Oct. 31, 1944. G. T. GERLACH ET AL 2,361,620

STRUCTURAL PANEL

Filed July 21, 1941 3 Sheets-Sheet 1

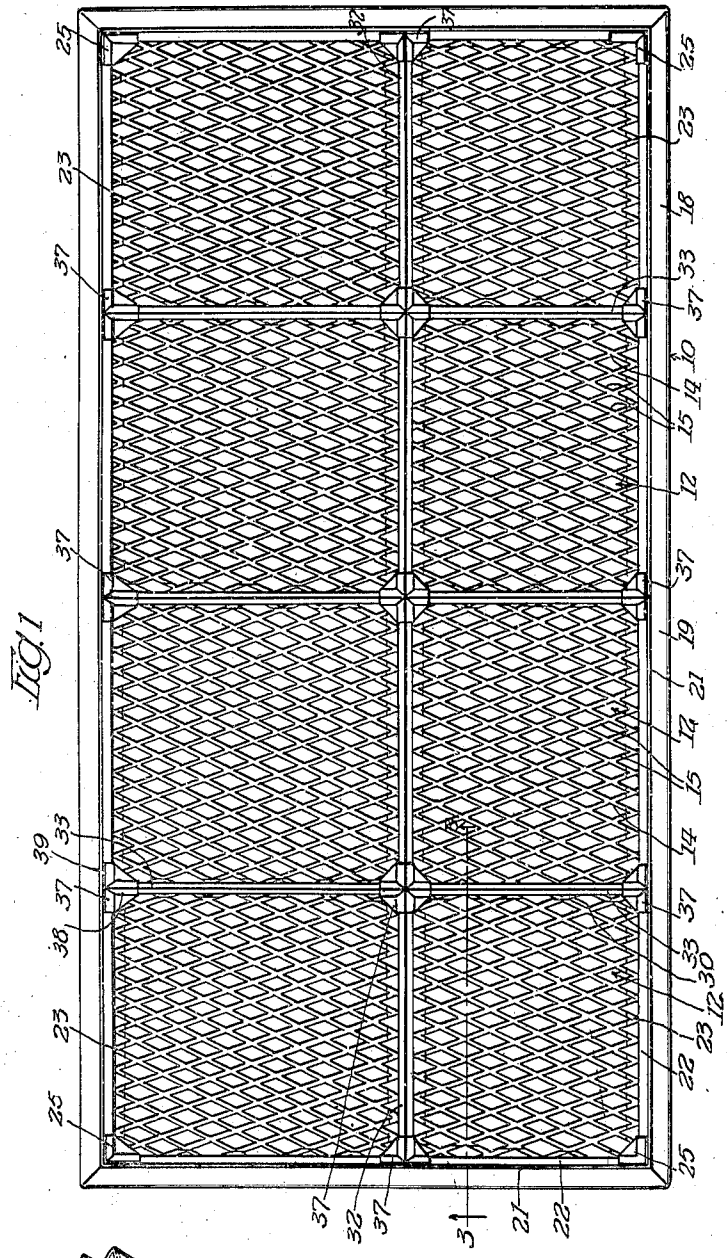


FIG. 1

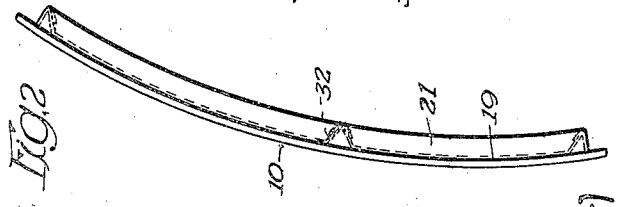


FIG. 2

