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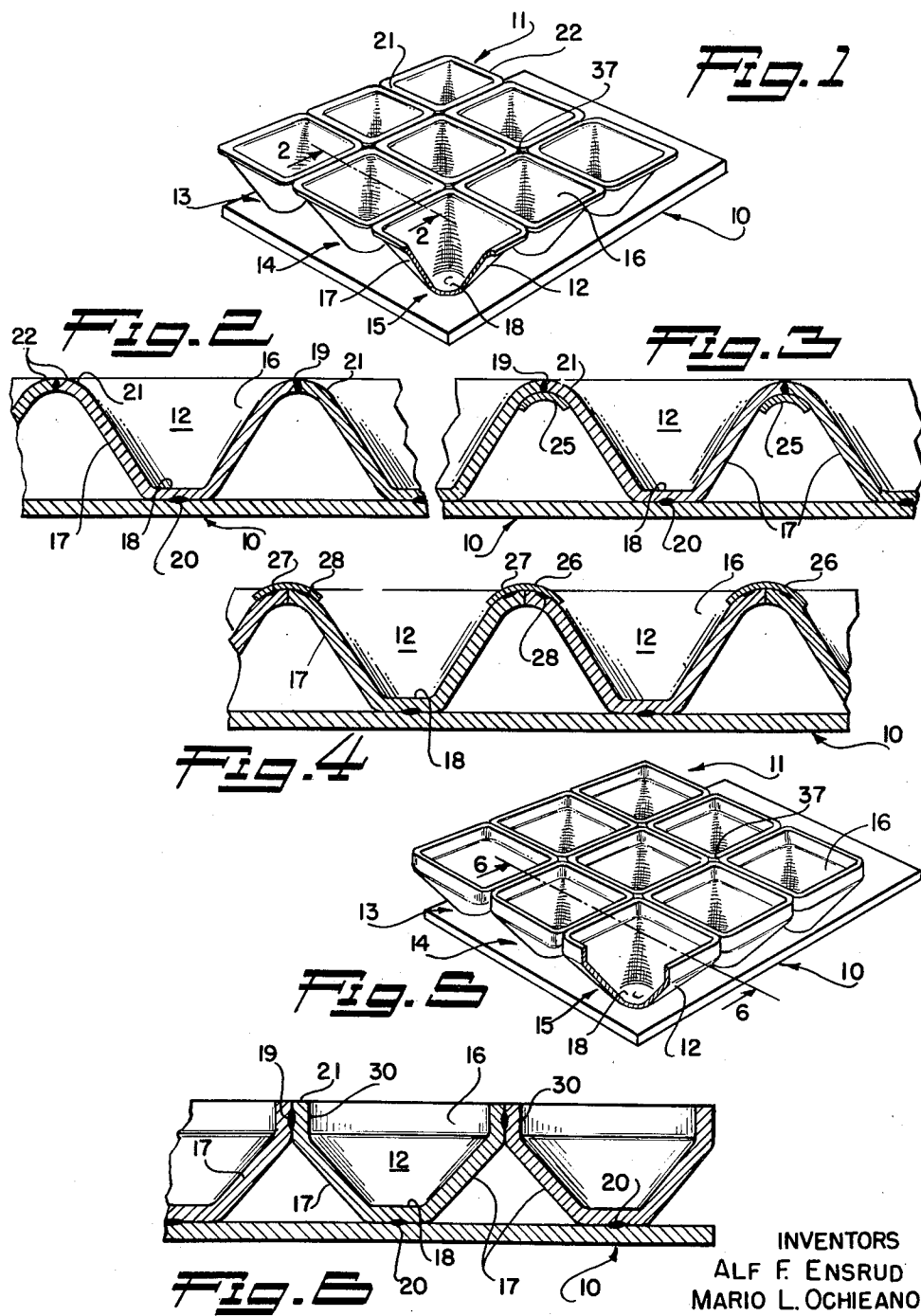
A. F. ENSRUD ET AL

