equal to the distance between the threads of the particular screw with which the structure is to be used, and subsequent operations performed without altering such thickness of metal.

Referring to Figures 5 and 6, a modified method of adapting the sheet metal structure or element for the reception of a screw, has been illustrated. In its completed form, the structure is the same as that shown in Figure 1, the steps involved in its production being somewhat modified over those hereinbefore described. First, the sheet metal is formed with a protuberance 40 of the general form of the finished structure and including a radial slit 42. The next step in the operation consists in punching or piercing a hole 44 in the top of the protuberance and

forming the adjacent wall of the protuberance into the form of a helix having a pitch approximating that of the screw, which the structure is adapted to receive. This latter step is preferably preformed as a compound operation in order that the edge or wall 45 of the opening 44 will be disposed perpendicular to the normal plane of the sheet, and maintained in that position during the formation of the adjacent metal to provide an opening of spiral form. By so punching and forming the opening, it will be clear that the danger of deforming the hole is eliminated.

The protuberance initially formed is preferably made of a size and shape in which the highest point is equal to the highest point of the finished structure, the angularity of the walls similar to the finished walls, and the base of a diameter equal to that of the finished base. Thus, it will be noted that the metal required for the finished structure is initially drawn out of the plane of the body portion, and subsequent steps are primarily for the purpose of producing the desired shape to the helical wall. Accordingly, the walls of the aperture are maintained of the correct thickness for proper reception of the cooperating screw thread. In other words, the helix walls are uniform throughout and not of varying thickness as a result of any subsequent drawing or forming operation. As the entire thickness of the protuberance will enter the helical groove in the shank of the screw and being uniform throughout, a thread of great strength will be formed.

The preferred operations may take place in rapid succession upon a single reciprocating movement of a compound die toward a suitable matrix, a part of the die and matrix cooperating to form the protuberance and slit, to be followed in succession by a punch to form the perforation, and a die to form the wall of the opening to produce the screw receiving aperture in helical form. A similar succession of forming and punching operations can be performed in a progressive die, as will be clearly understood.

The fastener shown on Figures 8 and 9 is similar to that hereinbefore described except for the side flanges 47 which adapt the fastener for a specific use. Figures 10, 11 and 12 show the method of forming this fastener. A strip of sheet metal 48 is provided and from this, a section 49 of the desired dimensions is cut. Formed in the piece 49 is a dome-like protuberance 50 which is imperforate and the sides of which taper gradually from the base toward the top which is slightly rounded. It will be observed that from the point *a* to the point *b* extending in a clockwise direction, the protuberance has radii of uniform length. Extending inwardly from the point *a* is a notch position *c* and from the inner end of the notch portion *c*, a surface *d* extends by a gradual curve, to and merges with the circular portion at the point *b*. Thus a protuberance is formed which may be defined as a composite involute circular protuberance, the circular portion as above indicated extending from the point *a* to the point *b* and the involute portion being the curved portion *d* which terminates at the inclined notch portion *d*.

In the next operation of forming the fastener as indicated on Figure 11, the protuberance is pierced to provide a hole 51 in the central portion thereof. This hole is formed with a circular portion extending from the point *a'* to substantially the point *b'*. From the point *b'* extends an inwardly curved surface *d'* which, as compared with the circular portion or portion of uniform radii *a'*—*b'*, the curved surface *d'* has decreasing radii. The curved portion *d'* terminates at a notch portion *c'* which is in the same general position with respect to the protuberance as the notch *c* above described. It will be manifest that the shape of the hole 51 resembles that of the base of the protuberance except in reverse position.

In the next step, the slot 52 is formed which extends from the point *a'* of the hole 51 substantially to the point *a* at the base of the protuberance. The side *e* of the slit is then pressed in a direction toward the sheet 49 in such a manner that a portion of the wall of the opening is formed into the inner portion of a helix. The helix extends progressively and uniformly to the outer portion *f*. The last described slitting and forming operations are done by dies and in such a manner that the edge wall of the hole 51 remains unchanged and in position at approximately right angles to the plane of the sheet 49. Preferably the formation of the flanges 47 is accomplished prior to the final forming steps of the fastener. A fastener produced in accordance with this method is particularly adapted for use in connection with heavier gauge metal and the fastener can be very satisfactorily produced to accommodate a screw formed with an acme thread.