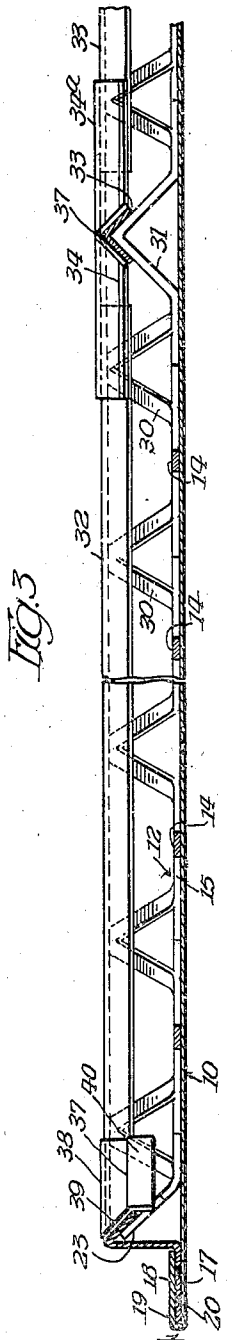


FIG. 3

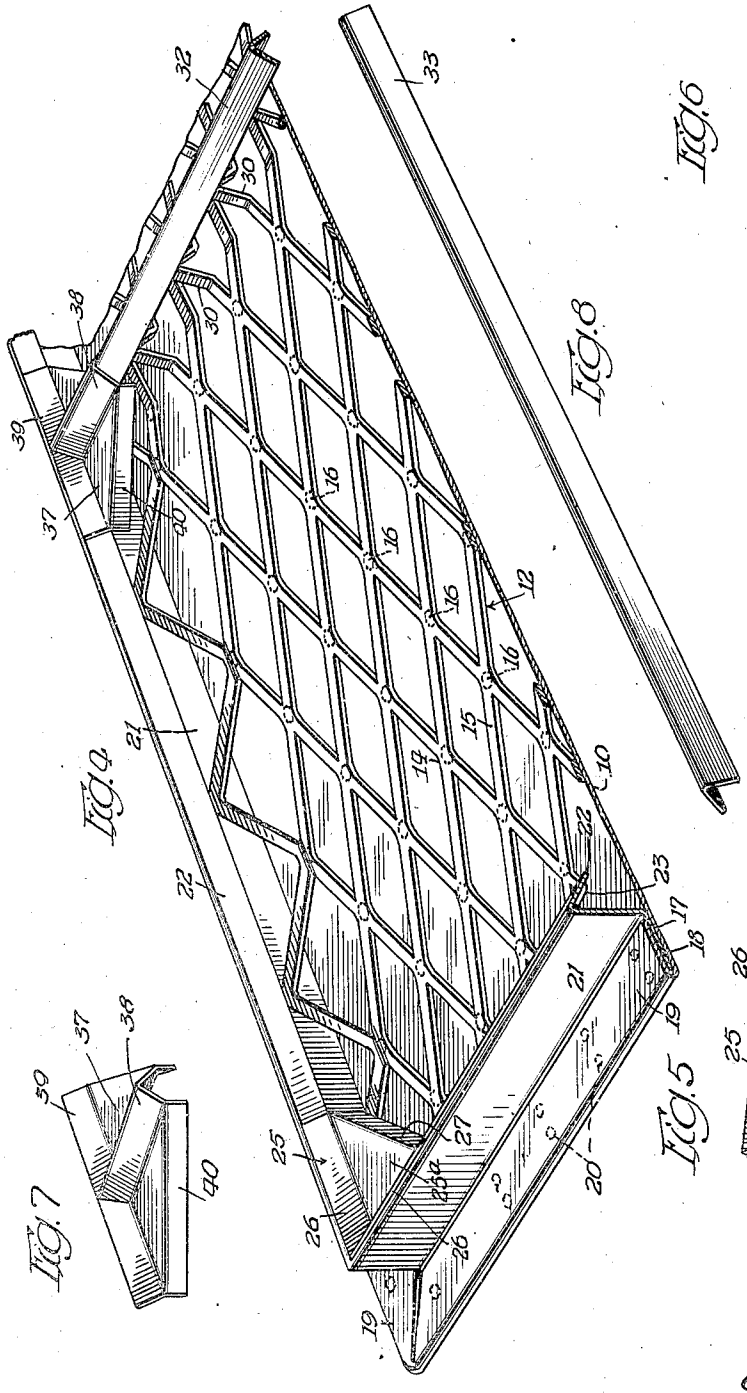
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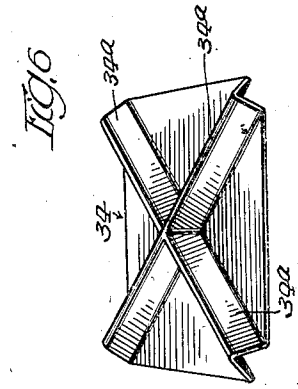
By Fred Gerlach, their Atty

