Dec. 9, 1952 S. P. JENKINS 2,620,552

METHOD OF SPOTFASTENING THIN SHEETS

Filed April 11, 1947 2 SHEETS—SHEET 1

Fig. 1

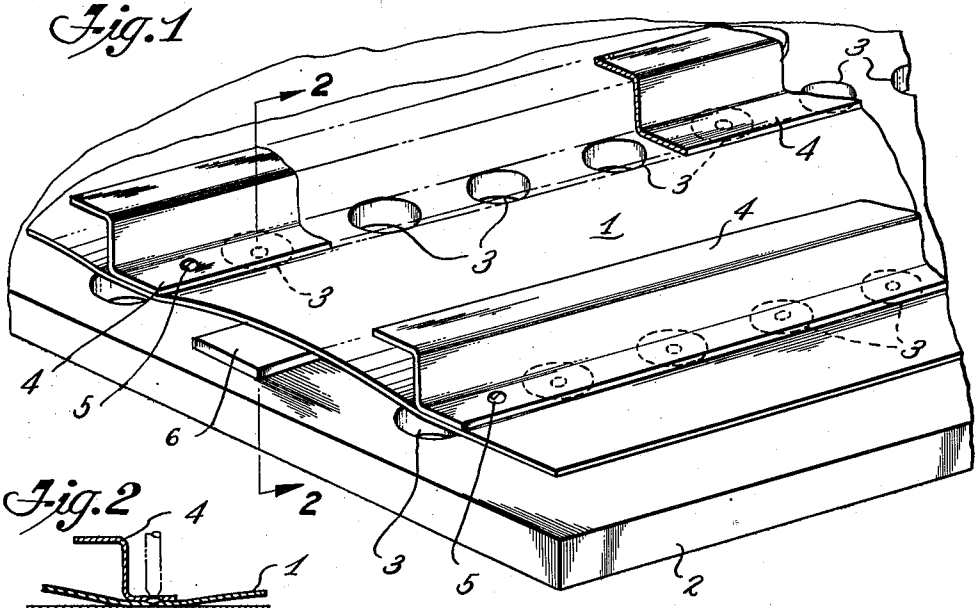


Fig. 2

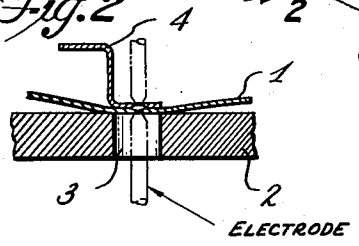
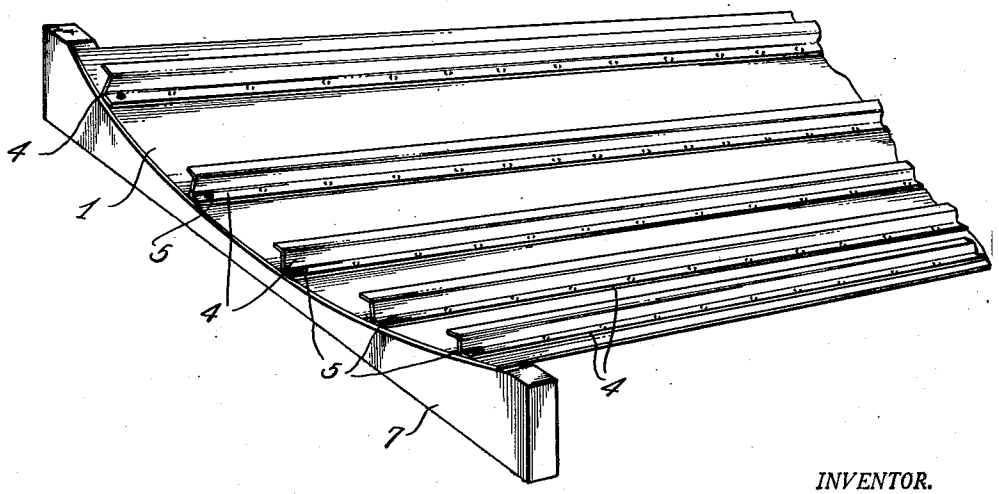