3,025,935

UNICORE PANEL CONSTRUCTION

Filed April 2, 1958

2 Sheets-Sheet 1



INVENTORS
ALF F. ENSRUD
MARIO L. OCHIEANO
FRANZ R. STEINBACHER
By *George Sullivan*
Agent

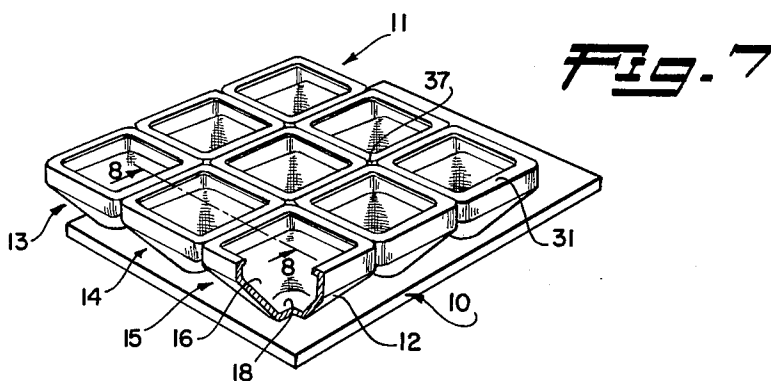
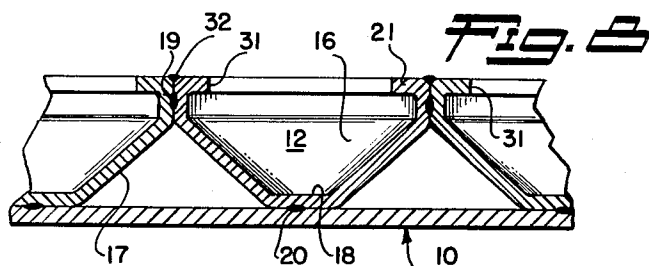
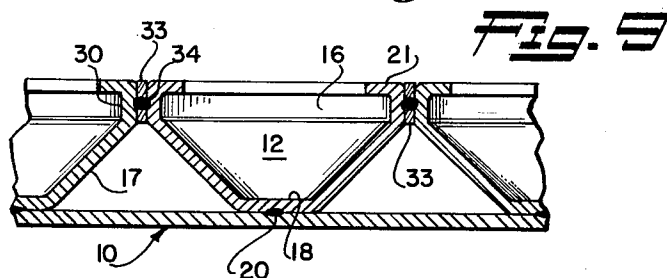
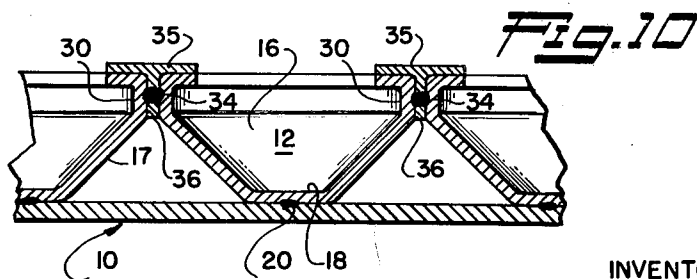
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INVENTORS
ALF. F. ENSRUD
MARIO L. OCHIEANO
FRANZ R. STEINBACHER

By *George C. Sullivan*
Agent

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UNICORE PANEL CONSTRUCTION

Alf F. Ensrud, North Hollywood, Mario L. Ochiano, Burbank, and Franz R. Steinbacher, Van Nuys, Calif., assignors to Lockheed Aircraft Corporation, Burbank, Calif.

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This invention relates to panel structures and relates more particularly to panels incorporating a skin sheet and a plurality of individual cup-like members secured to the skin sheet to impart materially increased structural strength and rigidity thereto.