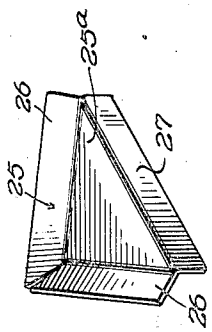
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STRUCTURAL PANEL

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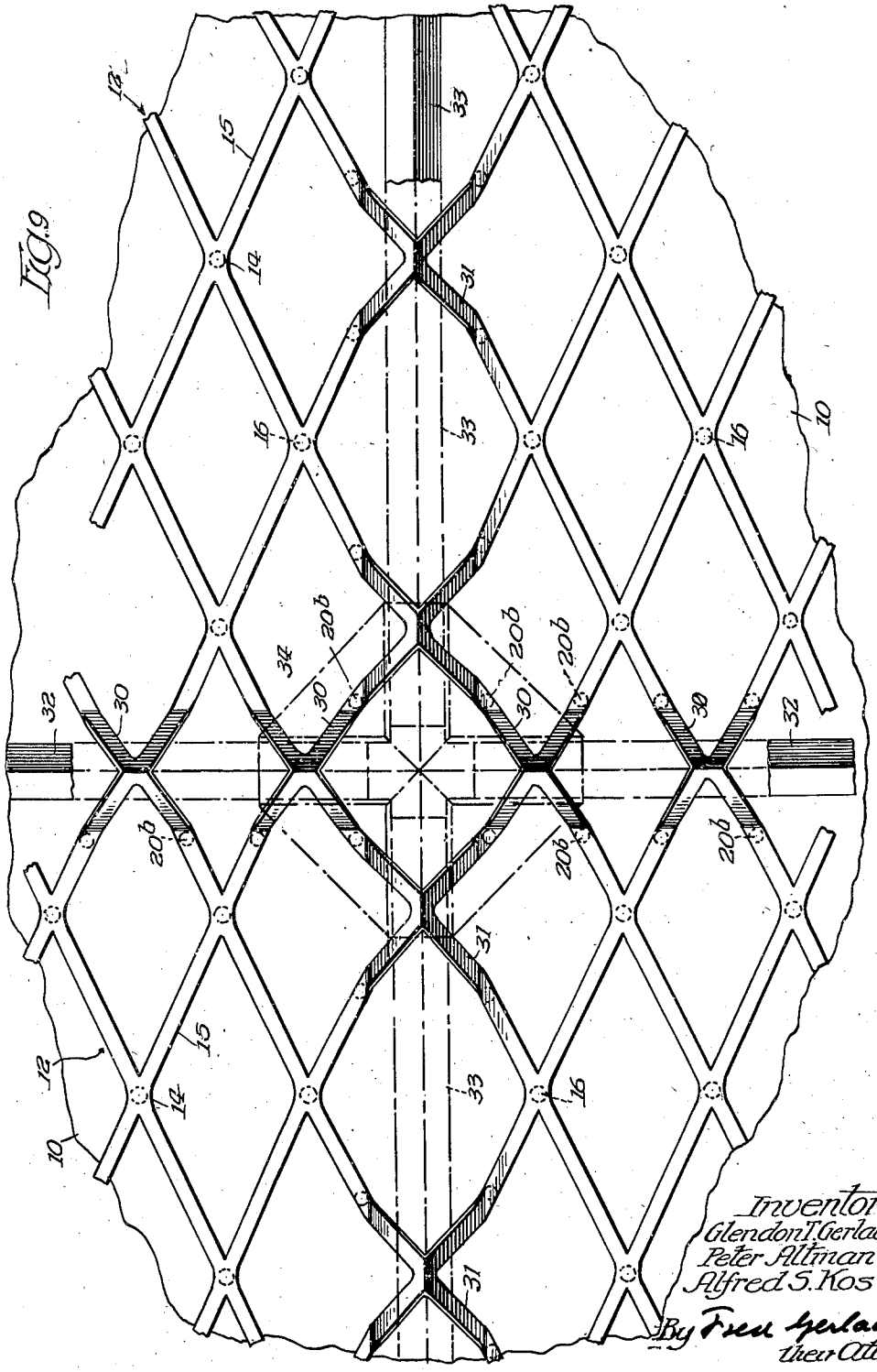
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Oct. 31, 1944. G. T. GERLACH ET AL 2,361,620