Fig. 3



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METHOD OF SPOTFASTENING THIN SHEETS

Filed April 11, 1947 2 SHEETS—SHEET 2

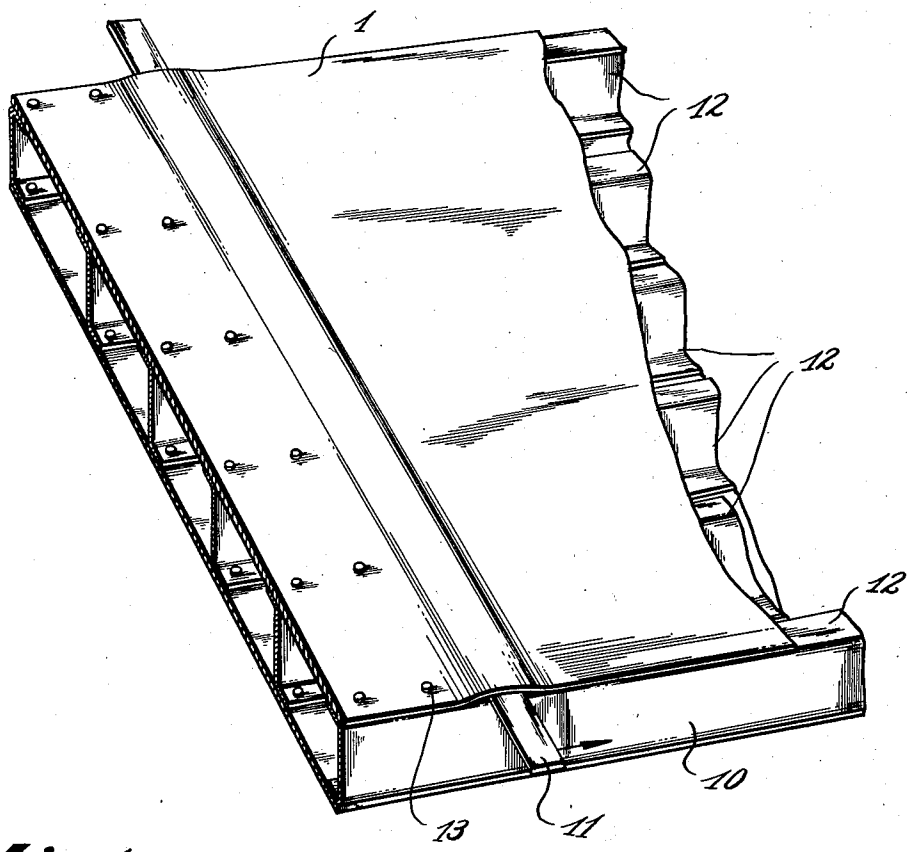

Fig. 4

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METHOD OF SPOTFASTENING THIN SHEETS

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5 Claims. (Cl. 29—148.2)

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My invention relates to spotfastening and more particularly to a means and method of spotfastening thin gauge aluminum alloy sheet to stringers without warping, buckling, or canning resulting in the sheet.

In the manufacture of aircraft, stringer-to-skin fabrication is a highly desirable type of construction but, because of lack of fabrication techniques, a much thicker skin has often been used than required from a strength point of view. Thin skins or sheets of aluminum alloy when spotfastened to rigid stringers, using customary methods of welding or riveting for example, cannot be kept flat during attachment as buckling, canning, or warping take place to such an extent that the resultant reinforced sheet cannot be used.