It is a general object of the invention to provide "single skin sheet panels" of extraordinary rigidity and physical strength characteristics. Panels have been proposed and introduced having two spaced external sheets or skins of metal, or the like, and an embossed or formed sheet therebetween having special "waffle patterns" intended to lend rigidity and strength to the assembly and yet permit the assembly to remain relatively light in weight. In such prior panel arrangements the inner rigidity imparting sheet has usually been formed or embossed to have a multiplicity of indentations on each side terminating in flat or relatively flat plateaus or lands to which the skins are secured by welding, riveting, brazing, cementing, or the like. In such prior double faced panels the cones, pyramids, or other elevated regions are joined one with the other by what we will term "bridges" and because the lands or apices of the elevated regions occupy the two outermost planes of the embossed sheet these bridges occupy planes between and usually about midway between the outermost planes. We have found that the bridges add greatly to the rigidity of the sheet but that the location of the bridges in areas or planes spaced between the planes to be occupied by the skins is not conducive to the development of maximum strength and rigidity in the panel, particularly in the case of single skin sheet panels.

An improved panel construction is shown and described in a co-pending patent application entitled "Panel Construction," Serial Number 607,642 and filed September 4, 1956, now abandoned. Although this panel construction has proven successful, it requires the forming of a single flat metal sheet into a sheet having many land areas and depressions. Similarly, other prior attempts to rigidize sheet metal have required embossing or otherwise forming a normally flat sheet into a panel of various patterns.

Difficulties have been encountered when attempting to form relatively hard materials having low elongation properties, such as titanium for example. These materials do not lend themselves readily to the extreme forming required to provide high lands and relatively deep depressions in a single sheet. Generally, when forming has been tried, the sheet tears or the required depth of draw cannot be achieved.

These difficulties are obviated by the employment of the present invention wherein a plurality of individually formed cup-like members or cores are secured together in an end-to-end relationship to form a rigidized panel. A flat sheet is secured to the rigidized sheet to provide a panel construction having extremely high rigidized characteristics.

Therefore, it is an object of the present improved invention to provide panels of the class referred to having an inner or reinforcing sheet made up of individually formed members of special configuration particularly de-

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signed to impart greatly increased strength and rigidity to the panel.

An object of the present invention is to provide a panel construction which comprises, in general, a plurality of pre-formed members or cores which may be readily assembled and secured to one another in an end-to-end relationship to form a rigidized sheet. Inasmuch as the individual cores are formed separately, many varying configurations can be employed which are not available when a single continuous flat sheet is formed or embossed to provide certain patterns.

Another object of the invention is to provide a panel construction of the class referred to wherein the adjacent edges of surrounding cup-like members are at or occupy the plane most remote from the plane occupied by the lands to which the skin sheet is attached. The adjacent edges are readily secured and are in the plane which defines the side of the sheet opposite the side to which the skin sheet is attached and are therefore in the most advantageous location from the standpoint of imparting strength and rigidity to the panel structure.

A further object of the invention is to provide a panel structure of this kind in which the bend radii or "angles" of the bridges are sharp or small, being as small as reasonably practical taking into account the nature of the material of which the sheet is constructed, the sharp angles of bridges further increasing the rigidity and resistance to flexure of the panel.

Other objectives and features of the invention will become apparent from the following description of typical preferred embodiments throughout which reference will be made to the accompanying drawings in which:

FIGURE 1 is a perspective view of a panel constructed in accordance with the present invention showing the inner side of the reinforcing or backing sheet made up of a plurality of individual cores;

FIGURE 2 is an enlarged fragmentary vertical sectional view taken in the direction of arrows 2—2 of FIGURE 1 illustrating one form of securing adjacent cores to each other;

FIGURE 3 is a vertical sectional view showing the cores of FIGURE 2 being secured in another fashion;

FIGURE 4 is a vertical sectional view showing the cores of FIGURE 2 being secured in still another fashion;

FIGURE 5 is a perspective view of a panel construction in accordance with the present invention incorporating another embodiment of core configuration forming a reinforcing or backing sheet;

FIGURE 6 is an enlarged fragmentary vertical view taken in the direction of arrows 6—6 of FIGURE 5 illustrating one form of securing adjacent cores to each other;

FIGURE 7 is a perspective view of a panel construction in accordance with the present invention incorporating another embodiment of core configuration forming a reinforced or backing sheet for the panel;

FIGURE 8 is an enlarged fragmentary vertical sectional view taken in the direction of arrows 8—8 of FIGURE 7 illustrating one form of securing adjacent cores to each other;

FIGURE 9 is a vertical sectional view showing the cores of FIGURE 7 being secured together in another manner; and

FIGURE 10 is a vertical sectional view showing the cores of FIGURE 7 being secured in still another fashion.