STRUCTURAL PANEL

Filed July 21, 1941 3 Sheets-Sheet 3

FIG. 9



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STRUCTURAL PANEL

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Application July 21, 1941, Serial No. 403,336

11 Claims. (Cl. 189—34)

The invention relates to metallic structural panels.

One object of the invention is to provide a structural panel which comprises a thin metal skin-forming sheet and expanded metal having outstruck portions serving as frame-members for stiffening the panel for carrying transverse loads and resisting transverse bending.

Another object of the invention is to provide a panel of this type which has a high strength-weight ratio against transverse bending.

Other objects of the invention will appear from the following detailed description.

The invention consists in the several novel features which are hereinafter set forth and are more particularly defined by claims at the conclusion hereof.

In the drawings: Fig. 1 is a side elevation of a panel embodying the invention. Fig. 2 is an end view. Fig. 3 is a section on an enlarged scale taken on line 3—3 of Fig. 1. Fig. 4 is a perspective of a portion of the panel. Fig. 5 is a perspective of one of the cap-plates at the corners of the border. Fig. 6 is a perspective of one of the cap-plates used at the intersections of the rows of V-shaped outstruck portions of the expanded metal. Fig. 7 is a perspective of one of the cap-plates between the ridge-strips and the border-strips. Fig. 8 is a perspective of one of the strips on the arched portions of the expanded metal. Fig. 9 is an enlarged fragmentary side elevation of the panel with some parts in dotted lines to show the structure underneath.

The invention is exemplified in a rectangular panel which is adapted to be used as a part of the fuselage of an airplane. The panel is built up primarily of a sheet 10 of thin metal for forming an outer covering or skin and flattened diamond-mesh expanded metal 12 which is spot-welded to the inner face of the sheet at a sufficient number of points to support the sheet against transverse flexure. The expanded metal comprises bonds 14 and strands 15. In practice, substantially all of the bonds may be spot-welded, as at 16, to the sheet but in some instances the welds may be more widely spaced apart. Before being welded to the sheet, the expanded metal is flattened so that at least one of its faces will fit against the inner face of the sheet 10. A border for reinforcing the edges of the panel comprises strips 17 of thin sheet-metal which are spot-welded to the margins of the sheet 10 which project outwardly beyond the margins of the expanded metal 12. Each border-strip comprises a flange 18 around which the margin of the sheet 10 is lapped, as at 19, to form a finished rim for the panel. Sheet 10 and flange 18 are spot-welded together, as at 20. Each border-strip 18 also comprises a transversely extending or right-angled flange 21 and an inclined flange 22 which extends inwardly from the inner edge of flanges 21 and is inclined inwardly toward the sheet 10. The marginal portions of the expanded metal 12 are bent transversely and obliquely away from sheet 10 to underlie the flanges 22 of the strips 17 and are spot-welded to the inner face of said flanges. These marginal portions of the expanded metal support the inner edges of the border-strips and reinforce them to render the border of the panel rigid in substantially all directions. Corner-plates or gussets 25 are welded to the outer inclined face of the flanges 22 at the meeting corners of the border-strips. Each plate 25 comprises inclined flanges 26 fitting the adjacent inner faces of flanges 22, a triangular member 25a, and an inturned flange 27 extending diagonally across a corner of the panel transversely inward. This exemplifies a panel comprising a skin-forming sheet and expanded metal bonded together and a border-construction which stiffens the panel and renders it transversely and longitudinally rigid. The panel may be flat or may be of arcuate contour, as illustrated in Fig. 2.