It is known that aluminum alloy sheets can be spotwelded to stringers by deforming both stringer and sheet within the elastic limit of both, prior to spotwelding, spotwelding, and then permitting the stringers and the attached skin to return to the original shape. Such methods, however, are subject to several disadvantages because, for example, when very thin sheets are to be fastened to stiff or short stringers, sufficient deformation of the stiffeners cannot be obtained to stress the skin enough to avoid buckling. Again, many stringers are so constructed that deformation of any type must be avoided, thus preventing the desired skin stress. Also, many times thin skins have to be blind fastened to frames that are in no way adapted to be deformed.

The present invention does not have the above disadvantages, as only the skin need be prestressed. In broad terms, the present invention comprises pre-stressing a thin sheet of metal within the elastic limit thereof, spotfastening unstressed rigid stringers or frames thereto and then permitting the skin to return to its original unstressed condition again without stressing the stringers or frame girders. This prestressing of the skin can be accomplished in several ways as, for example, by supporting the skin so that it is corrugated or curved into one or a series of column sections preferably parallel to the spotfastening line, or by contouring the skin in a single concave or convex column section preferably parallel to the spotfastening line. In either case, spotfastening of sheets as thin as .016 gauge to rigid and stiff stringers by either spotwelding or riveting has been found highly satisfactory, and all normal residual stresses introduced by the spotfastening operation have been found to be equalized in the finished product.

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The invention will be more fully understood by reference to the drawings in which:

Figure 1 is a perspective view of one means of prestressing a skin prior to spotwelding to parallel stringers.

Figure 2 is a cross-sectional view taken as indicated by line 2—2 in Figure 1.

Figure 3 is a perspective view of another means of prestressing a skin for the same purpose.

Figure 4 is a perspective view of another means for blind riveting a thin skin to a rigid internal frame.

Referring first to Figure 1, representing a spotwelding technique, a flat aluminum alloy sheet 1 of .016 gauge (24 STAL) for example, is placed on a fixture 2 of heavy plywood, for example. Parallel rows of holes 3 are bored in the fixture 2 where tack welds are to be made to parallel stringers 4, in this case of Z section, and, for example, of .064 gauge (24 STAL). The stringers 4 are placed over the sheet 1 and held down by fastening means to the fixture 2, in this case wood screws 5 preferably at the ends of the stringers. Before screws 5 are tightened, however, shims 6 are positioned between the sheet 1 and the fixture 2. The screws are then tightened to stress the sheet 1 between the stringers and along lines parallel to the spotweld center lines. The use of a .155" shim results in a radius of about 22.5 inches in the sheet when the stringers are placed 7 inches apart.

After the screws are tightened to prestress the sheet, the sheet is tackwelded, for example, at 8-inch intervals with a spotwelder such as, for example, a Taylor Winfield electrostatic machine, and the screws removed. The sheet then resumes its flat condition without warping, buckling, or canning present. The spaces between the tackwelds can then be filled in by additional spotwelds one-half inch apart without further buckling taking place.

An alternative and equally satisfactory means of pre-stressing the sheet alone prior to spotwelding is shown in Figure 3. Here the entire sheet 1 is curved by being fastened, along with the stringers 4, to end plates 7 of wood, for example by wood screws 5. A radius of about 22.5 inches has also been found satisfactory for .016 gauge 24 STAL in this embodiment. As before, the stringers are tackwelded to the skin, the end plates removed to permit the skin to flatten, and the space between welds filled by additional spot welds .5 inch apart. No buckling, warping, or canning will occur.

In the embodiment shown in Figure 1 some upward stress may be imposed upon stringers 4 if

they are long and held only at their ends by screws 5. This can be avoided by using several screws along the stringer length, if desired. In the embodiment of Figure 2, no stress at all is imparted to stringers 4, irrespective of their length, as the end plates hold the sheet in proper curvature.

In both cases, it will be seen that the skin sheet is prestressed by the formation of one or more column sections therein extending parallel to the line of spotwelds. The curvatures are within the elastic limit of the skin material and the skin returns to its original condition.