The particular panel of the present invention illustrated in FIGURES 1, 5 and 7 of the drawings comprises two sheets, namely a skin sheet 10 and a core sheet or backing sheet 11. It will usually be found most desirable to form the sheets 10 and 11 of metal, such as steel, stainless steel, titanium, or the like, and where the panel is to be employed in aircraft construction both sheets are

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preferably relatively thin. The skin sheet 10 is shown as a plane flat member having parallel surfaces and it is to be understood the sheet 10 may be shaped or contoured as required for given applications of the panel.

The core sheet or backing sheet 11 consists of a plurality of individual calathiform cores or members, such as core 12, which are arranged in adjacent rows, such as rows 13, 14 and 15. This arrangement provides the sheet 11 with a multiplicity of depressions or indentations 16 in one side thereof to leave or provide a multiplicity of protrusions or projections 17 on the other side of the sheet. While the invention contemplates that the indentations 16 may be of selected configuration, it is preferred to make them with rounded walls or sides. In the drawings we have shown the indentations 16 and the projections 17 to be rectangular in horizontal cross section, assuming the panel to be in a horizontal position and to have tapered sides converging toward flat lands 18. Accordingly, the indentations and projections, as illustrated, may be said to be of truncated pyramidal configuration.

Where the skin sheet 10 is flat the lands 18 are flat and lie in a common plane so as to be conveniently and effectively joined to the skin sheet by riveting, welding, brazing, cementing, or otherwise. In the drawings the numeral 20 designates welds such as spotwelds, joining the crests or lands 18 of the pyramidal projections 17 to the under or inner side of the skin sheet 10. While the proportions of the lands 18 may be varied considerably depending upon the particular general proportions and applications of the panel, it is of course desirable to make the lands sufficiently extensive to have adequate engagement with the sheet 10 and to be readily and effectively secured thereto by the rivets, welds, cements, or the like.

The core or backing sheet 11 is further characterized by areas or regions of joinder of the adjacent projections 17 of adjacent calathiform cores which regions we will term bridges 21. As illustrated in FIGURES 2, 6 and 8, these bridges 21 are in the nature of rounded ridges, or bends, or in the nature of flat areas having a thickness equal to the combined thickness of projection 17 of adjacent cores. The bridges 21 preferably lie in a common plane parallel with the lands 18 and the sheet 10, assuming the panel to be flat. Thus the bridges 21 joining the projections 17 of adjacent cores occupy a plane most remote from the sheet 10 and we have found that this location of the flexure resisting bridges is most advantageous in imparting rigidity and strength characteristics to the composite panel. Furthermore, by inspecting FIGURES 1, 5 and 7 of the drawings, it will be seen that the bridges 21 are joined one with the other by such means as weld 19 to constitute a grid-like pattern of a multiplicity of interconnecting squares or diamonds. This diamond pattern of the flexure resisting bridges 21 further imparts extra-ordinary physical strength characteristics and flexure resisting characteristics to the panel.

The cores of FIGURES 1-4 are characterized by the presence of an outwardly projecting flange 22 which extends about the periphery of the projections 17. The outward flanges of adjacent cores are in intimate contact to strengthen welds 19.

With reference to FIGURE 3, another embodiment of securing means employed with cores of FIGURES 1 and 2 is shown which includes an arcuate member 25 arranged directly adjacent the inner side of the bridge 21 regions of sheet 11. Member 25 connects adjacent cores and is secured thereto by suitable means such as weld 19 which secures adjacent cores.

FIGURE 4 illustrates still another manner of joining adjacent cores which includes an arcuate member 26 connecting the bridge region 21 by a pair of welds 27 and 28. In this arrangement, member 26 is secured to the outside of sheet 11 and this member represents the only connection between the cores since the cores are merely

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placed in contact with each other and are not fastened to each other in any fashion.