In practice it has been found that a panel composed of a sheet .007" in thickness and diamond-mesh expanded metal with a long axis of 3.25" and a short axis 1.56" and the strands approximately .050" in thickness without regard to the reinforcement of the border have greater transverse strength than aluminum .032" in thickness and that the weight of the composite structure will be no greater than that of the aluminum. It is advantageous to use ferrous metal on account of its low cost. The bonding of the expanded metal to the border makes it possible to produce a marginally rigid panel with a thin skin-forming sheet reinforced by the expanded metal. The stiffening border, deformations of the expanded metal and the strips when bonded together function as framing which also has a high strength-weight ratio.

The invention exemplifies a metal panel which comprises a skin-forming sheet, expanded metal bonded to the sheet, and a border composed of strips bonded to the expanded metal and to the sheet, which results in a panel with a high strength-weight ratio. The invention also exemplifies a frame-like reinforcement for the panel which comprises arched integral portions of the

expanded metal and rigidly connected by ridge-strips which function as frame-members for providing the required strength for various loads and stresses. The strips forming the frame-members of the border can be formed of relatively thin sheet metal. The invention also provides a panel which can be advantageously used as a part of an airplane structure or fuselage with an advantageous strength-weight ratio over the aluminum skin and frame-members now generally used in said structures.

In many instances the panel is subjected to loadings which result in shear and torsional stresses as, for example, in an airplane fuselage, and it is necessary to support the skin by frame-members. The invention provides ribbing or frame-members which comprise rows of V-shaped or arched portions of the expanded metal. These rows extend crosswise of one another or longitudinally and transversely of the panel and are sufficient in number to stiffen the panel throughout its area within the border. Before the expanded metal 12 is bonded to the sheet 10 it is bent to form a longitudinal row of V-shaped or arched portions 30 which extend transversely away from the sheet 10 and rows of V-shaped or arched portions 31 which extend crosswise of the longitudinal row of V-shaped portions 30. Longitudinally extending strips 32, which are V-shaped in cross-section fit over the apices of the V-shaped portions 30 between the crosswise rows 31 and the border-strips, are spot-welded thereto, and form rigid strips which connect series of said V-shaped portions 30 in the longitudinal row. Similarly V-shaped strips 33 extend over, are spot-welded to, and form ridge-strips which rigidly connect the series of the apices of the V-shaped portions 31 in the transverse rows between the border and the longitudinal row of V-shaped portions 30. At the intersections of the longitudinal and crosswise rows of the V-shaped portions 30, 31 a cap-plate 34 is spot-welded to the adjacent ends of the ridge-strips 32 and 33 to rigidly connect said strips at the intersections of the rows. The cap-plate 34 comprises four members 34a, V-shaped in cross-section to conform to the V-shaped faces of the strips 32 and 33. The ends of the ridge-strips 32 and 33 are each rigidly connected to the border by a cap-plate 37 which comprises a V-shaped member 38 conforming to one face of the ridge-strip, an inclined flange 39 conforming to the flange 22 of the border-strips 17 and transverse flanges 40. The flanges 39 are spot-welded to flanges 22 and the V-shaped member 38 is spot-welded to the apices of the V-shaped portions in the expanded metal.

In fabricating the panel the expanded metal, after it has been flattened, is bent in suitable dies to form rows of V-shaped portions 30, 31 and its marginal portions 23 are also bent, before any of the parts are welded thereto. The ridge-strips 32, 33 are next welded to the V-shaped portions 30, 31 of the expanded metal and plates 34, 37 are welded to strips 32, 33. Next, the bent portions 23 at the margins of the expanded metal are welded to the flanges 22 and the corner-plates 25. The expanded metal and border-strips are assembled with the sheet 10 by folding the flange 19 of the sheet over the flanges 18 of the border-strips and the expanded metal is spot-welded, preferably at the bonds, to the sheet 10. Adjacent the rows of V-shaped portions of the expanded metal the strands of the latter may be welded, as at 20b. All parts of the panel will then be rigidly connected to form a panel of a high strength-weight ratio and adapted for transverse and longitudinal loading and for resisting torsional and shear stresses when the panel is in use.