This application constitutes a continuation in part of my application Serial No. 264,956 filed March 30, 1939, and entitled "Method of forming fastening devices."

It is to be understood that numerous changes in details of construction, arrangement and operation may be effected without departing from the spirit of the invention especially as defined in the appended claims.

What I claim is:

1. The method of forming a sheet metal structure or element for self-locking engagement by a screw comprising pressing a portion of the metal out of the normal plane of the sheet to produce an imperforate substantially frusto-conical protuberance with an end wall inclinedly disposed relative to the plane of the sheet and side walls inclining gradually from the end wall to the sheet, piercing a round hole in said end wall with the circumferential wall thereof disposed perpendicular to the plane of the sheet, radially slitting the protuberance from one edge of the hole at the highest point of the protuberance and in a direction radially thereof to a point adjacent the base of the protuberance, pressing the metal at one side of the slit in a direction toward the sheet so that a portion of the wall of the opening is formed into the inner or lower portion of a helix which extends progressively and uniformly to the outer or higher portion of the helix, and holding the edge wall of the opening perpendicular to the sheet during said last pressing operation.

2. The method of forming a sheet metal structure or element for self-locking engagement by a screw comprising pressing a portion of the metal out of the normal plane of the sheet to produce an imperforate substantially frusto-conical protuberance with an end wall inclinedly disposed relative to the plane of the sheet and side walls inclining gradually from the end wall to the sheet, piercing a round hole in said end wall with the circumferential wall thereof disposed perpendicular to the plane of the sheet, radially slitting the protuberance from one edge of the hole at the highest point of the protuberance and in a di-

rection radially thereof to a point adjacent the base of the protuberance, pressing the metal at one side of the slit in a direction toward the sheet so that a portion of the wall of the opening is formed into the inner or lower portion of a helix which extends progressively and uniformly to the outer or higher portion of the helix, holding the edge wall of the opening perpendicular to the sheet during said last pressing operation, and restriking the developed structure to insure against deformation.

3. The method of forming a sheet metal structure or element for self-locking engagement by a screw comprising pressing a portion of the metal out of the normal plane of the sheet to produce an imperforate substantially frusto-conical protuberance with an end wall inclinedly disposed relative to the plane of the sheet and side walls inclining gradually from the end wall to the sheet, piercing a hole in said end wall with the circumferential end wall thereof disposed perpendicular to the plane of the sheet, said hole being round except for a notch and an involute curved edge portion contiguous thereto, and thereafter slitting the metal from said notch to the base of the protuberance and pressing the metal at one side of the slit in a direction toward the sheet so that a portion of the wall of the opening is formed into the inner or lower portion of a helix which extends progressively and uniformly to the outer or higher portion of the helix, and during said last step holding the edge wall of the opening perpendicular to the sheet.

4. The method of forming a sheet metal structure or element for self-locking engagement by a screw comprising pressing a portion of the metal out of the normal plane of the sheet to produce an imperforate substantially frusto-conical protuberance, piercing a hole in said end wall with the circumferential end wall thereof disposed perpendicular to the plane of the sheet, said hole being round except for a notch and an involute curved edge portion contiguous thereto, and thereafter slitting the metal from said notch to the base of the protuberance and pressing the metal at one side of the slit in a direction toward the sheet so that a portion of the wall of the opening is formed into the inner or lower portion of a helix which extends progressively and uniformly to the outer or higher portion of the helix, during said last step holding the edge wall of the opening perpendicular to the sheet, and subsequently restriking the developed structure to insure against deformation and to press the edge wall of the hole into a plane substantially parallel with the sheet and to make the extreme edge slightly thinner than the remainder, thereby to provide a portion for engaging substantially between the threads of a screw.

HAROLD W. KOST.