FIGURE 5 illustrates a panel having individual cores of a similar shape to the cores employed in the embodiment of FIGURE 1 with the exception that each core is provided with a straight and flat flange 30. Consequently, the cores are arranged so that the exterior surfaces of the straight flanges 30 butt together and are secured by means of weld 19. In this instance, the bridge region 21 is equal to twice the thickness of one flange 30 of a core.

FIGURE 7 illustrates a panel made up of individual cores having a similar shape to the cores employed in the embodiment of FIGURE 5 with the exception that each core is provided with an inwardly flanged construction 31. As shown in FIGURE 8, the cores are fastened by weld 19 and a fillet weld 32.

FIGURE 9 shows an alternate method of fastening adjacent cores which includes a bar 33 interposed between flanges or walls 30. The bar is secured to the walls by a spot weld 34.

FIGURE 10 shows an alternate fastening construction which includes a T shaped member 35 having a stem 36 interposed between adjacent flat walls 30 and secured thereto by weld 34. The T shaped member is preferably in close contact with the exterior surface of inward flanges 31.

By employing the individual cores of the present invention, each core may be formed to its particular configuration prior to assembly on sheet 10. Because the cores are formed individually from separate sheets, rather complex shapes can be achieved which cannot be done when a single sheet is formed to include many embossings, depressions and projections.

As shown in FIGURES 1, 5 and 7, a plurality of apertures, such as aperture 37 is provided at the corners of the assembled cores. However, these apertures may be closed when employing arcuate members 25 or 26 or bar 33 or T shaped member 35.

It is believed that the operation and features of the panels provided by the invention will be readily apparent from the foregoing detailed description. As above described the formed projections 13 of flat sided configuration are tapered to be of pyramidal shape which add greatly to the strength and rigidity of the composite panel, particularly where their crests or flats 18 are rigidly secured to the skin sheet 10 and their interconnecting bridges 21 define the rear or inner extremity of the core sheet to be as remote as possible from the lands and skin sheet.

Having described only typical forms of the invention we do not wish to be limited to the specific details herein set forth, but wish to reserve to ourselves any variations or modifications that may appear to those skilled in the art and fall within the scope of the following claims.

We claim:

1. A high-strength light-weight panel comprising, a skin sheet, a plurality of sheet material backing sheets, each backing sheet formed to have an indentation in one side and providing a projection on the other side, the projection being of truncated pyramidal configuration to have a land at the apex joined with the inner side of the skin sheet, means fastening the sides of the projections to form a rigid backing sheet, and relatively rounded bridges inner-connecting the pyramidal projections at their bases, the bridges occupying the bounding plane of the backing sheet most remote from the skin sheet.

2. A high-strength light-weight panel comprising, a skin sheet, a plurality of calathiform members, each member having tapered sides converging towards a flat land, each tapered side having an outwardly extended shoulder integral with adjacent side shoulders to form a general square shape configuration, the plurality of members arranged in a predetermined order so that adjacent shoulders of individual members abut, fastening means coupling the abutting shoulders to form a rigid sheet of calathiform

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members, an arcuate member secured to the abutting shoulders of adjacent calathiform members and secured thereto by the fastening means, the arcuate member being placed on the underside of the abutting shoulders facing the skin sheet, and means fastening the flat land of each member to the skin sheet.

3. A high-strength light-weight panel comprising, a skin sheet, a plurality of calathiform members, each member having tapered sides converging towards a flat land, each tapered side having an outwardly extended shoulder integral with adjacent side shoulders to form a general square shape configuration, the plurality of members arranged in a predetermined order so that adjacent shoulders of individual members abut, fastening means coupling the abutting shoulders to form a rigid sheet of calathiform

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members, an arcuate rigid member joining adjacent abutting shoulders of the plurality of calathiform members on the outward side of the shoulders facing away from the skin sheet, and means fastening the flat land of each member to the skin sheet.

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