The invention is not to be understood as restricted to the details set forth, since these may be modified within the scope of the appended claims, without departing from the spirit and scope of the invention.

Having thus described the invention, what we claim as new and desire to secure by Letters Patent is:

1. A structural panel comprising flattened expanded metal, a thin skin-forming sheet of metal bonded at points distributed throughout the area of the expanded metal, the expanded metal having a row of integral arched portions extending away from the sheet, and a strip of metal bonded to and connecting the arched portions.

2. A structural panel comprising flattened expanded metal, a thin skin-forming sheet of metal bonded at points distributed throughout the area of the expanded metal, the expanded metal having a row of integral substantially V-shaped portions extending away from the sheet, and a strip substantially V-shaped in cross-section bonded to and rigidly connecting the apices of the arched portions.

3. A structural panel comprising flattened expanded metal, a thin skin-forming sheet of metal bonded at points distributed throughout the area of the expanded metal, the expanded metal having rows extending crosswise of one another of integral arched portions extending away from the sheet, and strips bonded to and rigidly connecting the apices of the arched portions in the rows respectively.

4. A structural panel comprising flattened expanded metal, a thin skin-forming sheet of metal bonded at points distributed throughout the area of the expanded metal, the expanded metal having rows extending crosswise of one another of integral arched portions extending away from the sheet, strips bonded to and rigidly connecting the apices of the arched portions of the rows, respectively, and plates at and bonded to the strips at the intersections of the rows.

5. A structural panel comprising flattened expanded diamond-mesh metal, a thin skin-forming sheet of metal bonded at points distributed throughout the area of the expanded metal, a border comprising a strip of metal, the expanded metal having rows of integral arched portions extending away from the sheet and between the border, and strips of metal bonded to and rigidly connecting the apices of the arched portions, and secured to the border.

6. A structural panel comprising flattened expanded metal, a thin skin-forming sheet of metal bonded to and throughout the area of the expanded metal, and a border of metal extending transversely away from the sheet, the marginal portion of the expanded metal extending transversely away from the sheet and being bonded to the border along a line spaced transversely from the sheet.

7. A structural panel comprising flattened expanded metal, a thin skin-forming sheet of metal bonded at points distributed throughout the area of the expanded metal, and a border-strip of metal having a flange extending transversely away from the sheet, the marginal portion of the expanded metal extending transversely away

from the sheet and being bonded to the flange of the border-strip along a line spaced transversely from the sheet.

8. A structural panel comprising flattened expanded metal, a thin skin-forming sheet of metal bonded at points distributed throughout the area of the expanded metal, and a border of metal extending around the margin of the sheet and comprising a strip having a flange extending transversely away from the sheet and a flange around which the margin of the sheet is folded, the margin of the expanded metal extending away from the sheet and being bonded to the strip along a line spaced from the sheet.

9. A structural panel comprising flattened expanded metal, a thin skin-forming sheet of metal bonded at points distributed throughout the area of the expanded metal, a border of metal extending around and secured to the margin of the sheet and comprising a flange extending transversely away from the sheet and an inturned flange, the margin of the expanded metal being bonded to the inner face of the inturned flange along a line spaced from the sheet.

10. A structural panel comprising flattened expanded metal, a thin skin-forming sheet of metal bonded at points distributed throughout the area of the expanded metal, a border extending around and secured to the margin of the sheet and comprising a flange extending transversely away from the sheet, the expanded metal having rows of arched portions between the border and ridge-strips bonded to the arched portions, and to the border.

11. A structural panel comprising flattened expanded metal, a thin skin-forming sheet of metal bonded at points distributed throughout the area of the expanded metal, and a border of metal having a flange extending transversely away from the sheet, the marginal portion of the expanded metal extending transversely away from the sheet and being bonded to the border-member, the expanded metal having rows extending crosswise of one another of arched portions extending away from the sheet, strips bonded to arched portions, plates bonded to the strips at the intersection of the rows, and plates bonded to the strips and to the border.

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