Although the operation of spotfastening by spotwelding has been applied successfully to the means and method of Figures 1 and 3, it should be distinctly understood that riveting instead of spotwelding may be employed, with equally good results. This success leads directly to a third embodiment of the invention shown in Figure 4, where the thin skin 1 is shown as being applied to a rigid frame 10 which, for example, may be a flap or similar airframe structure finished except for one skin surface. In this case the final skin surface must be blind riveted, which of course can be done by using various types of blind rivets such as, for example, explosive rivets.

In this case the skin is stressed close to the rivet line by the insertion of a shim 11 resting on the internal stringers 12. The line of rivets 13 is then made, and shim 11 moved along the stringers to a point just beyond where the next line of rivets is to be inserted, and new rivets inserted. In this way the skin adjacent the rivets is always stressed, and the final skin is smooth and without buckles.

While spotwelds and rivets are the more usual types of spotfastening means used in aircraft construction, it is to be distinctly understood that the present invention is highly satisfactory to prevent canning when other spotfastening means are used such as, for example, bolts or self-tapping screws, and I do not wish to be limited to any particular fastening means.

A number of variations from the means described above to illustrate the method of the present invention will be apparent to those skilled in the art without departing from the invention as set forth in the attached claims. The main feature of the present invention is that only the skin is prestressed adjacent the place where the spot fastening is made.

I claim:

1. For securing a thin metal skin at spaced points to spaced substantially parallel rigid frame means, a method comprising: temporarily securing the metal skin at spaced points to a spaced pair of said rigid frame means and to a rigid backing member; flexing said skin between said rigid frame means; permanently securing said skin to said rigid frame means at spaced points along the frame means; releasing said pair of frame means from the backing member to relieve the flexing in said skin; and repeating the steps set forth between consecutive pairs of frame means until the skin is secured to all said frame means.

2. A method according to claim 1, where the flexing is produced by positioning a narrow length of material between said backing member and said sheet parallel to the frame means, and thereafter tightening down the frame means on said rigid backing member.

3. A method according to claim 1, wherein the skin is permanently secured by riveting.

4. A method according to claim 1, wherein the skin is permanently secured by spotwelding.

5. For securing a thin metal skin at spaced points to spaced, substantially parallel and relatively rigid frame means, a method comprising: temporarily securing the metal skin at spaced points to a spaced pair of said rigid frame means and to a rigid backing member with a narrow length of material positioned between said backing member and said sheet parallel to the frame means; tightening down the frame means on said rigid backing member whereby said skin is flexed between said frame means; tacking said skin to said rigid frame means at spaced points along the frame means; releasing said pair of frame means from the backing member to relieve the flexing in said skin; completing securement of the skin to the frame means at spaced points between the aforesaid spaced points, and repeating the steps set forth between consecutive pairs of frame means until the skin is secured to all said frame means.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
811,954	Richardson	Feb. 6, 1906
1,781,723	Fox	Nov. 18, 1930
2,019,272	Ragsdale	Oct. 29, 1935
2,037,067	Crossman et al.	Apr. 14, 1936
2,110,752	Wright	Mar. 8, 1938
2,146,768	Schmidt	Feb. 14, 1939
2,168,280	Klemm	Aug. 1, 1939
2,178,817	Small	Nov. 7, 1939
2,234,906	Wallis	Mar. 11, 1941
2,273,736	Raymond	Feb. 17, 1942
2,288,184	Dodson et al.	June 30, 1942
2,291,361	Walsh	July 28, 1942
2,304,976	Watter	Dec. 15, 1942
2,364,494	Upson	Dec. 5, 1944
2,342,025	Watter	Feb. 15, 1944
2,367,715	Chapman	Jan. 23, 1945
2,376,351	Gay	May 22, 1945
2,441,858	Watter	May 18, 1948
2,477,987	Kinghorn	Aug. 2, 1949