Aug. 8, 1939 B. C. PLACE 2,169,056

METHOD OF ADAPTING SHEET METAL FOR SCREWS

Filed April 26, 1937

Fig. 3

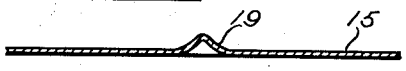


Fig. 4

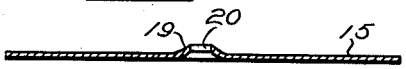


Fig. 5



Fig. 9

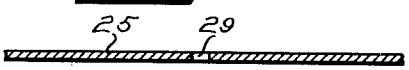


Fig. 10



Fig. 11



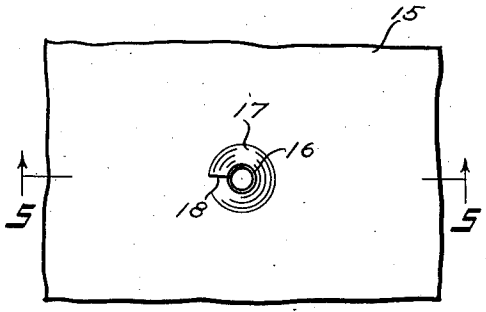


Fig. 1

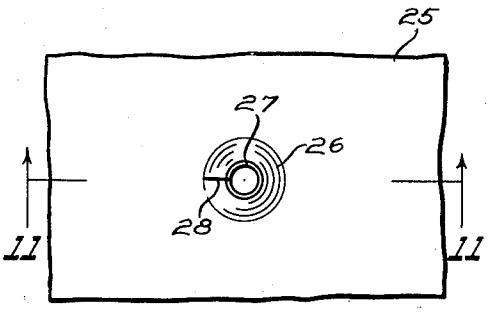


Fig. 7



Fig. 2



Fig. 8

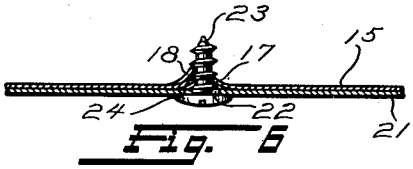


Fig. 6

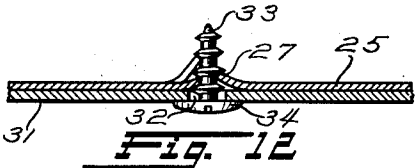


Fig. 12

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METHOD OF ADAPTING SHEET METAL FOR SCREWS

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Application April 26, 1937, Serial No. 139,081

10 Claims. (Cl. 29—148)

The present invention relates to an improved method of preparing sheet metal for threaded engagement by a screw.

More particularly, the invention is concerned with a method of adapting sheet metal for the reception of a screw by forming a self-locking thread having an effective thickness of that of the sheet of metal.

The primary purpose of the present invention is to provide a method of preparing a sheet metal structure for self-locking threaded engagement by a screw consisting in a relatively few simple operations that result in the production of a thread in an opening formed at the top of a bulbous protuberance in the structure.

Another object of the invention resides in an improved method for adapting a sheet metal structure for the reception of a screw, which results in a re-shaping or reforming of the metal to produce a thread disposed substantially above the normal plane of said metal in such a way that the complete thread can be moved bodily toward said plane during the application of the screw and so that in such movement the thread is positively caused to snugly embrace the screw at the base of the cooperating thread formed thereon.

Still another object of the invention consists in the provision of an improved method for preparing a sheet metal structure for a screw, involving the formation of a perforated protuberance of substantial depth in the metal, so that the edge of the protuberance merges with the top of the metal sheet on a smooth concave curve resulting in a protuberance which, when flattened, by means of pressure exerted against the top thereof, is certain to cause a contraction of the opening in the protuberance and thus firm engagement between the thread formed in the wall thereof and the shank of the screw.

This application is a continuation-in-part of application Serial No. 87,292, filed June 25, 1936, which issued as Patent 2,081,065 on May 18, 1937.

Still further objects of the invention will appear as the description thereof proceeds with reference to the accompanying drawing in which:

Figure 1 is a fragmentary plan view of a sheet metal structure prepared for the reception of a screw in accordance with the method of the present invention.

