March 15, 1949. H. E. VEIT 2,464,622

METHOD OF FORMING RIVETED JOINTS

Filed June 8, 1945

Fig. 1.

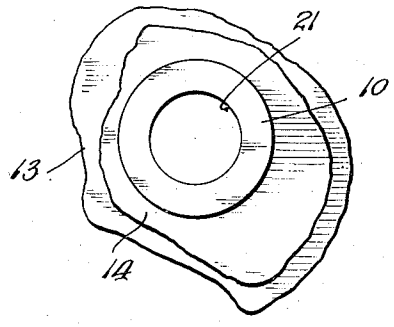


Fig. 2.

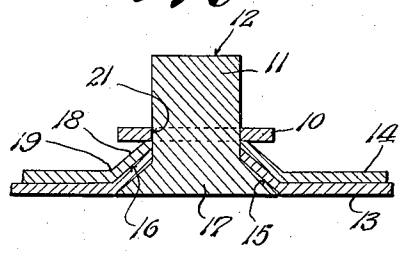


Fig. 3.

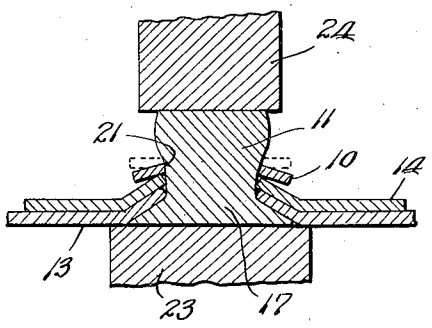
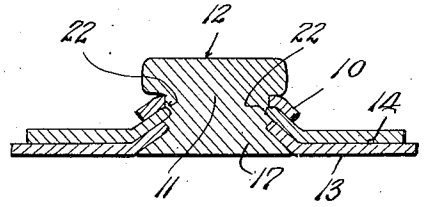


Fig. 4.



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Patented Mar. 15, 1949 2,464,622

UNITED STATES PATENT OFFICE

2,464,622

METHOD OF FORMING RIVETED JOINTS

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Application June 8, 1945, Serial No. 598,293

1 Claim. (Cl. 78—46)

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My invention relates to the art of riveting and more particularly a method of protecting the edges of dimpled rivet holes in high strength alloy sheets against cracking and breaking when riveted together.

In joining sheet metals, particularly in the aircraft industry, it is customary practice to dimple depress all rivet holes so as to allow for fitting of the rivet heads flush with the surface of the outside sheet presenting a smooth surface to the air stream. It is a fairly simple matter to rivet dimpled sheets of relatively soft alloys such as those composed of a high percent of aluminum. However, in riveting dimpled high strength alloy sheets containing a high percentage of magnesium or similar hard metal alloys there is a tendency for the sheets to crack outwardly around the rivet holes. Apparently this failure of the metal is due to the lack of ductility of these hard alloy metals and their inability to readily conform to the shape of the expanded shank of the rivet. This problem is serious in riveting thin magnesium alloy sheets, such as that known commercially as 52–SH and particularly in the thickness range of from .020 to .040 inch when riveted with standard $\frac{3}{16}$ inch, and larger, diameter rivets. My tests have shown that sheets of these thicknesses apparently have insufficient tensile strength in the metal surrounding the rivet hole to restrain the shank of the rivet as it is expanded during the riveting operation with the result that cracks and fissures are formed in the dimpled area adjacent the rivet.

The present invention provides a method whereby a flat washer of a given ductility is placed around a rivet and in contact with the inner sheet of a plurality of sheets being riveted together so that the strength of the washer is utilized to effect a collar-like action around the rivet, and absorb the excessive force developed in the rivet shank during riveting, expanding gradually to the shape of a cone, hugging the dimple and uniformly distributing the riveting load over a wide area of the dimpled portion of the sheet being riveted.

I have discovered that the expansion of the washer outwardly from the center aperture thereof effected by the expansion of the rivet shank acts to progressively cup the washer to the shape and contour of the dimple. This action results in a uniform gripping of the dimpled areas of the sheets under compression. I have found that best results are secured by using a washer formed from an alloy metal having substantially the

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same flow characteristics as the metal of the rivet. This assures a uniform expansion of the shank of the rivet and the washer when subjected to force. Furthermore, use of parts having the same metal alloys obviates the possibility of undesirable galvanic action between the rivet and washer. It is also to be noted that the use of aluminum alloy rivets with magnesium alloy in the combination herein referred to are known to have shown high non-corrosive characteristics under standard corrosion tests conducted by the United States Government.

It is among the objects of my invention to provide a method of riveting high strength metallic sheets such as magnesium alloy wherein a flat washer of ductile metal is expanded from the inside periphery thereof to form a cup or cone to restrain a dimpled rivet hole against cracking when engaged by the upset rivet shank. The use of a ductile washer allows for sufficient flow of the metal of the washer to conform to the contour of the dimple and restrain the metallic sheet against excessive expansion and resultant cracking, apparently caused by the inability of the metal of the sheet to uniformly flow with the expansion of the rivet during the riveting operation.

Another object of my invention is to provide a method of limiting the rivet shank expansion during upsetting so as to keep the expansion within the elastic limit of the metal sheet stock being riveted.