Figure 2 is an end view of the structure illustrated in Figure 1.

Figures 3 and 4 are respectively sectional views of the fragment of sheet metal showing the initial stages in the adaptation of the sheet metal for the reception of the screw.

Figure 5 is a sectional view taken on the plane indicated by the line 5—5 of Figure 1, looking in the direction of the arrows.

Figure 6 is a sectional view showing the manner in which the sheet metal structure is used with a screw.

Figure 7 is a fragmental plan view of a portion of a heavier sheet metal structure adapted for the reception of a screw in accordance with a modified method constituting a part of the present invention.

Figure 8 is a plan view of the structure illustrated in Figure 7.

Figures 9 and 10 are respectively sectional views of the metal sheet showing its form at several stages of the operation of adapting the sheet metal for the reception of a screw.

Figure 11 is a sectional view taken on the plane 11—11 of Figure 7, looking in the direction of the arrows.

Figure 12 is a sectional view showing how the sheet metal structure of Figures 7 and 8 is used.

Like reference characters indicate like parts throughout the several figures.

A fragment of a metal sheet adapted for threaded engagement by a screw, and produced by the method of the present invention, is illustrated in Figures 1, 2 and 5 of the drawing. In said figures, 15 indicates the metal structure, which, when adapted for the reception of the screw, is provided with a perforation 16 in the top of a bulbous protuberance 17, that is slit radially as illustrated at 18. The bulbous protuberance 17 is of substantial depth. In the completed structure the wall forming the opening 16 is disposed on a helix having the pitch of the screw for the reception of which the structure is designed. The edge of the protuberance 17 merges smoothly and gradually into the structure 15, the edge of the protuberance merging with the top of the metal sheet on a smooth concave curve as illustrated. The purpose of said curve will be hereinafter pointed out.

In forming the structure just described in relatively thin sheet metal, the following method is preferably employed and constitutes an essential part of the present invention:

First, the sheet metal structure is provided with a bulbous unperforated protuberance 19, illustrated in Figure 3, at the points at which the metal structure is intended to receive a screw. The next step in the operation consists in the punching of a hole 20 in the top of the bulbous protuberance 19, as illustrated in Figure 4. The opening 20 corresponds in diameter approximately to the diameter of the screw for which the structure is designed, measured at the base of the thread, or it preferably is smaller than said opening.

The next step in the operation of forming the structure of Figures 1, 2 and 5, is to slit the protuberance 19 radially of the perforation 20, and, preferably, in the same die-shaping operation, pressing the wall surrounding the opening into

the form of a helix having a pitch approximating that of the screw, which the structure is intended to receive. It will be observed that, in punching the opening 20, after the protuberance 19 has been formed in the sheet metal structure, the cut surfaces will be disposed approximately perpendicular to the normal plane of the sheet metal structure, and this arrangement of the wall of the opening is substantially maintained during the operation of forming the wall of the opening into spiral form.

The operations just described preferably are carried out in rapid succession in a single operation by successively functioning dies and punches, though it will be readily understood that the several operations may be separately performed. However, in order to reduce the cost of production, it is preferred, as already stated, that the operations take place in rapid succession upon a single reciprocatory movement of a compound die toward a suitable matrix, a part of said die and matrix first cooperating to form the bulbous protuberance, to be followed in succession by a punch to form the perforation 20, and a further die to form the slit 18 and reshape the wall of the opening 20 to produce the screw receiving aperture 16 having a helical form.

Preferably the protuberance is made of sufficient depth that the lowest point of the helical wall surrounding the opening 16 is disposed substantially above the normal plane of the metal sheet, and said helical wall is formed so that the pitch thereof substantially exceeds the thickness of the metal sheet.

Figure 6 illustrates how the sheet metal structure formed as already described is used. In this figure, the structure 15 overlies a further sheet metal, or similar structure, 21 provided with an opening 22 for the free passage of a screw 23 having a head 24 bearing against the outside of the structure 21. The structures 15 and 21 may be firmly secured together by the screw 23 by threading the shank thereof through the opening 16. It is of importance that the screw 23 be provided with a thread having a pitch substantially exceeding the thickness of the metal sheet, and that the thread have a width to overhang the top of the protuberance 17 as illustrated in this figure. When such a screw is used, the entire thickness of the metal sheet will enter the spiral groove in the shank of the screw, said edge forming a thread of great strength. The screw is turned to bring about a self-locking action between the thread and the shank of the screw, such self-locking action being brought about by continuing the turning of the screw until the protuberance is substantially flattened. In view of the concave curve between the top of the sheet metal structure 15 and the edge of the protuberance, buckling of the protuberance at any point will not occur as the rotation of the screw is continued to effect a substantial flattening of the protuberance. As the protuberance flattens the opening 16 is constricted in size and the wall forming said opening is moved into firm, and even biting, engagement with the shank of the screw at the bottom of the spiral groove therein. A satisfactory locking action between the sheet metal structure and the shank of the screw thus results, that is effective to resist all vibratory stresses tending to loosen the screw, whereby the screw effectively connects the structure 21 to the structure 15 without liability of accidental loosening or disengagement of the parts held by the screw.

It will be understood that the structure 15 may assume any form and may be a large or small sheet provided with one or more openings of the character already described, or it may be simply a small metal piece intended to be used after the manner of a nut and thus provided with only a single opening of the character stated.

Figures 7 to 11 illustrate the preferred method employed in adapting a relatively thick or heavy sheet metal structure for the reception of a screw. In its completed form illustrated in Figures 7, 8 and 11, the heavy metal structure 25 has a bulbous protuberance 26 having an opening 27 in the top thereof. The wall of the opening 27 is arranged to form a thread for the screw. A slit 28 extends radially of the opening 27, the high point of the helix formed by the wall of the opening 27 is disposed at one side of the slit, while the low point of said helix is disposed at the other side thereof. The low point of the helix is, as in the form of the invention first described, substantially spaced above the normal plane of the sheet metal structure. It will be apparent, upon referring to Figures 7, 8 and 11, that the wall of the opening 27 does not extend perpendicular to the normal plane of the sheet metal structure, but extends at an acute angle thereto, so that the inner corner of the wall forming the opening 27 is directed toward the opening.

The structure just described is preferably produced in the following manner. The sheet metal structure 25 is first provided with a perforation 29 punched therein at the point at which the structure is intended to receive a threaded fastener as illustrated in Figure 9. A bulbous protuberance 30 is then formed in the structure so that the opening 29 is disposed at the top and in the center thereof. In forming said protuberance the wall of the opening 29 is disposed at an acute angle to the normal plane of the metal structure as illustrated in Figure 10. Finally, the structure illustrated in Figure 10 is shaped into that illustrated in Figure 11, the slit 28 being formed in the bulbous protuberance, and, preferably in the same operation, the wall of the opening is shaped so that it lies on a helix having a pitch corresponding to the pitch of the screw for the reception of which the structure is intended. The pitch of said helix preferably substantially exceeds the thickness of the sheet metal structure.

Preferably the operations just separately described are carried out in rapid succession by the movement of a suitably formed die toward a suitably shaped matrix, though said operations may be carried out separately, if desired.

Figure 12 illustrates the preferred way in which the sheet metal structure produced as just described is used. Referring to this figure, the structure 25 is disposed on a sheet metal or like structure 31, having an opening 32 formed to freely permit the passage of a threaded shank 33 of a screw having a head 34. Preferably the screw 33 has a relatively deep spiral groove, providing a thread that substantially overlaps the upper corner of the wall surrounding the opening 27. That is, the thread has a width sufficient to substantially overlap said upper corner, so that when the screw is turned toward its final position it bears firmly upon the top of the protuberance and causes a flattening thereof thereby contracting the opening 27 somewhat and forcing the corner of the surrounding wall into very firm frictional, and even biting, engagement with the

shank of the screw at the bottom of the spiral groove formed therein. As in the form of the invention first described, the protuberance is formed so as to present a smooth concave curve between the normal plane of the sheet and the edge of the protuberance, so that when great pressure is applied tending to flatten the protuberance it will not be likely to collapse at any point, but will contract evenly and certainly into firm engagement with the shank of the screw at the bottom of the groove, thus producing a firm locking engagement between the sheet metal structure that forms a single thread and the shank of the screw.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by United States Letters Patent is:

1. The method of preparing a sheet metal structure for self-locking threaded engagement by a screw, which consists in first forming an exteriorly concave sided bulbous protuberance to a substantial depth in the sheet metal, then punching a hole through the top of said protuberance so that the cut surface forming the wall of said hole is disposed substantially perpendicular to the normal plane of the metal sheet, and then slitting said protuberance radially and shaping said wall so that it is disposed on a helix spaced in its entirety above the top surface plane of said structure and having a pitch substantially exceeding the thickness of the sheet of metal.