A further object of my invention is to provide a protecting retainer formed in situ around a rivet dimple that will prevent unequal distribution of the forces effecting the upsetting, peening or any other shank working.

A still further object of my invention is to provide a method of forming a rivet joint holding a plurality of metal sheets together in which the compressive effect of the rivet is evenly distributed around the rivet by a cup or cone washer formed during riveting.

Further objects, advantages and novel features of my invention will be apparent from the following description in which reference is made to the accompanying drawing, wherein:

Figure 1 is a plan view of the washer embodied in my invention.

Figure 2 is a sectional view showing the washer in place encircling the shank of a rivet seated in the dimple depression of a pair of metal sheets prior to riveting.

Figure 3 is a diagrammatic sectional view illus-

trating the movement of the washer during the riveting operation.

Figure 4 is a sectional view showing the same rivet riveted over the protecting washer formed to the conical surface of the dimpled inner sheet.

Referring to the drawing in detail, and particularly Figure 2, I have illustrated a washer 10 placed on the shank 11 of a rivet 12 in position for riveting two sheets of magnesium alloy together. The washer 10 is of the same ductile material as rivet 12 such as an aluminum alloy which allows for equal flow of the metals in these two parts when subjected to pressure during a riveting operation. In the preferred embodiment of my invention I illustrate the riveting together of two sheets of magnesium alloy in which the outer sheet 13 is to be secured to the inner sheet 14 by rivet 12 seated in nested dimples 15 of the outer sheet and 16 of the inner sheet so as to place the head 17 of rivet 12 flush with the outer sheet. The sheets may be of magnesium alloy of from .032 to .040 of an inch in thickness known in the art as 52–SH sheet stock. The rivet 12 is of currently standard annealed aluminum alloy, known in the art as 56–S, and may be $\frac{3}{16}$ inch in diameter. The washer 10 is of aluminum alloy, annealed to the same extent as rivet 12, and has an overall diameter less than the maximum outside dimple diameter. This latter dimension is important in that I have found that the washer 10 gives the best result if less than the size of the dimple area so that when shaped to its final position, as shown in Figure 4, the outside periphery of the washer 10 clears the edge 19 of the dimple and does not overlap onto the plane surface of inner sheet 14. Such overlapping would interfere with the even distribution of the compression force exerted on washer 10 by the riveted formation of shank 11 (Figure 4).

In forming washer 10 care must be exercised to assure that aperture 21 of the washer 10 is formed only slightly larger than shank 11 of the rivet 12 so as to provide for a snug fit between these parts. The snug fit of the washer 10 on the shank 11 of the rivet 12 facilitates the handling of rivets disposed from the horizontal and also assures a more collar-like action of the washer 10 when expanded with the rivet during the riveting operation.

A novel feature of my invention is that the equal flow of the two materials, namely washer 10 and rivet shank 11, is utilized to evenly expand the periphery of aperture 21 of the washer 10 which causes the washer 10 to assume a conical shape secured in place against dimple area 18 of the inner sheet 14 by the distorted sides 22 of rivet 12 as shown in Figure 4. The progressive movement of the washer 10 to a conical shape is illustrated in Figure 3 with the shank 11 in the process of being expanded against the inside diameter of washer 10 by force exerted on rivet 12 by riveter peen 23 acting against bucking bar 24. Movement of washer 10 from its original flat position is shown by dotted lines, the movement being approximately one half completed in this view. The final position of the washer 10, fully cupped by the expansion of shank 11, is as shown in Figure 4. The force imposed on rivet 12, during the riveting operation may be performed by any of the conventional means known in the art, such as upsetting, squeezing, peening or other forming methods to upset the shank 11 of the rivet 12 to a riveted condition securing the outer sheet 13 to inner sheet 14 with washer 10 bearing evenly against the dimpled surface area 18. The washer 10 acts as a buffer which protects the dimple from excessive expansion and grips the sheet materials to form a tight rivet joint irrespective of any unequal displacement of the metal in shank 11 of the rivet.

Although the preferred embodiment of my invention has been shown as the riveting of sheet metals common to the aircraft industry, and certain metal alloys and dimensions have been referred to, it is to be understood that these are for illustrative purposes only, and it will be appreciated that various alterations and modifications may be made without departing from the spirit and scope of my invention, and I therefore intend that my invention shall be construed in accordance with the principle herein disclosed and as defined in the accompanying claim.

I claim as my invention:

A method of riveting a plurality of magnesium alloy sheets having nested apertured conical dimples that comprises positioning an aluminum alloy rivet having a shaped head and a shank portion in said apertures with the shank extended through the apertures and beyond the apex of the bottom sheet and the shaped head seated flush with the outer surface of top sheet, placing an apertured flat metallic washer having substantially the same flow characteristics as the aforedescribed rivet on the shank thereof and in contact with the apex of the exposed conical surface of said dimple, applying sufficient aligned force to the shank to compress and expand said shank to a pear-shaped form outwardly against the aperture of the washer to differentially expand said aperture to change said washer from a flat to a conical shape and to effect downward movement of the washer against the conical dimples, and applying further force to the shank so as to form a second rivet head thereon having an overlap of less than one-half the radial width of said washer.

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