2. The method of preparing a sheet metal structure for self-locking threaded engagement by a screw, which consists in forming an exteriorly concave sided bulbous protuberance to a substantial depth in the sheet metal with a hole in the center of said protuberance, then slitting said protuberance radially and shaping the top of said protuberance so that the wall of said hole is disposed on a helix spaced in its entirety above the top surface plane of said structure and having a pitch substantially exceeding the thickness of the sheet of metal.

3. The method of preparing a relatively thick sheet metal structure for self-locking threaded engagement by a screw, which consists in punching a hole of a size less than the diameter of said screw at the root of the thread, then pressing a bulbous protuberance of substantial depth in the metal so that said hole is located at the top thereof, and then slitting said protuberance radially of said hole and shaping the metal adjacent said hole to form a helix having a pitch substantially exceeding the thickness of the metal.

4. The method of preparing a relatively thick sheet metal structure for self-locking threaded engagement by a screw, which consists in punching a hole of a size less than the diameter of said screw at the root of the thread, then pressing a bulbous protuberance of substantial depth in the metal containing said hole and enlarging said hole and thus turning the inner corner of the metal, and then slitting said protuberance radially of said hole and shaping said inner corner into the form of a helix having a pitch substantially exceeding the thickness of the metal.

5. The method of preparing a sheet metal structure for self-locking threaded engagement by a screw, which includes the steps of forming a perforated protuberance of substantial depth in the metal so that the edge of the protuberance merges with the top of the sheet metal on a smooth concave curve viewed from the top of the protuberance, and the subsequent radial slitting of said protuberance and shaping of the wall of the perforation in said protuberance to provide a helical thread.

6. The method of preparing a sheet metal structure for self-locking threaded engagement by a screw, which includes the steps of forming a perforated bulbous protuberance in the metal, concave sided when viewed from the outer side of the protuberance and slitting said protuberance and shaping the wall of said perforation into helical form.

7. The method of preparing a sheet metal structure for self-locking threaded engagement by a screw, which comprises pressing an inclined sided protuberance in the sheet metal so that the edge of the protuberance merges with the top surface of the sheet metal on a smooth exterior concave curve, perforating the top of said protuberance, forming a single radial slit in said protuberance, and shaping the wall of said perforation so as to provide a helical thread disposed in its entirety substantially above the under surface of said sheet metal structure.

8. The method of preparing a sheet metal structure for self-locking threaded engagement by a screw, which comprises pressing an inclined sided protuberance in the sheet metal so that the edge of the protuberance merges with the top surface of the sheet on a smooth exterior concave curve, and then perforating and slitting said protuberance and shaping the wall of said perforation to provide a helical thread spaced in its entirety above the plane of the under surface of said sheet metal structure.

9. The method of preparing a sheet metal structure for self-locking threaded engagement by a screw, which consists in perforating said structure, pressing a bulbous protuberance in said structure so that the perforation is disposed at the top of said protuberance, and then slitting the protuberance on a line extending substantially radially of said perforation, and shaping the wall of said perforation to provide a helical thread for said screw having its highest and lowest points at opposite sides of said slit.

10. The method of preparing a sheet metal structure for self-locking threaded engagement by a screw, which consists in perforating said structure, pressing in said structure a bulbous protuberance having a width at its base at least several times the diameter of said perforation so that the edge of the protuberance merges with the top surface of the structure on a smooth concave curve and so that the perforation is disposed at the top and in the center of said protuberance and then slitting the protuberance on a line extending substantially radially of said perforation, and then shaping the wall of said perforation to provide a helical thread for said screw having its highest and lowest points at opposite sides of said slit.

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